

**Pontiac Models
at NNL East**

Don Keefe's
**PONCHO
PERFECTION**

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505 Cubic-Inch '78 Trans Am

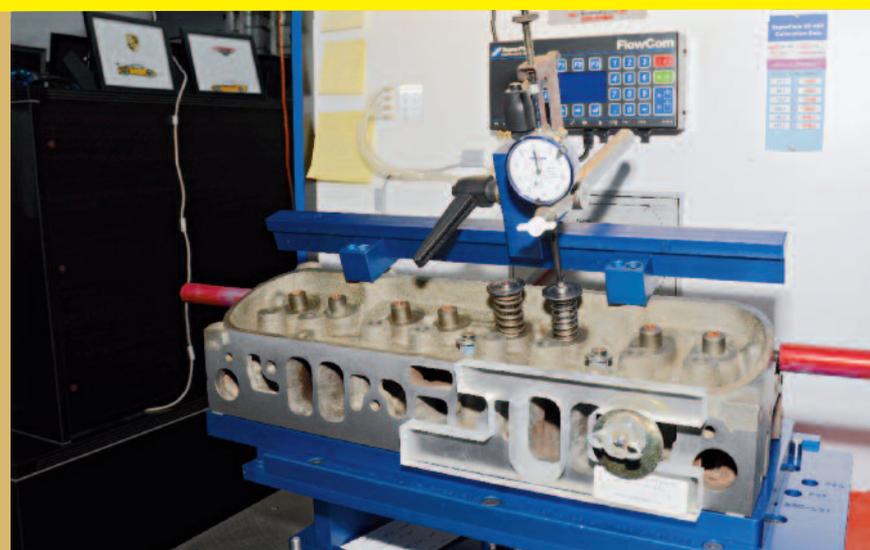
The ONLY All-Pontiac Magazine!



Department X: 1973 Formula X Pontiacs



Head Porting for Your Pontiac V-8



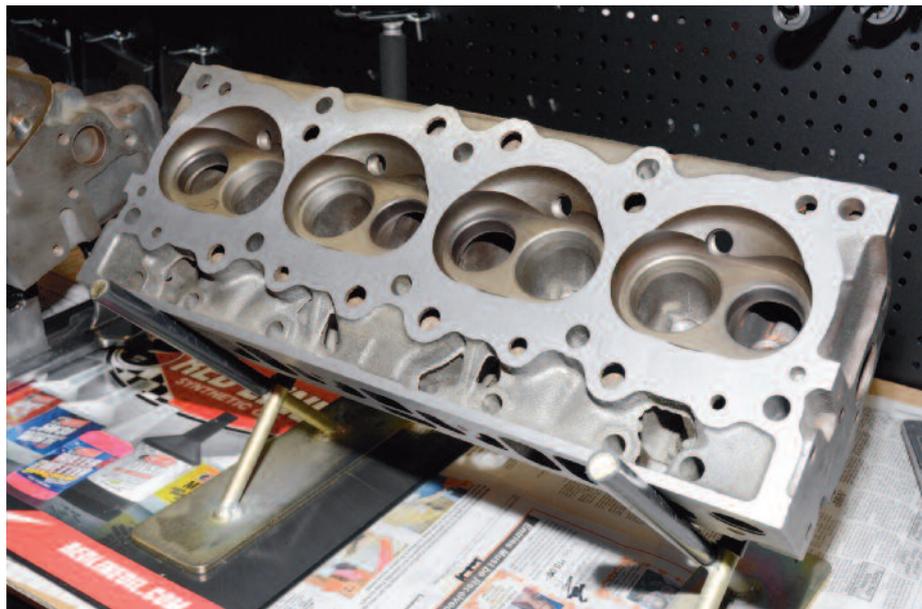
It's no secret that cylinder heads are, perhaps, the most vital components of your engine, in terms of its power-generating potential. You can have the best pistons, crank, rods, cam, and induction system money can buy, but none of that will matter if your cylinder heads won't flow enough air to sufficiently fill your Pontiac's cylinders.

Every performance upgrade that you can make depends upon the capabilities of your cylinder heads to get air and fuel into the cylinders, and exhaust out.

Pontiac knew how vital cylinder heads are, even back in the 1960s – that's why its engineers developed so many amazing heads, like the '68 Ram Air II "96" heads; the "722" and "614" Ram Air IV heads of 1969-70; the "197" or "7F6" HO heads of 1971-72; the "16" SD heads of 1973-74; or, of course, the legendary "44" or "184" tunnel-port Ram Air V heads from 1969.

