

# Joe Mondello's HORSEPOWER SECRETS



## **How to make a stock-looking engine run like the wind**

*text and photography by Chris Hemer*

Most musclecar enthusiasts want to restore their cars to original condition, but how can you ignore the car's potential for even more tire-frying power?

Traditionally, building an engine means straying from originality by bolting on parts that are clearly not OEM pieces. But a high-horsepower car does not necessarily mean tons of chrome and miles of steelbraided lines. A camshaft, headwork, ignition system, and other carefully-chosen components can dramatically improve your car's performance, yet leave it with a concours-quality appearance.

Joe Mondello is a leading authority on musclecar cylinder head and engine development. Though commonly associated with Oldsmobiles, Joe has ported and/or prepared every musclecar cylinder head ever offered (hundreds of times), and even helped GM develop many of their cylinder head designs. In addition, he has built record-breaking engines of all types for drag racing, marine, and Bonneville applications.

We visited his shop in Paso Robles, CA and talked to Joe about the best ways to improve horsepower in a musclecar engine without altering its appearance. He not only told us what

to do, he told us what not to do—how to avoid mistakes many novice engine builders make.

### **Camshaft And Valvetrain**

Power Increase:

Cam/lifters/springs: approximately 40 horsepower

Roller rocker arms: 25 to 30 horsepower

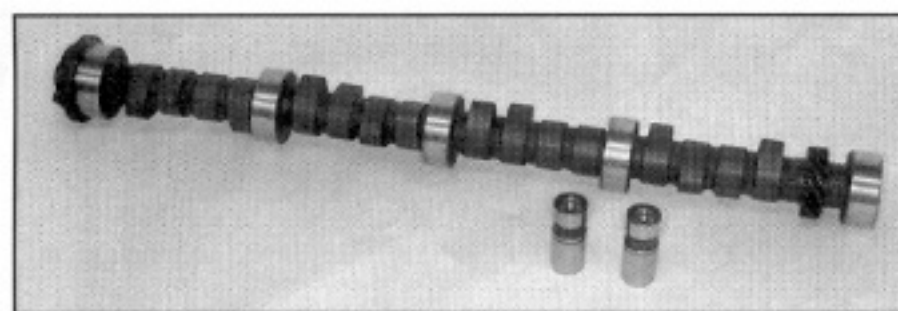
TOTAL: Up to 70 extra horsepower

We'll start with the camshaft since it has the most dramatic effect on your engine's performance—better or worse. Most musclecar camshafts were relatively mild for the large valve sizes used, so a larger camshaft can often improve performance. How large a camshaft you can use is influenced by the car's weight, torque converter size, gear ratio in transmission (especially four-speeds), rear axle ratio, tire

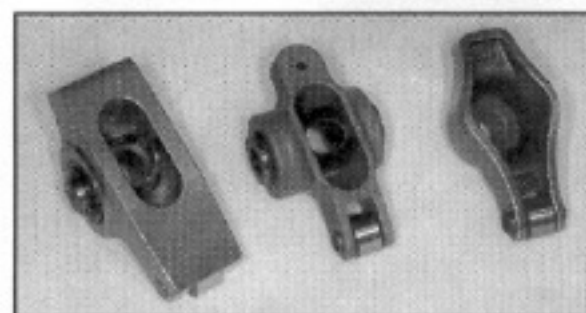
size, and the altitude in which you live.

Let's take what's probably a representative profile of many musclecar owners. Assuming you live at sea level, your car weighs about 3,400 lbs (typical), and you have a decent street/street torque converter (like a B&M Holeshot for example), 3.55-up gearing, stock tire size and stock transmission gearing. Joe says that a hydraulic camshaft in the .530-.560 lift range with 224 to 244 degrees of duration at .050 will work well. If your engine has a non-adjustable valvetrain (Mopar, Pontiac, Oldsmobile, or some Fords), camshafts above .480 lift and 230° of duration will require adjustable pushrods or adjustable roller rockers due to the smaller base circle of high-performance cams. Cams with up to .500-inch lift can get away with using adjustable pushrods, while cams above .500 lift will require adjustable roller rockers (which will increase horsepower as well—more on that in a minute).

