Stroking a Vintage 327 to 383 CID (Part 2)

by Joe Randolph

This article is a follow-up to my article in *The Restorer* Fall 2015, where I described how to stroke a vintage 327 engine to 383 CID. Stroking can be a great way to add power while retaining the NCRS-correct external appearance of a stock 327. Due to what I call NCRS disease, I place a high value on original appearance.

Certain small-block features such as the rear crankcase vent and the canister-type oil filter changed after 1967, and around 1980 the oil dipstick was moved to the passenger side. On close inspection, the later 350 blocks are visually distinguishable from the earlier 327 blocks. Perhaps the most useful feature of the vintage 327 block is the crankcase vent at the rear, next to the distributor. This makes it easy to use the original unvented valve covers and also retain the original PCV system.

And, if you want to have an NCRS-correct block for judging, it has to have the correct casting number and casting date. Most of the judging points for the block are assigned to the casting number, casting date, and broach marks on the pad. If the only deviations from the judging standard are the numbers stamped on the pad, the deduction is only 50 points out of 4500 for the whole car. Since the block used in the Corvette was also used in passenger cars, it is not hard to find a passenger-car block with the desired casting number and casting date. I used a $300 block that was from a Camaro.

My first article highlighted the importance of selecting the best stroker-profile rod for a 327 to minimize the amount of clearancing that needs to be done to the 327 block. Once you have completed the necessary work to increase the displacement to 383 CID, an NCRS-correct short block has the same power-generating potential of any 383 short block made from a 350 block.

Deciding Where to Draw the Line

When I started the project, my goal was to create a 383 that looked exactly like a correct 327/350-HP L79 except for the numbers stamped on the pad. I had just finished taking my original-engine Corvette through the NCRS judging process all the way to the national level, and I had a severe case of NCRS disease. Even small visible deviations from stock bothered me.

For people who want to use a 383 for NCRS judging, this approach can work out well. Judges can't tell that you have more displacement inside the engine, but you get the pleasure of having more power for driving around. Aside from the increased displacement, another hidden internal change that yields big improvements is to have stock heads pocket-ported by an experienced builder. I think the combination of more displacement and pocket-ported heads is a great way to achieve the most bang-for-the-buck in power production while maintaining an NCRS-correct external appearance for judging.

This was all I intended to do when I started the project, but as time passed my NCRS disease moderated a bit. After all, I was through having the car judged, and I already had the original 327 available if I ever wanted to return the car to judging. So I relaxed my criteria a bit.

This shows the end result of my particular project. Experienced NCRS judges will be able to find some deviations from stock in the photo, but the overall appearance is very much like a stock L79.

My revised goal was to maintain, even for a casual NCRS observer, the *general appearance* of a stock L79 while allowing for some slight differences detectable upon close inspection. In addition, my new goal included trying to match the performance of the GM ZZ383 crate engine, rated at 425 HP and 449 ft-lb of torque. This meant that I would probably have to go beyond just stroking the short block and pocket-porting the vintage heads.

The following sections briefly describe the specific steps I took pursuing my revised criteria. Some of the things I chose to do were not particularly cost effective, but cost was not a driving factor for this project. The goal was to see if I could match the performance of a modern ZZ383 crate engine with an engine that looked like it came straight out of 1967. Readers who are considering building their own 383 can pick and choose the specific changes that suit their tastes and budget. I have tried to include as much useful information as possible without getting into too many details.

Carburetor

The stock 585 CFM 3810 Holley carb used on the L79 would probably work pretty well on a 383 and would give excellent throttle response, but it is a little bit on the small side for a 383. The benefit of a larger carb would likely only be apparent at high RPMs, but since I was trying to match the ZZ383, which has a 770-CFM carb, I decided to use a larger-than-stock carb.