Of course, many of those revered factory heads are nearly impossible to find today. And even if you did, they're completely impossible to afford. And while we're fortunate to have a plethora of performance heads available from the aftermarket for our traditional Pontiac V8s, many come with a hefty price tag and a number of trade-offs, not the least of which is a decidedly non-stock factory appearance.

But Nitemare Performance's Darrin Magro has learned that you don't necessarily need to shell out big bucks for a set of rare factory heads or aluminum aftermarket



Before Nitemare begins cutting and grinding on the heads, it prepares by cleaning the heads and inspecting them for cracks. Once satisfied that the heads are safe to use, the deck and intake surfaces are checked for flatness and milled as necessary.

castings to make big power from your Pontiac. With careful preparation, less-celebrated heads can often be improved to flow as well as some of the legends and the aftermarket offerings.

Read along to learn about the modifications that Nitemare Per-

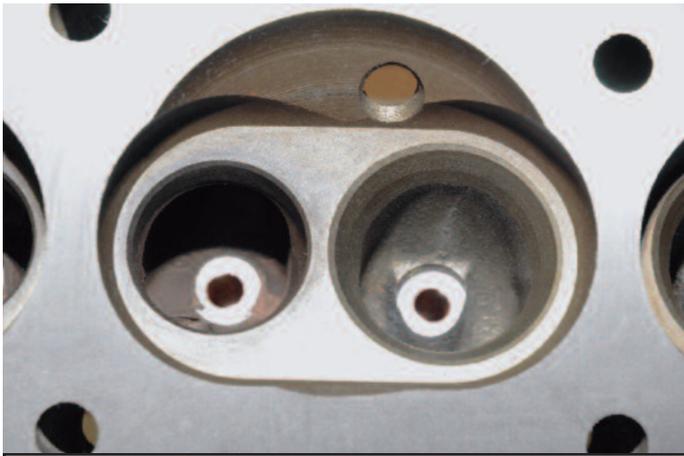
formance makes to a set of typical 6X heads, like those being fitted to the crate engine it will be raffling off later this summer.

Head Selection

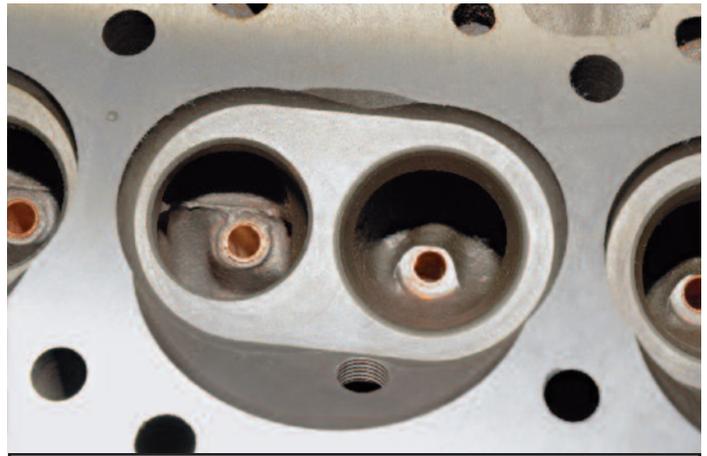
Magro says that while Nitemare can vastly improve the flow of any



Before doing any machine work, Nitemare also sonic-tests the heads to ensure that the casting didn't suffer from core-shift when it was originally made at Pontiac's foundry. Core-shift could result in the walls, floor, or roof of the ports or bowls being too thin for porting, and would risk cracking or breaking through into a water passage.



Here's a peek at the rough, as-cast valve bowls. Notice the huge guide bosses, and the visible parting line, and how much narrower the "throat" (the area just under the valve seat) is than the bottom of the seat. All of these either disrupt or restrict air flow into the cylinder.



Here, you can clearly see a big, ugly, flow-disturbing parting line in the exhaust valve's bowl (and even the adjacent exhaust bowl, too). Pontiac may have understood the importance of good-flowing heads back in the 1960s and 1970s, but its manufacturing processes left a lot to be desired.

of the dozens of available factory Pontiac head castings, there are some that they prefer to start with, most notably the well-respected 6X heads from 1976-1979. According to Magro, 6Xs provide a decent starting point, because Pontiac engineers specifically designed them to flow well to preserve some semblance of performance during the smog-motor era of the late-1970s. "They have good basic port shapes

plus large-ish 2.11 and 1.66 valves, and they have decent low-lift flow, as-is," Magro said, while he bolted a 6X onto the company's Rottler guide and seat cutting machine. "And it's still pretty easy to locate a set [of 6Xs] for a decent price, so we can keep a supply of good cores on-hand." Of course, for folks who want to keep their Poncho numbers-matching, Nitemare can port your heads, as long as they're

suitable for rebuilding.

