FSC

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INSIDE:
LS-Wonder Breaths Better

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SUPER-BOIL!

History Made at Route 66

Coverage INSIDE!

Motive Gear NMRA NMCA SUPER BOWL I OF STREET LEGAL DRAG RACING

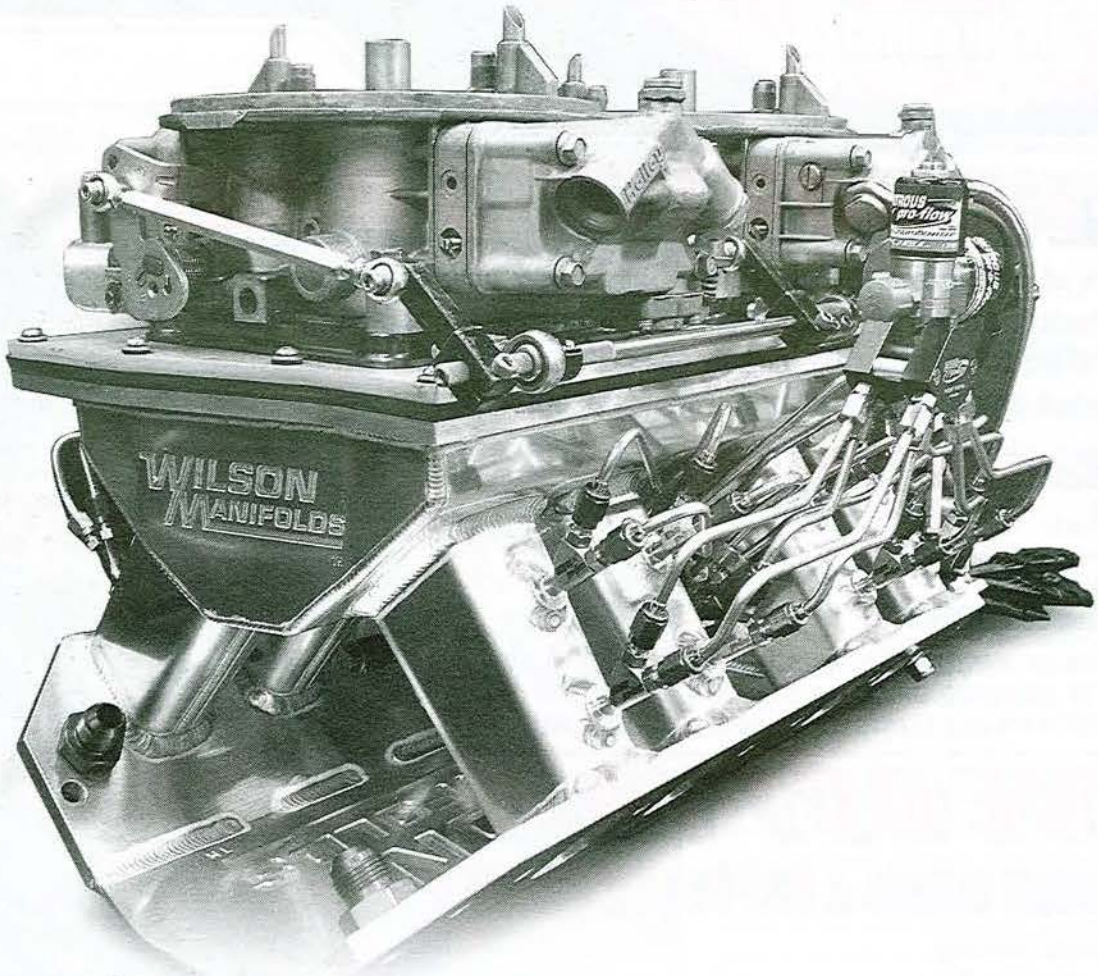
Brian Robbins
Denso Pro Street

Interview With Bryan Markiewicz
Nitto Tire Super Street 10.5W Racer

PLUS:
- Sleeving Blocks
- Engine Block Buyers' Guide
- Fabricated or Cast Intakes: Which is For You?