I determined that the throttle body of the Holley 780 CFM, List 3246 and List 3247, used on certain big blocks had all the key physical characteristics of the stock 585 CFM L79 3810. An important feature was the configuration that used the divorced choke that connects to a choke stove mounted on the intake. The main difference was that these 780 CFM carbs have dual-feed fuel bowls and a metering block on both the primary and secondary sides, while the 3810 has single-feed fuel bowls and only a metering plate only on the secondary side. My plan was to put the 3810 bowls and metering devices on one of the 780 CFM throttle bodies. This would result in a 780 CFM carb that looks like a stock 585 CFM 3810.

However, as my NCRS disease began to moderate, I decided that it would be easier and less expensive to just purchase a new Holley Street Avenger 770 CFM carb. After all, the carb is pretty hard to see with the air cleaner installed and my criteria for NCRS-correct appearance had been relaxed a bit.

Intake Manifold

The stock 1967 L79 intake 3890490 is probably a decent intake, but the right angle bends in the runners made me suspect it would be no match for the modern GM Performance intake on the ZZ383. An experienced racer told me that the intake used on the 1967-1972 Z28 and LT1 engines was generally considered the best factory intake that GM ever made for the small block. Visually, this intake looks like it would flow much better than the 3890490.


This photo shows the two manifolds side by side, with the Z28 intake on the left and the L79 intake on the right.

The family of 1967-1972 Z28/LT1 intakes all shared the same basic runner design with minor differences in the placement of the thermostat housing and other details. I determined that the 1967 Z28 3917610 intake had all the key details of the 1967 L79 intake, which made this particular version the best match for my goals.

The photo at left shows the two manifolds side by side with the Z28 intake on the left and the L79 intake on the right. Several important details on the Z28 intake are an exact match for the 1967 L79 intake. These include the choke stove next to the carburetor (essential if you want to use a 100% correct choke), the Winters snowflake casting mark, the off-center rotated thermostat housing, the temperature sender location, and the oil fill tube that leans toward the driver side. With the air cleaner installed, it takes a very sharp eye to detect that the Z28 intake is not an original L79 intake.

The Z28 intake is about one-half-inch taller than the L79 intake, and on some C2 Corvettes, this makes the air cleaner interfere slightly with the hood. I fixed this by adding four shims to every body mount, effectively lifting the entire body by 1/4 inch.

Heads

With professional pocket-porting, the stock 462 heads can be made to perform pretty well. However, a lot has been learned about head design in the past 50 years, based on improved computer modeling and wet-flow testing. Modern performance heads typically use a kidney-shaped combustion chamber, and subtle aspects of flow optimization have been developed for arcane factors such as tumble and swirl. Modern performance intake ports look quite different from the 462 intake port and typically embed the valve guide in a vane in the roof of the intake port.

Since I was trying to match the ZZ383 that had GM Performance's modern fast-burn performance heads, I felt that I needed a set of modern aftermarket heads to have the best chance of matching the ZZ383. Here though, my NCRS disease just wouldn't allow me to use heads that look so different from the stock heads. Original 1967 heads have sloped sides, no accessory mounting holes, and the iconic double-hump casting mark. The external appearance of aftermarket heads is significantly different and would really stand out on an otherwise stock-appearing engine.

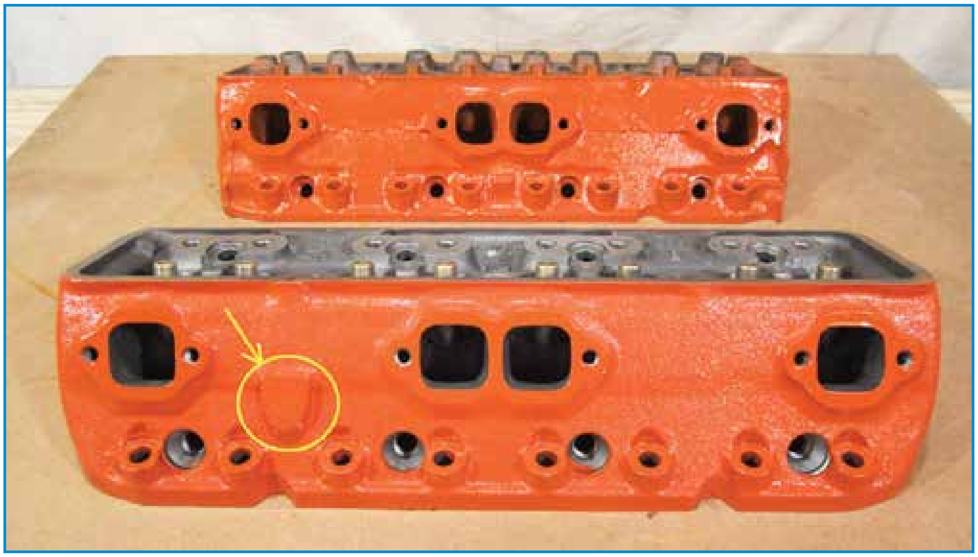
I researched various methods that people have used to disguise aftermarket heads. Simply filling the accessory holes and painting the heads Chevy Orange helps a lot. Some people have rounded off the edges and even added fake camel humps.