Fit For Service

Whether they come out of inventory or are customer-supplied, Nitemare starts head rebuilds with the basics: making sure they are suitable for service. Heads are cleaned and checked for cracks, then given a once-over with a sonic tester to verify that each casting's walls are thick enough to



Nitemare also has the intake surface checked for flatness and milled as necessary to ensure a good, leak-free seal. Again, the ports have a rough finish, visible parting lines, and under-sized openings, all of which Nitemare Performance addresses during porting.



Once the heads are certified crack-free and thick enough to be worked on, they're media blasted and shot-peened. Then the real work begins: boring the factory guides to accept bronze liners.

be ground without risking cutting into water jackets or weakening the heads to the point that they're likely to crack, later.

Heads that pass muster are then media blasted and shot-peened before having their deck and intake surfaces checked for flatness and milled as necessary to ensure optimal head and intake gasket sealing.

Valve Guides & Spring Seats

Nitemare Performance begins modifications to the head by boring out the guides. New, bronze guide liners are installed, cut to the proper length, and honed to the proper clearance, based on the stem diameter of the valves that will be used.

With the new guides installed, the tops of the tubes are cut on the Rottler to allow for the installation of PC-type seals, and to provide sufficient clearance to run dual-coil valve springs.

While still on the Rottler, Nitemare also cuts the spring seats—including the base of the guide tube – to ensure the seats are flat and at a consistent depth and diameter for each valve. This step ensures that the springs are properly seated and securely located around the guide, plus it makes shimless more consistent.

Ports

In the old days, porting was a dark art – would-be experts would grind on the heads, bolt the engine back together, then rely on track times to gauge whether they were successful or not. To say it was unsci-

entific would be putting it mildly.

Nitemare Performance's approach eliminates the guesswork aspect by relying heavily on their SuperFlow SF-450 flow bench to test the flow capabilities of their modified port profiles.

For the porting work on the Raffle Motor's 6X heads, Magro started by gasket-matching the intake ports to minimize turbulence as the air/fuel mixture transitions from the intake to the head.

Next, Magro skillfully blends the transition between the ports into the bowls. At the point where the cross-sectional area is the smallest, he performs a little creative grinding aimed at keeping velocity up along the roof but lower along the floor, to minimize turbulence that would result from flow along the floor separating at the short-turn radius, which would disrupt the flow along the roof. Maintaining a fast-flow aimed at the back-side of the valve and bowl helps induce a swirling effect within the chamber, for better air/fuel distribution, for improved combustion efficiency.

Magro then blends the port shape from the mouth of the port at the intake surface to the bend into the bowl, again, to smooth the transition for enhanced flow.

In Stage 1 and 2 porting jobs, much of the work focuses on the intake side, because, in Magro's experience, the exhaust port flows sufficiently, especially when you factor in that exhaust gases are forced out of the cylinder under pressure, thanks to the upward travel of the piston. Upgrading to larger-diameter 1.77-inch exhaust

valves, applying their top-secret multi-angle valve job, cleaning up the bowls, and smoothing the transition into the port all increase flow without needlessly running up the spendometer.

Bowls

Again, using the Rottler, Magro cuts the valve bowls for consistently-round diameters to precise depths, which helps minimize flow variations cylinder-to-cylinder. After cutting, Magro again checks the walls of the bowls adjacent to water jackets, to verify that the walls have remained thick enough after cutting to prevent leaking or later cracking.

With the basic shapes cut on the Rottler, Nitemare streamlines the guide bosses by hand, to improve the incoming air/fuel charge's transition from the port to the bowl.

Valves & Valve Seats

Valve and seat angles are a big part of Nitemare's "secret sauce" that results in their ported heads flowing so well. Without giving away any trade secrets, Magro uses the Rottler to machine several precise cuts to the seat area, starting above the face of the valve and transitioning into the throat of the bowl, always with the goal in mind of enhancing the flow of the incoming air/fuel on the intake side, or smoothing the path of exit for spent gases on the exhaust side.