On both valvetrain designs, power brake applications should seek 110° lobe centers (for improved vacuum) while manual brake applications can get even more bottom end power from a cam with 108° lobe centers. Choosing

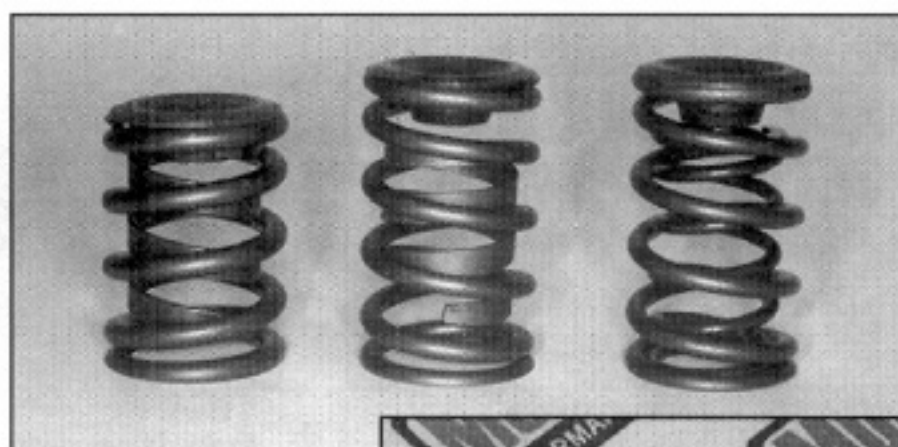


Joe maintains that a good hydraulic cam with properly matched valvetrain can make over 40 extra horsepower and rev up to 6500 rpm. Use a new Cloyes True Roller timing chain and gearset with your new cam for best results.

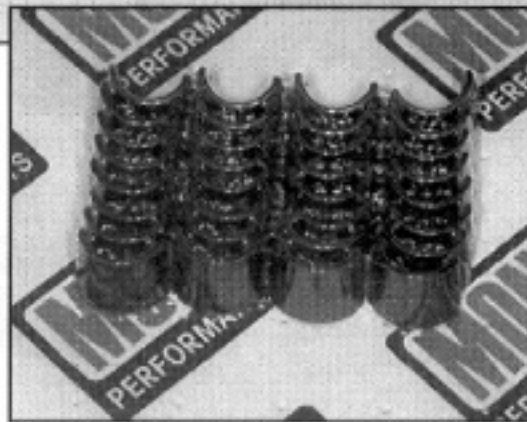


Joe says even a stock ratio roller rocker can boost horsepower. The three varieties of roller rockers are (L to R): aluminum, stainless steel, investment cast steel. Which one you choose depends on

your budget and your clearance under your stock valve covers.



When using a bigger cam, always upgrade to stiffer valve springs, chrome moly retainers and hardened steel valve locks (right). From right to left: stock style spring with inner damper, tall spring with inner damper, and tall spring with inner coil (stiffest).



a camshaft in this range will provide the engine with maximum breathing capacity, without the worry of piston-to-valve clearance in stock applications. If the cylinder heads have been milled more than .030, however, Joe recommends checking piston to valve clearance.

When installing a new camshaft, two items are a must: new lifters and new valve springs. Hydraulic lifters, the type used in the vast majority of musclecar engines, develop a wear pattern for the cam they were used with, and if a new camshaft is installed with old lifters, both the cam and lifters will wear abnormally and fail over time (sometimes very quickly). A good aftermarket lifter is all most musclecar engines need, according to Joe, and most will rev to 6500 rpm if used with a well-balanced valvetrain (correct valve spring sizes, proper rocker arm geometry, correct lifter pre-load, etc.). New valve springs must be used for two reasons: the originals in your engine have likely lost most of their life by now, and even if they were brand new, they weren't designed to handle the increased lift of a true high-performance cam. Mondello Performance Products carries a variety of valve springs for different applications, but typically Joe says that you want to shoot for a valve spring that has 110 to 140 lbs of seat pressure and 290 to 330 lbs of open pressure at the cam manufacturer's recommended installed height.