In my research I ran across Brzezinski Racing in Wisconsin. Randy Brzezinski has developed a CNC milling machine program that will reshape the exterior of a Dart Iron Eagle 200cc head to look like a stock 462 head. Once I saw a photo, I knew that was what I was going to use.

Brzezinski's CNC program is not complete, mostly because he has had little demand for the 462-disguise package. His program does the ends of the heads really well, but the side where the exhaust manifolds mount is only partially done. I decided to complete the sides manually with a die grinder. To get the rough texture of factory cast heads, I mixed some fine glass beads with the paint.

Interestingly, the circled boss in the bottom photo is actually correct for my late '67 Corvette. This boss started to appear on production 462 heads around March 1967; in fact, the original March heads on my Corvette have this boss, while some other March heads do not. If you ever see this boss on a pre-1967 small block, it's an indication that the heads are newer than the car.

Above shows an end view with the modified Dart head on the right and a stock '462 head on the left. Below shows a side view, with the modified Dart head in front and a stock '462 head in back.



It's important to note that the Dart heads have no provision for an exhaust crossover under the carburetor. This means that the engine will not run as well for cold starts in cold weather. This was not a major concern for me, but the lack of an exhaust crossover also means that the choke stove on the Z28 intake manifold probably wouldn't get hot enough to properly operate the OEM-style choke. This issue was a concern for me and was a factor in my decision to just use an aftermarket carb with an electric choke.