Naturally, it isn't just the seats that get the multi-angle treatment: the Ferrea stainless steel MaxFlow valves do, as well. Incidentally, the Ferrea valves reduce valvetrain

weight, as well, improving valve control and extending the RPM range slightly, not to mention resisting corrosion and carbon build-up.

Magro says they typically make a rough-cut of the valve seats following porting and bowl work, then flow test the heads and revise the porting as needed to achieve consistent numbers, port-to-port. The valve cuts are then cleaned up, once the ports hit the target flow numbers.

As for precise angles applied by Nitemare ... they've been carefully honed through years of trial-and-error experience and countless hours testing different combinations on their SuperFlow flow bench to develop significant improvements in low-lift flow through moderate-lift conditions typically employed on street and street/strip engines. Of course, if you're looking for an all-out race motor, Magro explained he has an entirely different machining protocol that's just as effective for high-lift, high-velocity applications, as well.

Combustion Chambers

Like the exhaust ports, the combustion chambers receive only modest clean-up work from Nitemare, because in Magro's experience, the chambers feature an efficient shape that's difficult to improve upon without significant and extensive modifications.

When Pontiac originally introduced its Strato-Streak line of V-8s in the 1950s, the heads featured a closed, bathtub-shaped chamber

that wasn't quite the epitome of efficiency. But Pontiac engineers learned fairly quickly and by the mid-1960s had redesigned its heads to feature a far more efficient wedge-shaped open chamber, that survived with some modifications through the end of production of the Pontiac V-8, in 1981.

As mentioned earlier, a standard step in Nitemare's rebuild regimen involves milling the deck surfaces to ensure optimal head gasket sealing. That milling also reduces chamber volume slightly, which reduces the quench area between the piston and chamber, and obviously increases compression somewhat. In a bit of counter-intuitive logic, increased compression doesn't always lead directly to engine-damaging detonation; in fact, reducing quench tends to increase the burn rate of the air and fuel within the chamber, as long as the mixture remains well-distributed throughout the chamber. A faster burn rate preempts detonation and contributes to increased power through greater cylinder pressure and other factors.

Of course, a huge part of chamber shape is the actual deck of the piston, since it forms the bottom of the chamber. While it was common in the 1960s for high-performance engines to rely on pistons with an elevated dome, such designs disrupt even distribution within the cylinder and chamber and inhibit flame front propagation during combustion, making detonation more likely. Today's performance engines tend to rely more on flat-

topped or even dished pistons, as they tend to improve combustion efficiency. Not surprisingly, when possible, Nitemare employs a similar, modern approach to its crate engines, to enhance combustion efficiency for increased power.

So, apart from the valve seat work and deburring the chamber surfaces to minimize any detonation-inducing hot spots, Nitemare leaves the chambers mostly the way that God and Pontiac's engineers intended them to be.

Pushrod Holes

One step that rebuilders who aren't as familiar with Pontiac V8s often overlook is enlarging the holes through which the pushrods pass, in the event that the owner opts to install 1.65:1 rocker arms, as Nitemare is doing on the Raffle Motor.

If you don't enlarge the pushrod holes, the revised geometry created by 1.65:1 rockers will result in the pushrods rubbing against the head, which will eventually lead to pushrod failure ... and in the short term will result in metal particles in your oil, which could create problems in other areas, like bearing clearances or between the lifters and cam lobes.

The Proof In The Pudding

So, how effective are Nitemare Performance's porting and prep processes? Pretty darn effective.

Magro flow-tested several heads on the company's SuperFlow SF-450 flow bench (all at 28" of water). The following table lists the flow numbers of a stock, un-modified



Here's a close-up of a bronze liner about to be installed into the reamed-out iron guide.



And here's the bronze liner being inserted into the oversize bore of the iron guide. Nitemare Performance has a dedicated head-prep room that is configured with custom-built workstations for the various jobs, to make cylinder head blueprinting efficient and repeatable.



Another piece of specialized equipment is this guide cutter, which is used to cut off the excess guide liner from each end of the guide, since liners are furnished extra-long to fit a variety of applications.



Once the bronze liners are installed, they need to be honed to the proper size, based on the needs of the valve stems that will pass through them. Here, a special micrometer is being calibrated to the thickness of the Ferrea MaxFlow stainless steel valves (2.11"/1.77") that are being used on the Nitemare Raffle Motor.



Nitemare Performance then uses a hone to open up the new bronze liner's inner bore slightly to ensure the proper clearance between it and the valve for optimal performance.