Whether your new cam has over .500 lift or not, a set of adjustable roller rockers are always a good idea. True roller rockers (roller fulcrum and tip) reduce frictional losses in the valve train, and prevent unnecessary side-to-side movement of the valves. Mondello has found that roller rockers, even in their stock ratio, can add as much as 25 to 30 hp; increased ratio rocker arms (not recommended unless you have a low lift/lazy camshaft and have adequate piston-to-valve clearance) can boost power even more.

Roller rockers come in three metals: investment cast roller tip, forged aluminum, and stainless steel. Investment cast roller rockers are a good choice for those engines which may have limited valve cover clearance, and are by far the least expensive of the three. However, if your valve covers and wallet allow, Joe recommends you go with either aluminum or stainless steel roller rockers.

## Porting

Next to the camshaft, cylinder heads will unlock more horsepower from your engine than any other single component. Correct porting techniques, along with oversize/undercut valves and a good three-angle valve job will improve airflow and the quality of the air/fuel mixture into the engine, especially when teamed with the right cam. But like camshaft choices, you can overdo it, or do it wrong. Joe recommends a "street/strip" porting job for most musclecar applications, which includes opening the valve bowls (the area directly beneath the valve), re-shaping and "teardropping" the valve guide boss, re-shaping and blending the short side radius, raising the exhaust roof approximately .100, and cleaning and polishing the combustion chambers.

You may have noticed that we didn't mention the intake ports; that is because Joe is against touching the ports unless they can be "done correctly." He notes that there is a trend toward "gasket matching" intake ports, which he says is totally ineffective and may even prove harmful. This is because it is impossible to know where the gasket will be once the intake manifold is torqued into place; it can shift up or down, or side to side, protruding into the port opening.

If you really want to match the intake ports on the manifold with that of the cylinder head, Joe says there's only one correct way to do it: Port the intake port to match the gasket open-

ing, then raise the intake roof approximately .100 to .200 inch, depending on head design. Glue the intake gasket in place on the head, then trim to match the new opening. Paint the intake gasket with Prussian Blue non-drying layout dye, and the face of the intake manifold with red Dykem. Bolt the manifold on, torque in place, then remove. You should have a perfect impression of the intake ports on the intake manifold, indicating exactly where material must be removed (NOTE: make sure the manifold fits properly before starting this procedure). If this sounds like too much work, Joe says you can still improve intake port flow by concentrating your efforts on radiusing the pushrod side of the intake port, and equalizing port size from top to bottom.

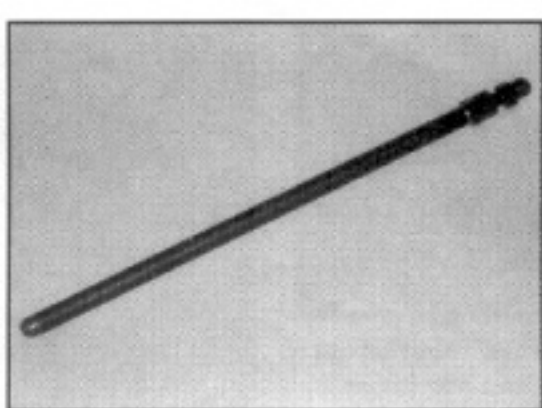
## Valves/Valvework

The majority of musclecar engines have valves that are sufficient quality for street/strip duty. Most exhaust valves are made of a stainless steel alloy or are austenitic stainless (stainless a magnet will stick to) while intake valves are usually either high-carbon steel or austenitic stainless steel.