TECH

Manifold Mania | TO FAB OR NOT TO FAB?

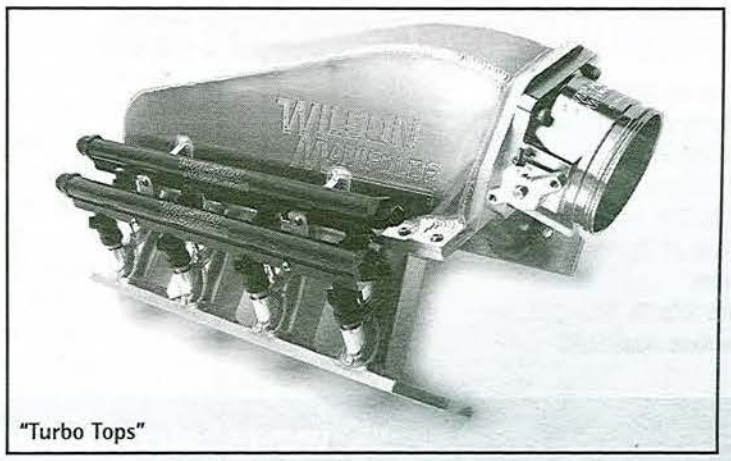


Written by Chris Speis
Behind the Lens: The Manufacturers

Everybody knows a sheet metal intake is better, right? While conventional wisdom may say sheet metal is the only way to fly, the truth is (as with most engine components) there are a number of factors to consider when choosing an intake, and sheet metal may not be right for your engine. Though a manifold is arguably the least complicated looking piece of equipment on an engine, it is deceptively so. At a high level, a manifold is often likened to a funnel, which delivers air and fuel into the cylinder heads. Unlike a funnel however, seemingly minor dimensional changes can have a very noticeable impact on a manifold's behavior.

Starting things off is the inlet to the manifold, the throttle body mounting flange(s). In general, bigger is better...to a point. As long as the entry permits the use of a throttle body or carburetor(s) large enough to avoid excessive pressure drops, all is well. Limiting carburetor/throttle body size significantly alters the behavior of the air/fuel mixture. Manifolds using restrictor plates or undersized carbs will experience greater pressure pulsations in the plenum than those equipped with optimally sized carb/throttle bodies. This being the case, the plenum may need to be enlarged in an effort to improve distribution, minimizing charge robbing between cylinders. There is a downside however, as making the plenum larger also weakens the signal at the carb and may negatively impact throttle response, particularly at low RPM.


6061 Billet


"Turbo Tops"