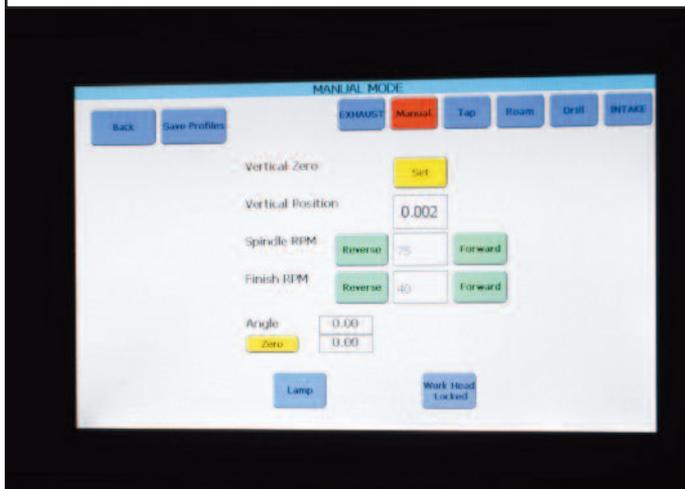
Here, Nitemare Performance's Darrin Magro demonstrates the painstaking process of measuring the honed diameter of the bronze guide liner. This particular process is repeated dozens of times, until each guide liner bore is the precise size.



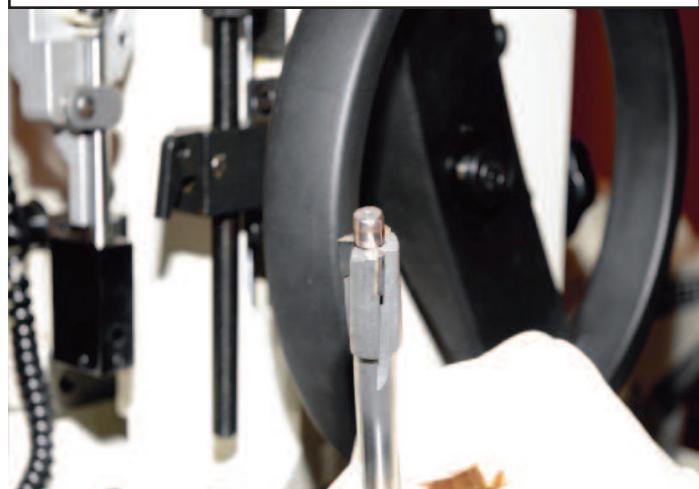
Next, heads are fitted to Nitemare's Rottler guide and seat cutter, which enables Magro to accurately machine various aspects of the heads to precise dimensions and depths, which helps ensure that each intake port flows as well as all the others in the head.



The Rottler is calibrated with a hyper-accurate probe that gets inserted into the lined guides to establish a base line, then cutting can begin.



Here's a look at the Rottler's display, which shows cut depth to the thousandth of an inch, as well as angles, and cutting head RPM, among other values.



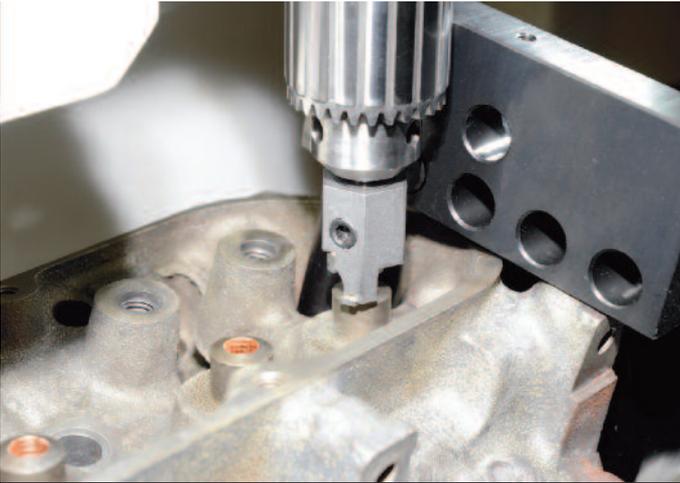
A flat cutting bit is used to machine the top of the iron guides flat, as part of the preparations for installation of PC-style seals.