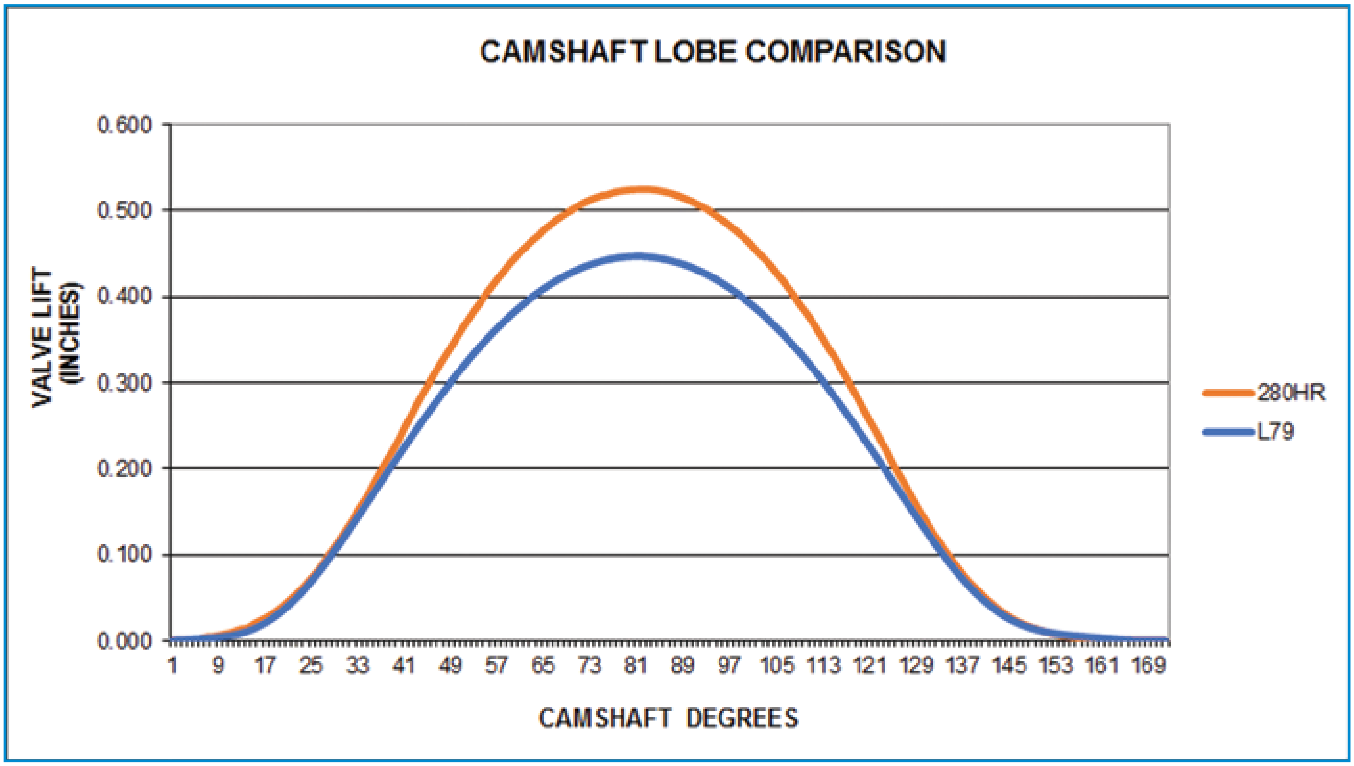
Camshaft

I do not have space here to provide a full discussion of camshaft-selection criteria, but I will try to provide some general insights for non-cam experts and enough detailed specifications to satisfy the experts.

When selecting a camshaft, there is a general tradeoff to be made between peak power at high RPM and available torque at low RPM. Most Corvette owners are familiar with the famous 365-HP small-block 30-30 cam that represents a focus on peak power at the expense of low-end torque. That cam makes great power at 6000 RPM, but it is pretty much of a dog below 3000. An example of going the other way is the 300-HP cam that makes great torque from 2000 to 4000 RPM but with a power peak at about 4500 RPM. I wanted something in between these two extremes. For street driving, I wanted the most possible torque at low RPM because torque is what makes a car feel powerful and responsive during ordinary low-RPM street driving. I decided to maximize low-RPM torque, but with the constraint that the engine should still pull strongly to 6000 RPM for an occasional run to redline. Both the ZZ383 cam and the 327-350 HP L79 cam are good examples of this type of compromise.

Originally I intended to use the L79 camshaft. This is a hydraulic flat-tappet cam with 222/222 degree intake/exhaust duration at .050 lift, peak lift of .447/.447 and 114 degree lobe separation angle (LSA). In my view, this is a terrific all-around cam for street driving and would be a very good choice for a 383.

However, I knew that the ZZ383 had a hydraulic roller cam with duration similar to the L79 but more lift (222/230-degree intake/exhaust duration at .050 lift, peak lift of .509/.528, and 112 degree LSA). This meant that it was likely to produce more power than the L79 cam. To maximize my chances of matching the ZZ383 performance, I decided to install a hydraulic roller cam retrofit kit intended for use in vintage small blocks.



The above graph compares the lift profile of the L79 cam to the profile of the 280HR roller cam. It is easy to see that there is more area under the curve for the 280HR lobe compared to the L79 lobe. This translates to greater flow capability, and greater power potential.

One advantage of roller cams is that they can open and close the valves faster than flat-tappet cams, and as a result, they can achieve greater peak lift for a given duration at

.050 lift. This will increase the amount of air/fuel mixture that can be processed without requiring any ncrease in lobe duration. The greater the lobe duration, the more difficult it is to maintain good low end torque.