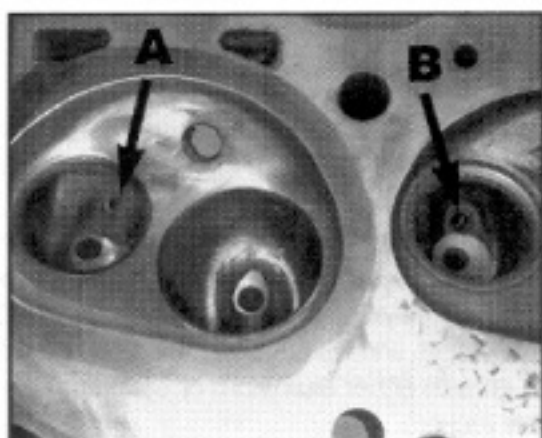
Making the move to oversize valves is a good choice, according to Joe, but care must be taken here, too. Certain cylinder heads with oversize valves (small block Chevy, for example) must have the chambers unshrouded to make full use of the new valves; there should be at least .100 clearance between the edge of the valves and the side of the chamber. And no cylinder head can benefit from oversize valves unless the valve bowls are opened up to match.

"Try to imagine a funnel," says Joe. "If you make the top of the funnel bigger but leave the bottom the same size, it isn't going to flow liquid any faster. Only until you make the bottom bigger will you realize any increase in flow."

So, if your machinist is capable of porting



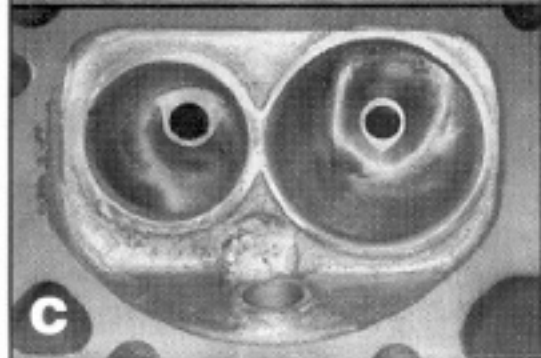
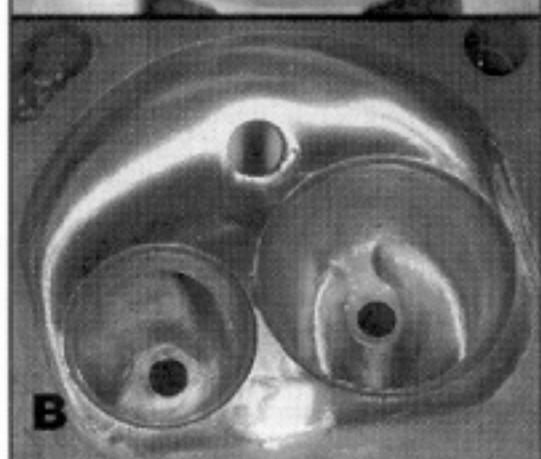
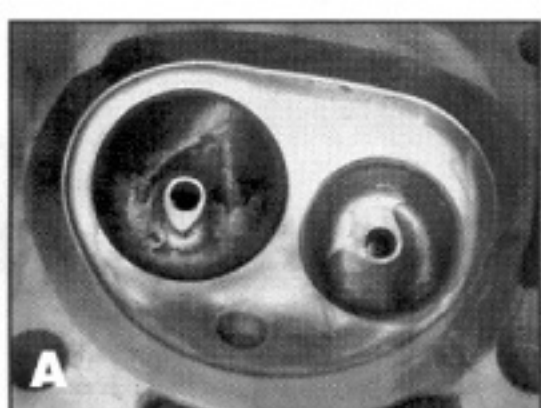
*If roller rockers are not in your budget and your engine has a non-adjustable valve train, you might consider adjustable pushrods. Simply loosen the lock nut, then adjust the pushrod to desired length in order to obtain correct lifter pre-load. These are available from a variety of sources, including Mondello, Smith Bros., Crane, and Competition Cams.*



*Some heads from low-emissions engines have cast-in thermactor ports, a substantial hump in the exhaust port that impedes flow significantly. Joe says this hump can be ground away without problems, as it has been in this 429 head (arrow A). Compare it to the stock hump in the port to the right (arrow B).*

the bowls to match the new valves, go with the bigger valves. If not, don't waste your money. Here's another tip: Rather than spending big money on aftermarket stainless steel valves, first see if there is a larger OEM valve available. For example, a big-block Chrysler with 2.08/1.78 valves can move up to 2.14/1.81 production valves. If no larger OEM valves are available, Joe recommends you use a good quality aftermarket stainless steel valve such as Manley, Milodon, Mondello, or Ferrea.