the 411

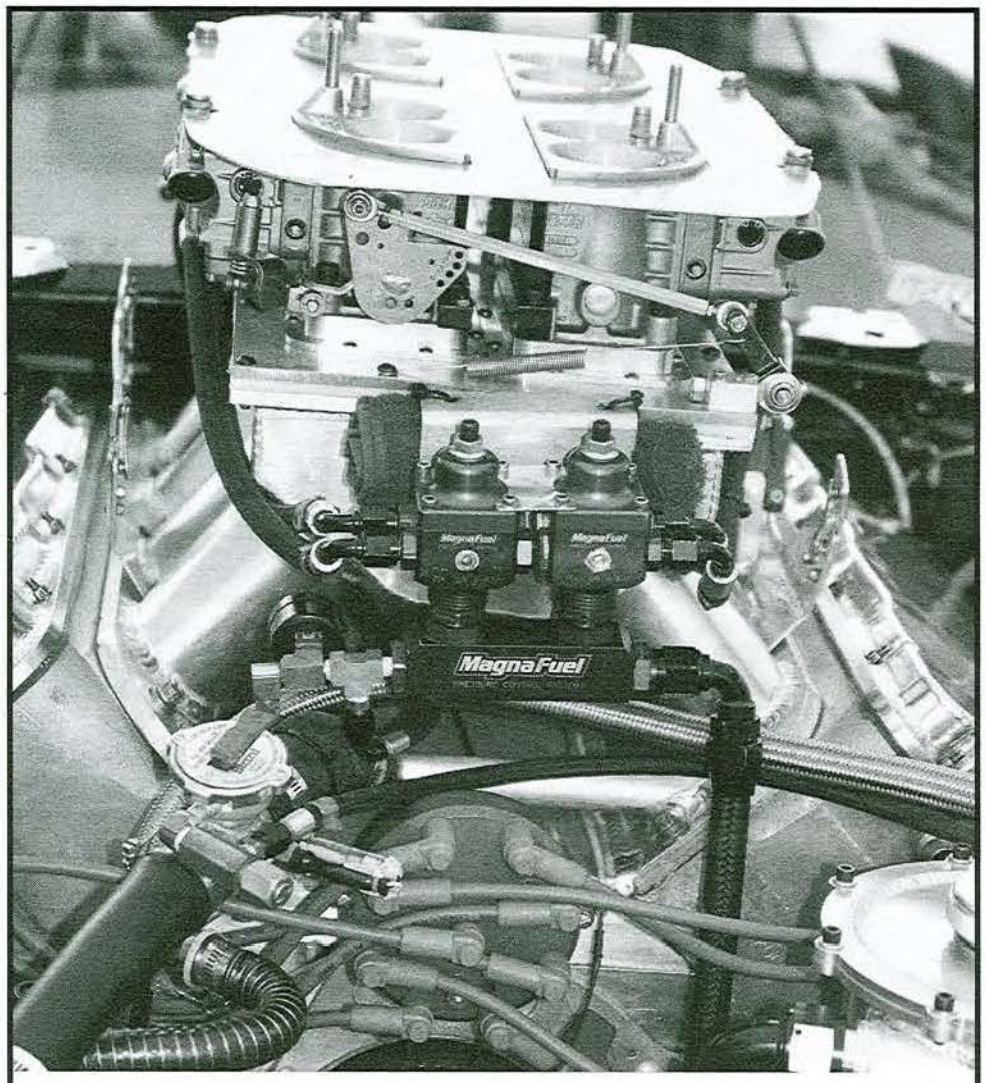
▸ In an effort to produce maximum runner to runner consistency, Wilson has developed a series of CNC machined **6061 billet** aluminum runners. With 3-D modeling and machining software at their disposal, they are able to develop runners for most any application. This particular manifold was developed for an all out N/A NHRA Comp Eliminator application.

▸ A popular arrangement on turbocharged and centrifugally supercharged applications, Wilson has developed their **"turbo tops"** which cleanly interface their monoblade throttle bodies with a classic tunnel ram type manifold base.

TECH

Manifold Mania

TO FAB OR NOT TO FAB?



Cast vs. Sheet Metal Considerations

If you've ever picked up a sheet metal manifold, you were most likely surprised at how much lighter it was when compared to its cast counterpart. We asked Billy Carroll from Wilson just how much lighter a sheet metal manifold can be when compared to it's cast counterpart, and he advised that a racer could expect to save 5-10lbs. Though that might not sound like a lot, every pound you can get off of the nose is a pound that may be placed elsewhere in the vehicle and put to better use. This is particularly important in nitrous and N/A applications where racers must often run at base weights much lower than their boosted counterparts. Another point Carroll raised was that sheet metal units are typically constructed from 1/8" 5000-6000 series aluminum and are 100% custom built with no compromises, every critical dimension may be optimized.