In the end, the cam I selected was a fairly mild roller cam that had almost the same duration at .050 lift as the L79 cam, but somewhat more lift. I used the Comp Cams 280HR, which has 224/224 intake/exhaust duration at .050 lift, .525/.525 peak lift, and 110-degree LSA.

Valve Train

Since the 280 HR roller cam lifts the valve higher than the L79 while using the same number of cam degrees, the opening and closing ramps of the 280HR roller cam are somewhat faster than those on the L79. This creates more stress on the valve train. To keep control of the valves, the valve springs must be stiffer than vintage OEM springs. The pushrods and rocker arms usually need to be stiffer as well.

If the roller cam ramps are not too radical, simply changing to stiffer valve springs may be sufficient, and the OEM valve train can remain otherwise unchanged. However, the OEM rockers and pushrods will be working harder than they were originally designed to do.

I decided to be conservative and upgrade the entire valve train. I installed stiffer valve springs but used the so-called "beehive springs" that provide adequate valve control with less spring pressure than conventional dual valve springs. I also decided to install stiffer pushrods and stronger full-roller rockers.

For converting to roller rockers, a key challenge was figuring out a way to make them fit under the stock aluminum Corvette-script valve covers. An easy solution is to use extra-thick aftermarket valve-cover gaskets or even aluminum spacers, both of which are readily available aftermarket parts. In my case though, I wanted to maintain a stock appearance using the thin cork gaskets.

Some Internet research revealed that the main reason roller rockers do not fit under stock valve covers is not due to the rocker itself. Rather, the tall rocker stud and associated adjustment nut are what hit the OEM valve cover. I made a template of the inside clearance of the stock valve cover and confirmed that the adjustment nut was the only problem. I reduced the overall height of the adjustment nut by making four changes:

1. Purchasing the shortest nuts I could find, which were .865" long from Crower
2. Shortening the top of the nut as much as I could while retaining the ability to get a wrench on it
3. Substituting a 1/4" inner lock screw for the 3/8" version that came with the Crower nuts
4. Purchasing the shortest screw-in rocker studs I could find, and then shortening them further based on careful measurements

When considering this type of stud/nut modification, it is very important to finalize the required height of the rocker before any changes are made to the stud/nut arrangement.

This photo shows the end result. The template shows that the valve cover clears the rockers by a comfortable margin even with no gasket at all. Since the OEM cork gaskets are pretty thin and can compress quite a bit, I felt the best approach was to make no assumptions about the compressed thickness of the cork gasket. If you are comfortable using a thick aftermarket gasket with steel inserts that guarantee a minimum compressed thickness, you won't have to do all the things I did to reduce the installed height of the nut.

The correct height of the rocker is dictated by the valve height, the cam, and the pushrod length. Pushrod length must be carefully selected to ensure that the contact pattern of the rocker's roller tip is centered on the tip of the valve stem. This setup procedure must be completed first to determine how much the rocker stud can be shortened.

Exhaust System

Due to NCRS disease, I wanted to retain the stock appearance of the cast-iron ram's horn exhaust manifolds and undercar exhaust system. I knew I would be giving up some power by not using headers, but I wasn't sure how much. I decided to do the best I could with a stock-appearing exhaust system. Out of curiosity, I decided to do an actual dyno comparison with headers when the engine was complete. The results will be discussed in the upcoming section on dyno results.

For my stock-appearing setup, I made only three changes. The first was to switch the original 1967 2.0" outlet ram's horn exhaust manifolds for a set of 1965 manifolds with 2.5" outlets so that I would have a full 2.5" exhaust system. Fortunately, there are 2.5" manifolds that appear otherwise identical to the original 2.0" manifolds. I also replaced the heat-riser valve with the spacer used for fuel-injection engines.

The only remaining task was to select the mufflers. Most NCRS members know that in 1967 GM offered an off-road exhaust system that flowed better than the stock system. This should not be confused with side pipes, which were yet another option. The off-road system had the same external appearance as the stock undercar system, but the mufflers had less internal restriction.