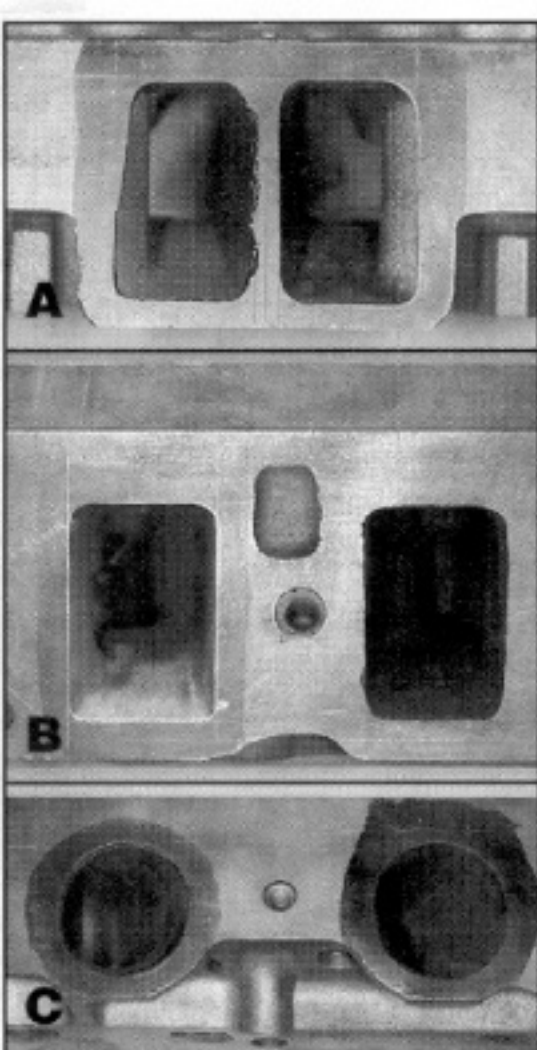
When it comes to the rest of the cylinder head machine work, Joe has more recommendations. As we mentioned earlier, you shouldn't machine the cylinder head surfaces more than .030 for three reasons: One, if you have non-adjustable rockers, your lifter pre-load will be incorrect. Two, even if you do have adjustable rockers, you run the risk of piston-to-valve clearance when using a larger than stock cam. Three, removing excessive material from the cylinder heads may cause the intake manifold to fit improperly.



*When it comes to cylinder head porting, Mondello recommends you spend most of your time opening up the bowl area (the area immediately under the valves) and re-shaping or teardropping the guide boss. Here three examples are shown: A) 429 Ford, B) 350 Olds, C) small block Chevy. If you burn unleaded fuel in your engine, have your machinist install hardened exhaust seats before this type of work is performed.*

If you have the valve guides replaced, use only hardened steel or mehanite iron guides because they wear better, particularly with today's unleaded fuel (unleaded doesn't have the same lubricity as leaded does). These guides should contain an internal knurl to hold oil (if possible) and should be run at .0015-.002 clearance unless your heads have a large heat cross-over passage or siamese exhaust ports, in which case the two closest exhaust valves should have .0025 clearance due to added heat.

If you've got your heart set on bronze guides/liners or already have them in your heads, you should run leaded fuel (racing gas), an octane booster, or a top engine lubricant like Marvel Mystery Oil. In either case, Joe recommends you use a good quality, positive (the type that mounts on the guide itself) Teflon valve seal on the intake side, and an umbrella-type rubber seal