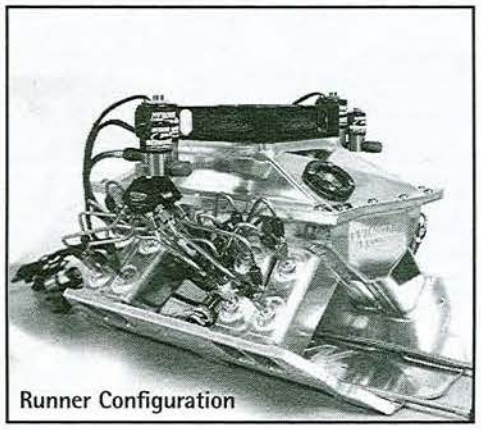
While cast manifolds can be made to work quite well, they are generally limited in that high tooling costs prohibit manufacturers from offering as broad a variety of plenum and runner shapes, sizes and lengths as can be made with a box of sheet metal components. However, there is a tradeoff since, once tooled up, manufacturers can produce cast manifolds much more quickly and economically than their sheetmetal counterparts. However, in the case of heads-up applications, the labor necessary to bring a cast manifold up to snuff may rival that required to build a sheet metal unit. In fact, Carroll advised that Wilson charges $1,575 for "basic" race preparation of a cast manifold and those figures can double or even triple if you want them to wring every last ounce from it. If you want one of their sheet metal units, you can expect to spend at least $3,300; add another $500 if you want one of their billet runner models. Cost here is certainly a huge consideration, but if you plan on running a class where sheet metal is the norm, you better be prepared to ante up the bucks.

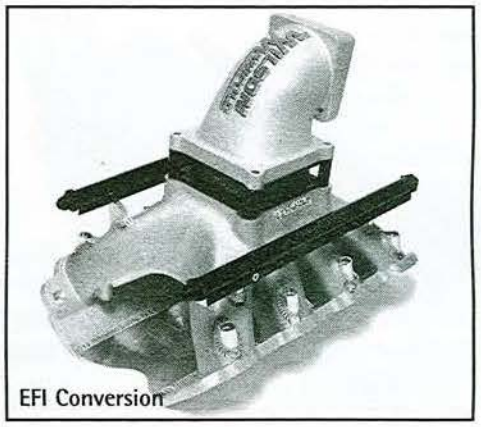
When designing runners, there are a number of variables that are manipulated; runner length and cross sectional area, and to a lesser extent runner shape and profile.

Beyond the plenum lies the most critical component of any manifold—the runners. When designing runners, there are a number of variables that are manipulated; runner length and cross sectional area, and to a lesser extent, runner shape and profile. A runner's cross sectional area is largely dictated by the peak flow of the cylinder head.

Adjustment of the runners cross section provides a manifold designer control of the velocity of the air charge and allows them to keep it at levels historically proven to produce optimal power throughout a given RPM range.

While most cast manifolds utilize a rectangular profile at the runner entry, sheet metal manifolds are often constructed with more rounder, often times a nearly circular profile, which gradually shapes the charge to the more rectangular profile typically found at the cylinder head end of the runner. The


Runner Configuration


EFI Conversion

the 411

▸ When sizing manifolds for boosted applications, total airflow drives the design. This particular manifold, developed for nitrous applications uses a **runner configuration** designed to maximize cylinder to cylinder to distribution. Wilson feels their optimized designs improve engines reliability and offer a wider variety of tuning options.