My car already had an Allen's off-road 2.5" system purchased about ten years ago. At the time, I was told that their off-road muffler was not an exact copy of the original. Rather, it was simply their stock muffler with one of the internal baffles removed. This made the muffler louder (and presumably less restrictive), but experienced NCRS people told me the original muffler was louder than Allen's.

A few years ago I heard that Corvette Central had worked with an exhaust vendor to make an exact copy of GM's original off-road Corvette muffler, using an original muffler as a reference. They commented that the GM off-road muffler was much different internally from GM's standard Corvette muffler and resembled a turbo-muffler design.

I decided to buy a set and try them. The Corvette Central off-road mufflers were noticeably louder than my Allen's. In fact, they were almost too loud for my taste. However, they were also likely to be less restrictive. I decided to measure the difference in back pressure.

Using an oxygen sensor port that I had installed in the head pipe, I found that with full throttle on my 327, the Allen's off-road muffler created about 3 PSI of back pressure at 6000 RPM, while the Corvette Central off-road muffler created about 2.3 PSI. Using the Performance Trends Engine Analyzer software package, I worked backward from these measured values and concluded that a pair of the Allen's off-road mufflers flows about 400 CFM, while a pair of the Corvette Central off-road mufflers flows about 500 CFM. Since a 383 generates even larger exhaust flow than a 327, I decided to use the Corvette Central mufflers for my 383.

Ignition System

I made only three minor changes to the stock ignition system. The first change was to install a points-elimination kit from Lectric Limited. This change had actually been made some years prior and was already present in the distributor on my 327.

The second change was to revise the mechanical advance curve. My stock distributor had a total of 30 degrees advance that was all-in at 5100 RPM. When combined with an initial advance of 6 degrees, the maximum advance at full throttle was (30 + 6) = 36 degrees.

Current thinking among hotrodders is that while 36 degrees total is about right, they get better throttle response and more torque by combining a higher initial advance with less mechanical advance and making the mechanical advance all-in at about 2500 RPM. So, I modified the mechanical advance inside the distributor to have a maximum value of 20 degrees, all-in at 2500 RPM, and combined this with an initial advance of 16 degrees. The maximum total advance was (20 +16) = 36 degrees, identical to the OEM design. The only difference was that the new advance curve started out with more initial advance at idle and reached the 36-degree total at 2500 RPM instead of 5100 RPM. Note that this change has no effect on peak power, since both designs are all-in with 36 degrees at any speed above 5100 RPM. The only benefits are a potentially better throttle response and possibly some extra torque in the mid-range RPM band.

The third change I made was to modify the vacuum advance so that it maxed out at 10 degrees instead of the OEM value of 16 degrees. Some people feel that this works better with today's fuels. In any event, vacuum advance only affects idle and cruise conditions where there is sufficient vacuum to activate it. It has no effect on power at wide-open throttle. In fact, for all the dyno testing, the vacuum advance was not even connected.

Dyno Testing

Since I was trying to match the GM Performance ZZ383, I wanted to get some actual dyno data. The specs on the ZZ383 are 425 HP and 449 lb-ft torque. These values are obtained on an engine dyno with open headers, so I wanted to test my engine under the same conditions. With open headers, my dyno results were 424 HP and 436 lb-ft torque.

Interestingly, the dyno operator had on file dyno results for a bone-stock ZZ383 that he had tested. Those results only covered 4000 to 6000 RPM, but over that range, my 383 was almost identical. On his dyno, the ZZ383 had produced 426 HP and 436 lb-ft torque, while mine had produced 424 HP and 436 lb-ft torque. So, I think my stock-appearing 1967 327 did a pretty good job of matching the ZZ383.

Here is my engine on the dyno with the stock exhaust. As the data show, headers with mufflers still beat iron manifolds with mufflers, but not by much, especially at less than 3800 RPM. At 5500 RPM though, the difference was about 28 HP.

Another interesting outcome was that iron ram's-horn manifolds with open exhaust generated about the same power as headers with mufflers. Clearly, even the low-restriction off-road mufflers from Corvette Central had an effect on power production. There are aftermarket mufflers available with less restriction than the off-road Corvette mufflers.