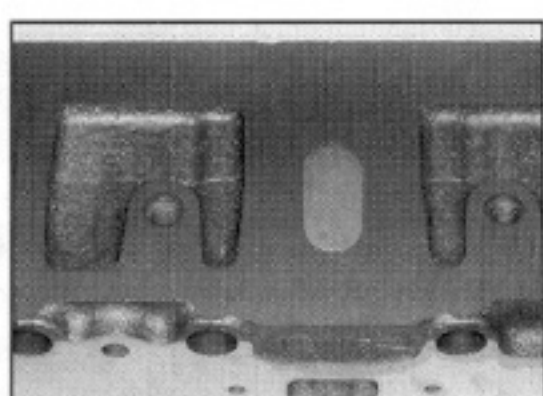
Next to bowl work, Joe says that straightening the intake port opening and radiusing the pushrod side of the port is the next most important improvement you can make, but he warns against matching the port to the intake gasket because it does not accurately represent where the gasket will line up once the manifold is bolted on (see text). Here are three examples of properly re-shaped intake ports: A) Small block Chevy; B) 455 Olds, C) 429 Ford.

on the exhaust, as it will allow a small amount of oil to leak past and keep the guide lubricated. One last word of caution on valve guide work: Once your heads are bolted on the engine, make sure there is at least .100-inch clearance between the bottom of the retainer and the top of the valve guide seal to prevent cylinder head/cam-shaft damage.

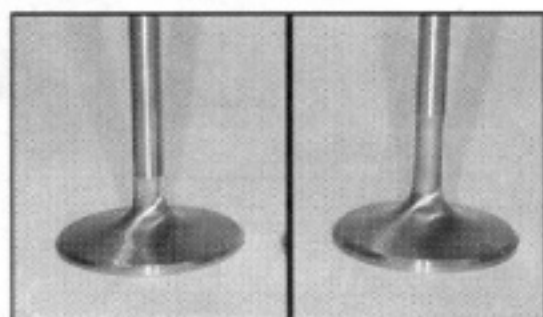
## Induction, Ignition and Exhaust

In most instances, the best way to improve horsepower in the induction system is with an aftermarket intake manifold such as the Edelbrock Performer, and a well-massaged carburetor built by a carburetor expert like Brad Urban's Carburetor Shop. But if you're a purist, and an aftermarket intake is out of the question, then you may consider having the stock manifold ported or Extrude Honed.

The Extrude Hone process consists of an abrasive media that is suspended in a



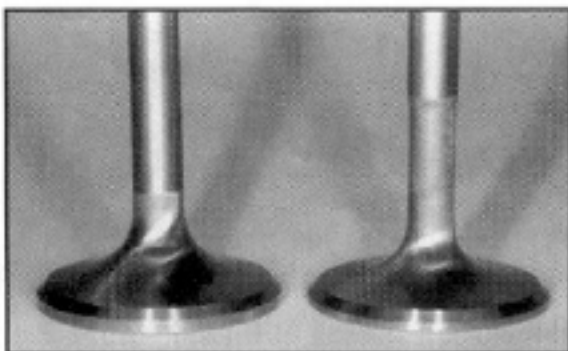
If you run a manual or electric choke and don't run the car in temperatures below 40° F, Joe recommends filling the heat cross-over passage with Mondello ZA 12 alloy, which he sells in five-pound packages. The alloy is melted, poured in and allowed to harden, then ground smooth. This prevents nearest exhaust valves from sticking in their guides due to excessive heat, helps valve springs live longer (again by reducing heat), and keeps the intake manifold cooler for denser air/fuel mixture.



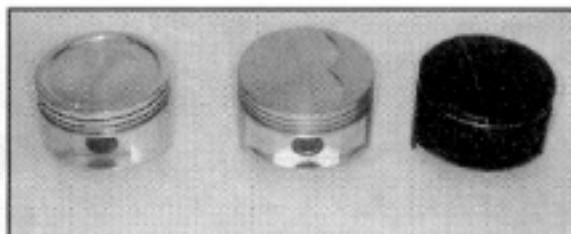
When choosing new valves, Joe says the stockers are usually more than adequate for street/strip duty. Should you decide to purchase aftermarket stainless steel valves, choose a brand that features an undercut stem for increased flow around the valve. The valve on the left has stock-style stems, while the valve on the right features an undercut stem.

clay-like substance. The media is pumped through the plenum and runners of the intake manifold, removing material in the necessary areas as it passes through. This process differs from porting in that it can reach around corners and deep into runners where a carbide cutter simply cannot go. According to Mondello, an Extrude Honed intake manifold gains 30 to 35 percent in flow, 18 to 30 lb-ft of peak torque and 15 to 25 horsepower. The same process may also be applied to the exhaust manifolds as well, for up to a 30 percent increase in flow. As with the intake manifold, Extrude Honing is only recommended by Mondello for the staunch purist; exhaust headers by either Doug Thorley or Hooker are always a better choice when it comes to maximum performance.