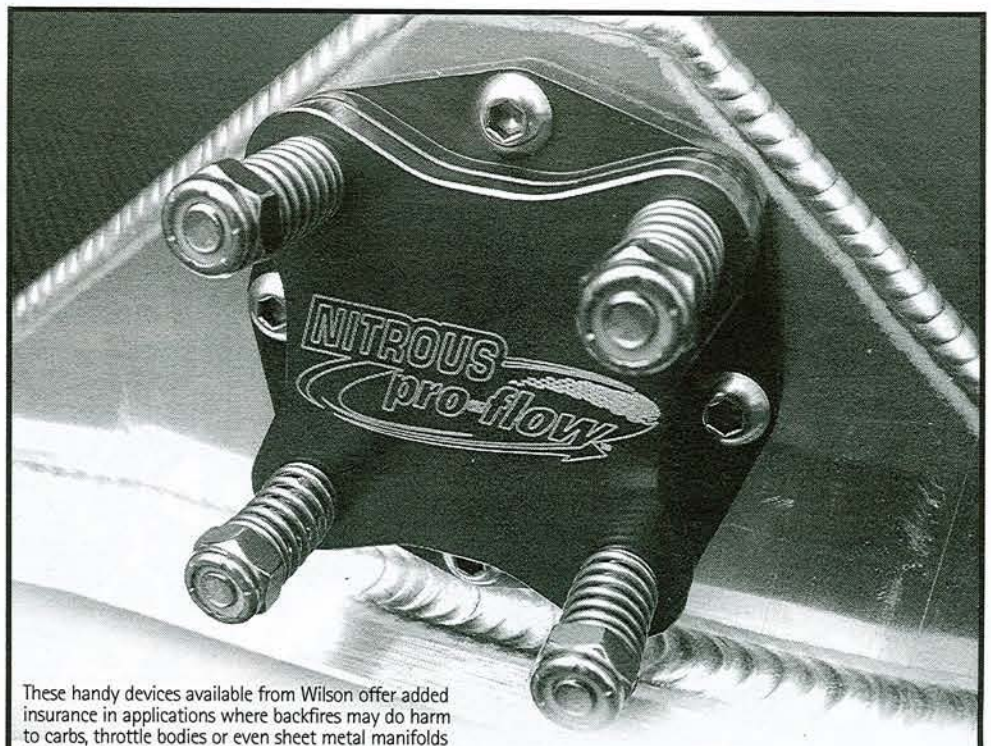
▸ For those wanting a top notch **EFI conversion**, Wilson offers the industry's cleanest package. Send them your carb manifold and they'll return it fitted with their high flow rails, injector bosses, injectors elbow and throttle body.

Manifold Mania

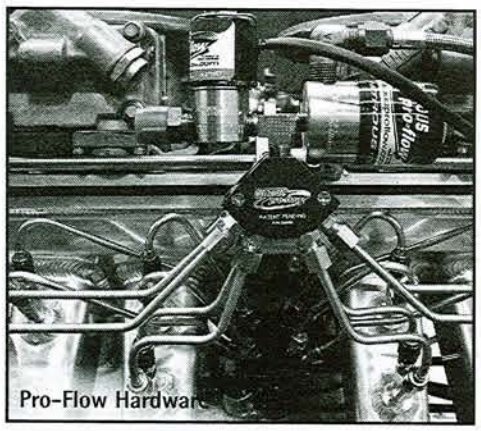
TO FAB OR NOT TO FAB?

A poorly matched manifold can render even the finest cylinder head designs ineffective.

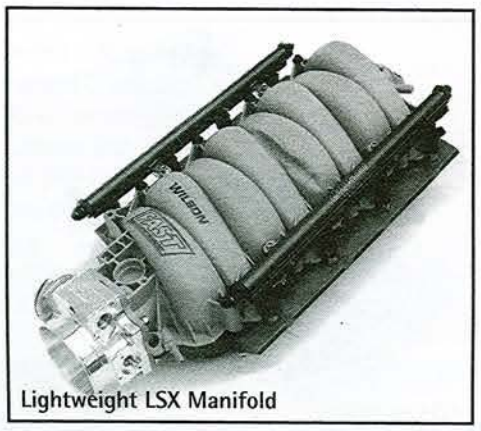
cross sectional area of the runner typically starts larger than at the exit, this tapering allows the air to smoothly accelerate up to the desired velocity rather than abruptly accelerating as it passes from the plenum to the runner. Consider this; a cylinder is only able to exert a fixed amount of energy when drawing the charge into the cylinder. Just as taking off more slowly from a stop sign (We understand that doing this opposes every fiber in your being, but please bear with us for the sake of this example) reduces fuel consumption, accelerating the charge gently reserves more of the available energy for transport into the cylinder. A manifold with oversized runners requires the cylinders to act on a larger air/fuel mass during each intake cycle. With only a finite amount of energy available to do the job, the runners must be sized large enough to feed the cylinder without restriction, yet small enough to avoid wasting energy accelerating fuel and air which won't find its way into the cylinder but rather tumble or stir within the runner.