For people who want even more peak power and don't mind some loss of low end torque, simple changes can be considered. Using a modern single-plane intake instead of the dual-plane Z28 intake that I used would probably yield another 25 HP at high RPM with some loss at low RPM. More aggressive cams will also yield more peak power, but at the expense of low-end torque. And, while the iron Dart heads I used are good performance heads, there are better aluminum heads available if the goal is maximum peak power. With changes to the intake, cam, and heads, the peak power of a 383 can reach 500 HP with open headers.

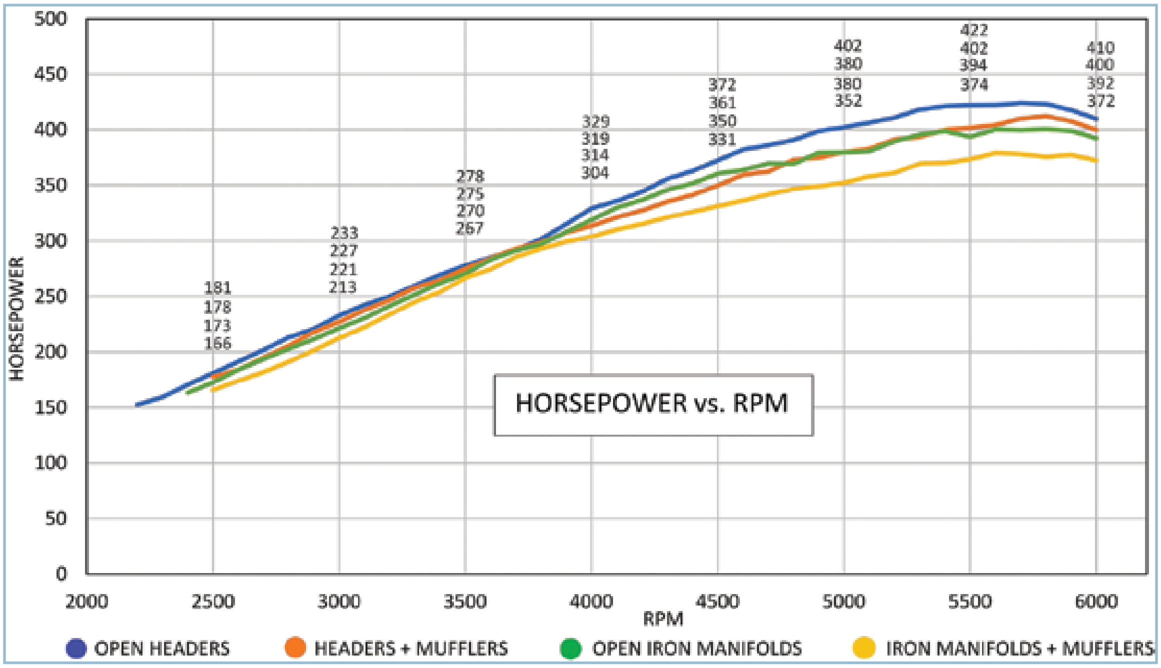
Comparing the Effect of Exhaust Configuration on Power Production

Almost all the engine builds written about in car magazines are tested with open headers. When these same engines are run with a stock exhaust system, less power is produced. One cause of the power loss is simply the loss of the pressure-wave tuning that long-tube headers provide. A second factor is the back pressure from the mufflers. To some extent, putting mufflers on headers works to defeat the advantages of the pressure-wave tuning.