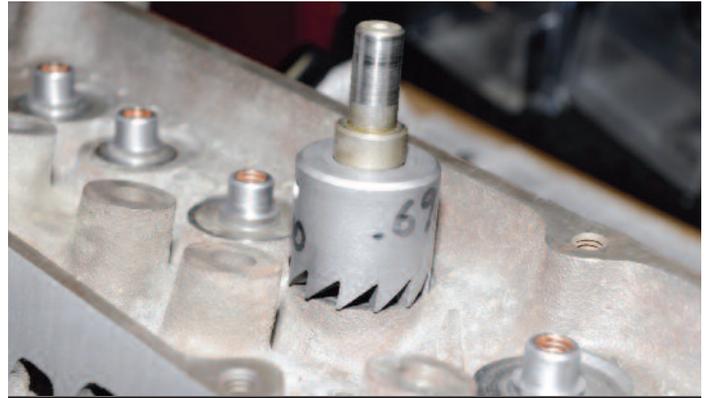
The beauty of the Rottler, is that each cut is precise and repeatable – each is cut to the same depth at the same RPM, making each machining step precisely the same. Here, the guide cutter is starting to machine the top of the guide flat.



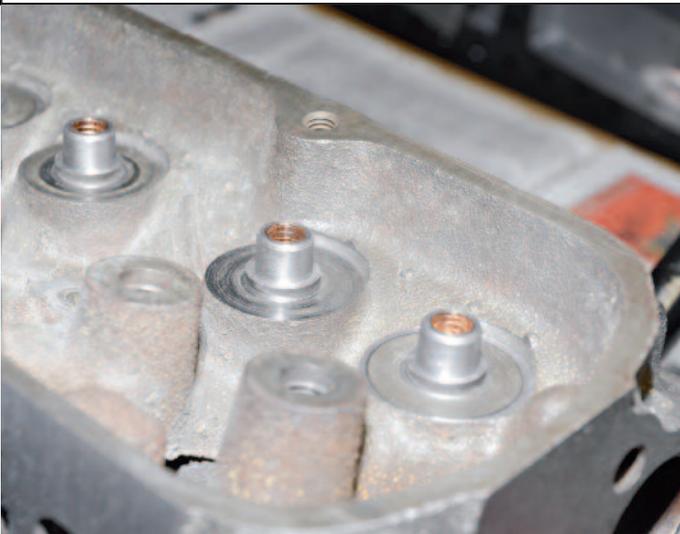
Next, a more radical cutter is swapped into the Rottler to reduce the diameter of the iron guide top ... but only to a specific depth.



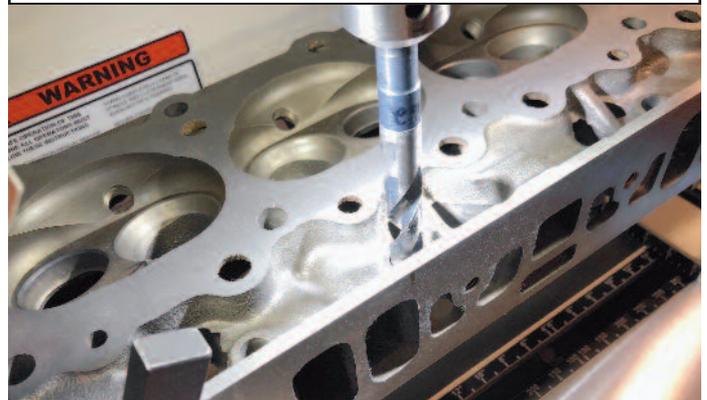
The guide reducer will gnaw off material around the guide to reduce its diameter, to allow PC-style seals to fit within the inner spring, without contact.



Another cutter—which we missed on the Rottler—is this spring seat cutter, which ensures that the spring seats are perfectly flat and cut to a consistent depth and diameter, every time. This step ensures the springs sit properly and any shimming is consistent, valve-to-valve.



And here are the finished guide tops and spring seats. Note the reduced diameter but the retention of a step at the bottom, which keeps the springs properly located without the need for spring cups.



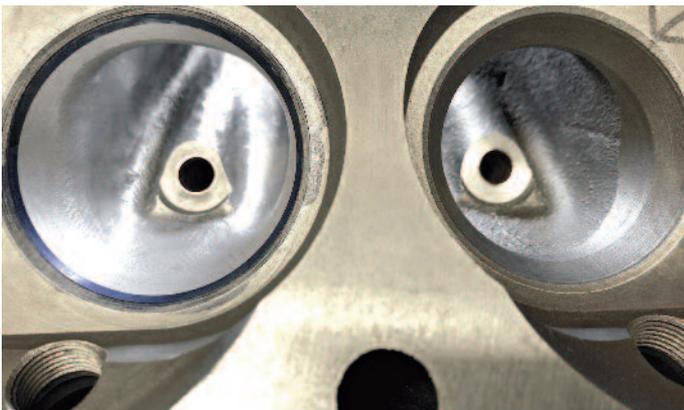
Another process Nitemare performs is enlarging the pushrod holes, to ensure sufficient clearance for the use of 1.65:1 rocker arms, should the customer decide to ever run them. Not all factory heads have sufficient clearance for the longer-ratio rockers, which could lead to contact between the pushrods and the head, and eventual failure of the pushrod (or rods). This quick, easy process eliminates that possibility.