These handy devices available from Wilson offer added insurance in applications where backfires may do harm to carbs, throttle bodies or even sheet metal manifolds in extreme occurrences. They are available as spring loaded maintenance free devices as well as screw in units with replaceable inserts. These can be thought of as a fuse of sorts for your manifold.



Pro-Flow Hardware



Lightweight LSX Manifold

Variables to Consider

When selecting a manifold, there are a multitude of things which must be taken into account. As you've read so many times before, it all begins by having the customer send them an application data sheet which provides them info about the engine size, compression ratio, rpm range, vehicle weight, transmission type and number of gears, what if any type of power adders and packaging requirements. Though there are a number of mathematical relationships, which may be used to establish theoretically optimal plenum and runner dimensions.

In addition to basic manifold design/construction, Manufacturers often fit manifolds with nitrous plumbing, fuel injector bungs and rails, "turbo tops" for boosted applications, and disc or spring type pressure relief devices (even a modest nitrous backfire can quickly turn a state of the art manifold into a pile of scrap without these pieces in place). Their typical turnaround time (from Wilson) on cast manifolds is 2-4 weeks, while the built from scratch sheet metal units generally require 6-8 weeks from start to finish.

Manufacturers often fit manifolds with nitrous plumbing, fuel injector bungs and rails, "turbo tops" for boosted applications, and disc or spring type pressure relief devices.

the 411

▸ If you've ever tried to plumb your own nozzle system, you can certainly appreciate the workmanship seen in this piece crammed full of Wilson's nitrous **Pro-Flow hardware**. With several nozzle designs at their disposal, Wilson can assemble a setup for even the most radical applications.

▸ In a joint venture with the folks at FAST, Wilson has developed the **lightweight LSX manifold** for the new Gen Chevy V-8's.

Manifold Mania

TO FAB OR NOT TO FAB?

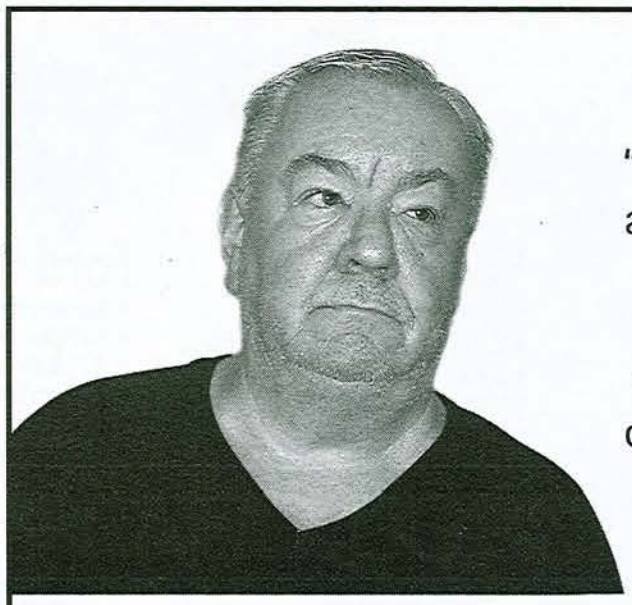
When properly sized, a manifold runner can notably improve an engine's Volumetric Efficiency (VE) through minimization of pumping losses associated with accelerating the air/fuel charge as well as optimization of inertial cylinder filling. Inertial cylinder filling is the ability of the air/fuel charge to continue filling the cylinder after the piston begins to slow and pass BDC.

While a good manifold may not be able to overcome the inefficiencies of a bad cylinder head design, a poorly matched manifold can render even the finest cylinder head designs ineffective.

Runner length is another dimension which is manipulated to alter the RPM at which ram effects reach their peak; increasing runner length will shift torque peaks further down in RPM, while shortening has the opposite effect. This is apparent when looking at the design of many OEM manifolds as their longer runners are designed to enhance power levels at lower RPM. Though some things can be done to modify the effective runner length on a cast manifold, this is generally an area where a sheet metal manifold can be readily modified to accommodate a given application.