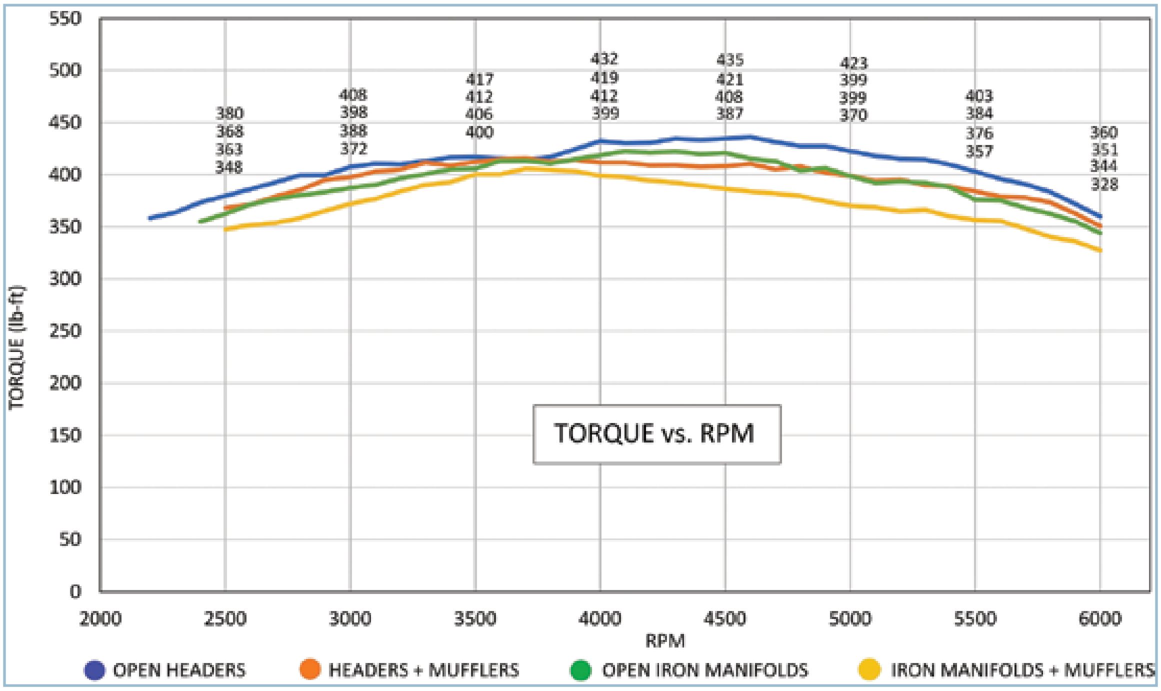
I have seen many debates on Internet forums about the benefits gained by installing headers on a street car. To satisfy my curiosity about headers versus stock exhaust, I paid for an extra day of dyno testing to get some actual data. My theory was that the flow restriction of adding mufflers to headers might defeat any advantage that headers could offer. To get a complete picture of the situation, I had my engine tested with four different exhaust configurations:

1. Open Headers
2. Headers with mufflers
3. Open ram's horn 2.5"cast iron manifolds
4. Ram's horn 2.5"cast iron manifolds with mufflers

Hopefully, the dyno plots included here will be helpful for people who want to estimate the effects of various exhaust configurations. Note that these data are for just one specific engine with one specific set of heads, intake, cam and mufflers. The power differences among the four configurations would likely be different for another combination.



These graphs show how the four test conditions compared for horespower and torque. I think they provide some very useful insight.



Summary

Part 1 of this series described how to stroke a vintage 327 to 383 CID. In terms of power production, the resulting short-block assembly is no different from a 383 built from a newer 350 block. Any difference in power production will be due to the intake, heads, and cam.

Part 2 has shown that with careful attention to the intake, heads, and cam, a 383 based on a vintage 327 block can match the power production of a modern GM Performance ZZ383 crate motor while still having the appearance of a stock L79. For someone with NCRS disease, this can be a satisfying accomplishment.

I want to reiterate that the best bang-for-the-buck on a stealth L79 is probably to just stroke the engine to 383 CID, pocket-port the OEM heads, and retain the flat-tappet L79 cam and stock valve train. The cost of such a conversion is only slightly more than the cost of a standard rebuild for a 327, but the performance gains are significant. A further advantage of this low-cost approach is that the outside appearance of the engine can remain 100% NCRS correct.

However, for those who want to make the highest possible power with a stock-appearing engine, a better intake, heads and cam will provide more power but at greater expense.

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