For porting, Nitemare Performance still relies on old-school tools of the trade: a grinder and numerous carbide cutting bits and sanding/polishing cones.



Compare this shot to the one earlier of the unmodified factory ports. Magro has gasket-matched the port mouth, and smoothed the walls, floor, and roof as they sweep in toward the bowl to remove impediments that would restrict or disrupt flow.



Nitemare uses the Rottler to cut the precise angles required for the valve seats, then continues to cut the throat of the bowls so that they're perfectly round and of precise diameters at specific depths, bowl-to-bowl. Magro then streamlines the guide boss by hand to minimize any disruption that it presents to flow, and blends the bowl-to-port transition using a little magic that greatly enhances flow.



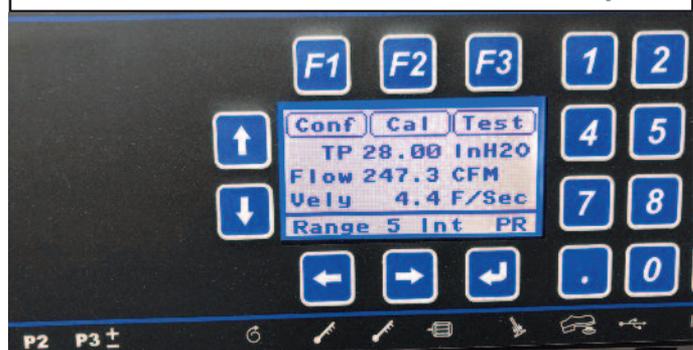
Nitemare Performance typically uses stainless steel Ferrea MaxFlow valves—2.11-inch intake, 1.77-inch exhaust—on its heads. The valves are treated to a custom multi-angle valve job that's matched to the specific valve seat cuts applied by the Rottler.



Flow readings are taken at precise valve openings, as measured by a dial indicator ...



And here's where the rubber hits the road: each Nitemare-ported head is tested on the company's SuperFlow SF-450 flow bench—often multiple times, as each port is massaged until it yields the desired flow characteristics. Magro emphasizes that good heads aren't just about flowing peak numbers, either—for the street, a good head has to flow well at low-lift and moderate-lift conditions to make monster torque.



And the SuperFlow's display tells the tale: at 247.3 cfm at .600-inch lift, Nitemare Performance's Stage 2-ported 6X heads outflow one of the most legendary stock Pontiac heads, the Ram Air IV, plus they flow within a few cfm of popular aluminum aftermarket heads that are one-third more expensive. All while retaining a completely stock appearance, for those who appreciate that sort of thing.

Iron vs Aluminum

Not so long ago, aluminum cylinder heads were considered “exotic” ... which tended to translate into “expensive.” Today, while aluminum heads are far more common, they still tend to be pretty pricey. The benefits of aluminum heads have been debated for years amongst engine builders and especially enthusiasts.

Clearly, aluminum heads provide a weight savings. When it comes to a pair of Pontiac heads, you’re looking at losing roughly 75 pounds off the front of your car – a significant diet, to be sure. In terms of power production, however, things are less clear.

Aluminum is about 2.5 times as effective at dissipating heat than gray iron, which theoretically allows you to run a bit more compression. For 91-octane pump gas, builders often shoot for 9.5:1 compression with iron heads to avoid the likelihood of detonation, but with aluminum heads they can push that to 10.0:1 or possibly even 10.25:1 depending on other factors.

Normally, more compression means more power. But aluminum’s heat-shedding characteristics have a catch: a good portion of the heat from the combustion cycle is transferred more quickly to the coolant, which effectively reduces cylinder pressures and thus power, effectively negating the benefits of the higher compression.

Iron heads, in contrast, tend to have three benefits over aluminum. First, iron heads typically cost considerably less than aluminum, especially since most folks with a Pontiac V8 already have a set of iron heads – the pair that came on the engine.