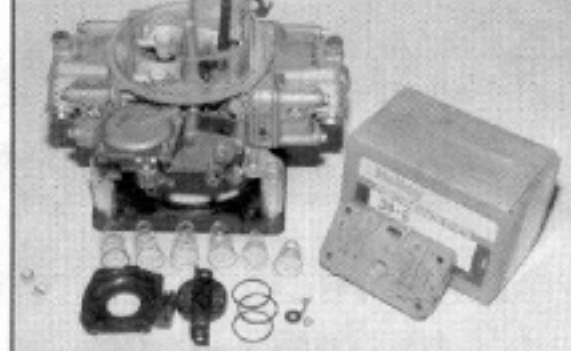
There are many ways in which the ignition can be improved as well. First, the points should be discarded in favor of an electronic system, and stock plug wires should be replaced with high-performance 7mm suppression plug wires, like those available



Another area you should pay attention to when buying new valves is the valve margin, or thickness of the valve. When using a thick margin, (left) it should be ground down to .060 thick on the intake valve, and .080 thick on the exhaust side in order to maintain OEM valve spring installed height. This is only critical on engines with non-adjustable valvetrains.



To increase compression, you may mill your heads as much as .030-inch without running into valvetrain problems. If that still isn't enough, Joe recommends using a good aftermarket piston, such as those offered by Federal Mogul, Arias, JE, Ross, Wiseco and Venolia. From right: dished top (to lower compression), flat-top (for increased compression in engines that came with dished pistons) and domed. The domed piston is coated with a black dry film lubricant, another way to gain a few extra horsepower.



Holley carbs can be improved without radical modification. This Holley 3310 750 cfm four-barrel is shown with Moroso clear sight plugs, vacuum secondary quick-change kit, vacuum secondary springs and rear metering block kit. These parts, as well as pump cams, squirters and jets, are all available from Holley and specialists like the Carburetor Shop in Rancho Cucamonga, CA.

## This Is Joe Mondello

At 15 he was porting and relieving flat heads for Jack Kennedy Automotive. At 16, he was racing at airports and drag

strips across Southern California in a '40 Ford coupe powered by a 303 flathead with Stromberg carbs, Edelbrock heads and manifold, and an Engle cam. Before he was 17, Joe had ported and relieved more than 50 flathead Fords for the finest engine builders of that era.

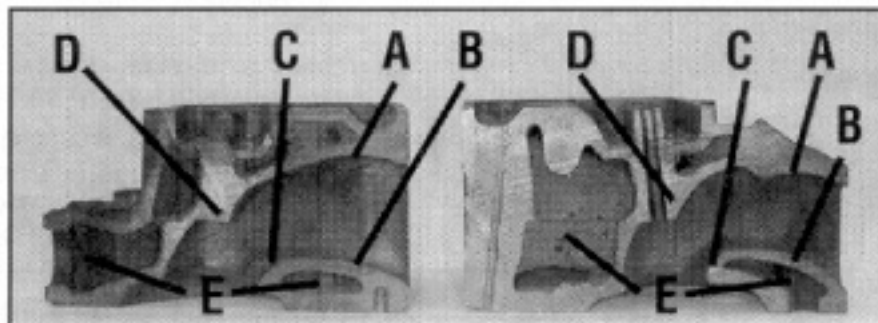
In the 1960s, Joe worked part time prepping heads and engines for Carroll Shelby's racing Cobras. Traco Engineering, known at the time for their winning Indy and Sprint cars, used Mondello heads exclusively.

"Back in those days, our shop's clientele read like a 'who's who' of racing greats," Joe recalls.