As far as overall runner shape goes, a carbureted engine favors a straight runner which permits fuel to stay better suspended in the air/fuel mixture as it isn't forced to turn the corner into the cylinder head; fuel injected engines however aren't as greatly disadvantaged, as fuel is typically introduced nearer the manifold flange where it can get a relatively straight shot at the intake valve. As far as the manifold flange itself, manufacturers try to match the manifold to the cylinder head as precisely as possible. This ensures that there are no sudden changes in charge velocity. When possible, they prefer to have you send your heads with the manifold so they can mock everything up and precisely match the manifold to the intake port entry.

That is in a nutshell, what is taken into account when designing a manifold; you can imagine the many other intricacies a manifold designer/porter faces when optimizing an intake manifold. This month we approached the folks at Wilson Manifolds, and asked them to shed a little more light on the topic. They were quite forthcoming as we grilled them with questions regarding manifold design, construction and in particular their take on some of the key differences between sheet metal and cast manifolds. ■

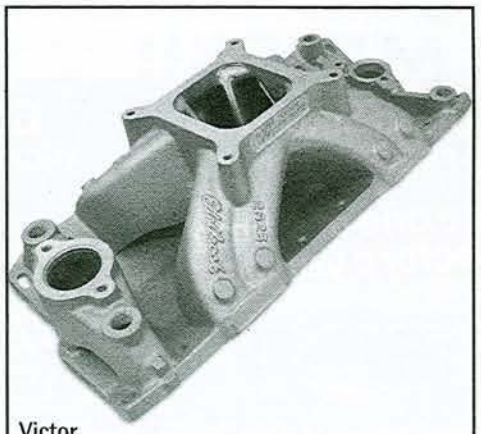


"I really think that a fabricated sheet metal intake should be used when there is no casting available."
—Joe Sherman

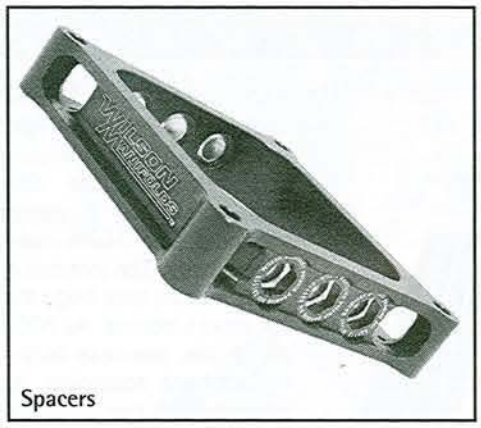
Sherman's Advice

Joe Sherman, noted engine builder and *FSC*'s occasional "voice of reason" says there is a time and place for both fabricated sheet metal intakes as well as cast. "I really think that a fabricated sheet metal intake should be used when there is no casting available. If there is a cast manifold available for what you're building I really think from a practicality standpoint it makes sense to go in that direction. That being said, there are several applications where a sheet metal intake is the only way to go. For instance a lot of the 18-degree head stuff, for the most part, needs fabricated intakes. Also, those who choose to utilize two carburetors on a tunnel-ram type set-up are prime candidates. Cast tunnel rams just aren't being produced at the same rate as they were years ago, so that has allowed the sheet metal market to fill a gap.," Sherman said.

Sherman's bottom line advice is there is a great need for fabricated intakes, but usually they should be reserved for high-end, very hardcore applications. For tamer, less-exotic setups, he says you can't beat cast.



Victor



Spacers

As far as overall runner shape goes, a carbureted engine favors a straight runner which permits fuel to stay better suspended in the air/fuel mixture.

the 411

▶ These CNC ported Edelbrock **Victor** intakes offer racers operating on a modest budget a cost-effective manifold option. These units feature CNC blended, port matched runners, re-contoured dividers, roofline and plenums.

▶ Burst panel **spacers** offer another degree of protection for those who use a cast intake and nitrous plate systems. Not only is it safer, it will also save your butt some bucks in the event of powerful backfire.

S O U R C E

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