Iron heads also tend to be highly durable, so you’re far less likely to have a rocker stud, or intake or exhaust manifold or other bolt strip its threads.

Finally, because aluminum expands at a different rate than iron, aluminum heads necessitate more-forgiving head gaskets that can compensate for the different expansion rates without leading to compression or coolant leaks between the heads and the iron block. The different rates can also require head bolts to be periodically re-torqued to ensure that they haven’t loosened due to the way in which the dissimilar metals respond to repeated heat cycling. Iron heads, on the other hand, expand at the same rate as the block, so head gaskets don’t need to deal with temperature-induced variations, likewise head bolt torque tends to remain more stable.

Each material has its advantages and disadvantages. But as Nitemare Performance has demonstrated, power output isn’t necessarily one of those differentiating factors.

6X intake port with a factory valve and factory valve job, next to those of Nitemare’s Stage 2 ported 6X with a street-strip valve job and performance-enhanced valve mods ... and just for fun, a factory-stock Ram Air IV 722 intake configuration:

By .300-inch of valve lift, Nitemare’s Stage 2-ported 6X is showing a nearly 12 percent improvement in flow. By .400-inch lift, Nitemare’s 6X is flowing almost 20 percent better than the factory head. And by .500-inch lift, the Stage 2 6X actually out-flows a factory-stock Ram Air IV intake port – and it improves on that up to .600-inch lift. In terms of power, the stock 6X’s airflow would limit horsepower to just under 428, while Nitemare’s Stage 2 6Xs can support more than 506 horses – a 78 horsepower gain! Not bad for “smog” heads.

And how do they stack up against aftermarket heads? Well, conveniently enough, Nitemare’s Stage 2 ported 6X heads match the flow of popular aluminum aftermarket heads that cost nearly one-third more than a set of Nitemare Performance Stage 2 blueprinted 6Xs.

And with that kind of left-over cash, just imagine what other improvements you can make to your Pontiac’s powerplant!

PP

Cylinder Head Flow (cfm)

Lift (in.)	Stock	Stage 2	Stock #722
.200	136	138	147
.300	178	199	198
.400	200	235	238
.450	205	238	--
.500	207	242	241
.550	208	246	--
.600	--	247	242

Sources

Nitemare Performance

(203) 239-6868

www.nitemareperformance.com

Cylinder head machining

Ferrea Racing Components

www.ferrea.com

Stainless steel Max Flow 2.11-inch intake and 1.77-inch exhaust valves



About Nitemare Performance

Nitemare Performance, located in North Haven, Connecticut, specializes in the restoration and race-preparation of vintage Pontiacs. In addition, Nitemare manufactures a full line of precision-engineered performance parts for Pontiac engines.

Win This Engine!

One hundred tickets are being sold at \$100 each, with all proceeds from the raffle going to The Tomorrow Fund and Alex's Lemonade Stand Foundation charities to benefit children afflicted with cancer. Each \$100 ticket gets you a 1-in-100 chance of winning this very engine. The engine build-up will be covered here in the pages of *Poncho Perfection*, and the drawing for the raffle will take place on September 23 at the Pontiac Registry's "Pontiacs With A Purpose" event in Warwick, Rhode Island.

To purchase a ticket, make out a check or money order to Pontiac Registry Fund and send it along with a self-addressed, stamped envelope to:

Nitemare Performance
11 Belmont Rd
North Haven, CT 06473

Don't forget to include your full name, daytime phone number, and email address for notification purposes.

For more info about the raffle, visit nitemareperformance.com; event info: pontiacregistry.com.

A promotional poster for 'A Pontiac Celebration' featuring three cars and a teddy bear on a motorcycle. The poster is blue and white with yellow stars. It includes the text 'CELEBRATING PONTIAC'S RICH HISTORY', '2018', 'PONTIACS with a Purpose', 'A PONTIAC CELEBRATION', 'EASTERN REGIONAL MEET', 'Warwick, Rhode Island • September 21-23, 2018', and 'ALL PROFITS GO TO FIGHT CHILDHOOD CANCER'. It also lists several activities: Friday Night Parking Lot Party and "Teddy Bear Cruise" at Host Hotel- all cars welcome!, Informative Technical Seminars, Saturday Afternoon ALL Pontiac Show, Saturday Night Family BBQ Party, Sunday Farewell Breakfast, and Swap Meet & Arts and Crafts. For information, it provides an email address (info@pontiacregistry.com or frdigi@cox.net) and a phone number (941-792-6279 or local (RI) 401-934-0663).