By the late 1960s and early '70s, Joe Mondello's Matsubara Blown Fuel Altered captured two national even titles and became the fastest wedge-head Chevrolet, running a 7.24 @ 213 mph at the '69 US Nationals. The first seven, six and five-second Top Fuel runs and the first 200-mph runs in Top Gas, Top Fuel, Injected Fuel and Fuel Altered were all accomplished using Mondello heads.

Joe was also involved in R&D for Oldsmobile and Chevrolet.

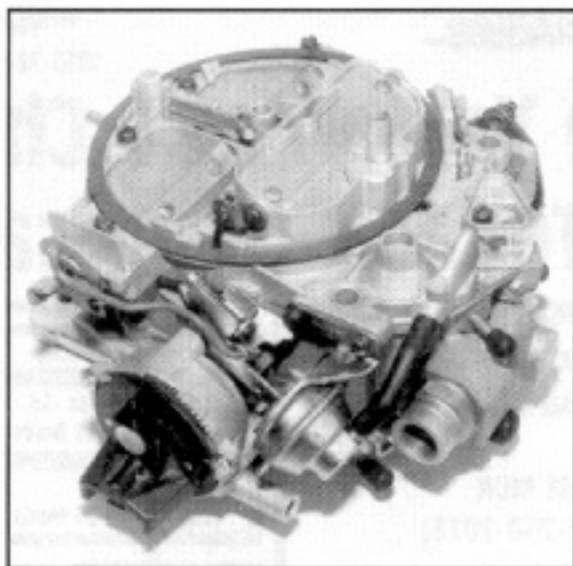
Joe Mondello's racing and high-performance exploits span 45 years, and at age 60, he still takes pride in building the best cylinder heads and engines money can buy. Mondello Performance also offers the largest and most complete line of high-performance Olds parts and accessories in the world.



Cutaways reveal port layout of the 455 Olds engine, with intake port on right and exhaust on left. A) port roof; B) port floor; C) short side radius; D) valve guide boss; E) water jackets.

from Jacobs Electronics, Taylor Cable, MSD, and others (hang onto the stock wires for car shows if you wish). A stock-shaped, high-performance coil like MSD's Blaster or Jacobs Energy Team Coil can be painted black and bolted into place, and amplifiers like the MSD 6A or Jacobs Energy Pak can be neatly wired and hidden in a variety of places, such as under the dash, between the fender and splash guard. A well-matched ignition system can add as much as twenty horsepower to a mildly modified musclecar engine.

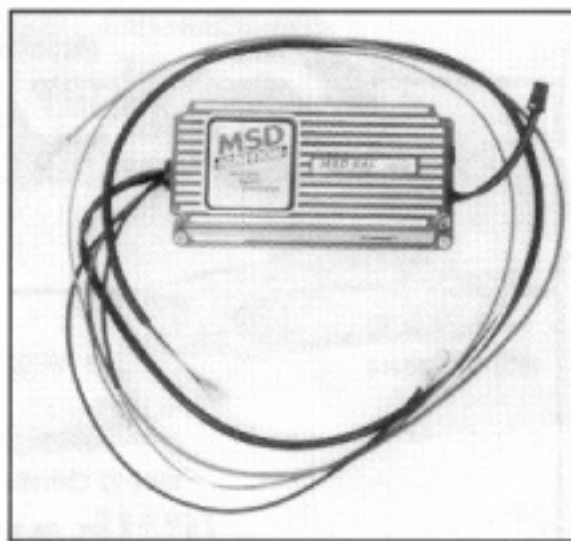
So as you can see, it's relatively easy to build 100 horsepower or more into your musclecar's engine, and no one will be the wiser.



If your GM musclecar uses a Quadrajet carburetor, sending it to the Carburetor Shop is a must. Their experts can rebuild and blueprint your Q-jet for your particular application, and can also re-dye it with their ColoRestore process to make it look brand new.

Now you can stop feeling guilty about hot rodding your pride and joy, and go out and have some fun!

MCR



Ignition systems like the MSD 6AL can dramatically improve performance on a modified engine, especially when used with a good set of spark plug wires and coil.

## Sources

Mondello Performance Products, Inc.  
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Send \$9.00 for a complete catalog on Oldsmobile products and cylinder head work for all brands.