**'68½ PONTIAC RAM AIR SETUP:**

Pontiac's groovy Stage II Ram has new pistons, wild porting, oversize valves and an out-of-sight computer designed cam. It figures to be

# THE MACHINE TO BEAT

on the street or in D/Stock

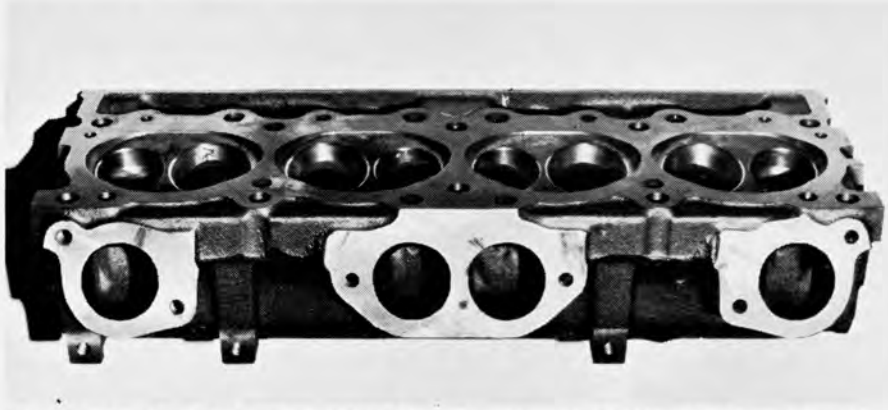
**BY ROGER HUNTINGTON**


Royal Pontiac took prototype '68 GTO to the Miami Dragway for initial test of the groovy new 68-1/2 Ram Air package.

ANY SAVVY PONTIAC engineer will admit that GTO's and Firebird 400's have been a little short on horsepower in the Stoplight Grand Prix for at least two years. Even the wild Ram Air engine option. You have to remember that the basic design of the Pontiac V-8 dates back 14 years. Successive improvements in cylinder heads, manifolds, cams, lower end, etc. have done a good job of *keeping up* with the performance models from other companies; but they've been fighting an uphill battle. Meanwhile other new engine designs like the Mopar Street Hemi, Dodge-Plymouth 440-cu. in. hi-performance, 427 Chevy "stagger-valve," tunnel-port Fords, Olds 400 and 455-cu. in. performance engines, etc. have been making things tougher.

So now we've got a new shot in the arm for the "1968-1/2" Ram Air engine. By the time you read this Pontiac will be in a volume production on a revised Ram Air option for GTO's and Firebird 400's, to replace the well-known '67-'68 design (360 hp) that you're all familiar with. New goodies include cylinder heads, exhaust manifolds, forged pistons, new camshaft and several new valve gear components, plus recalibrated Quadrajet carburetor and ignition advance. It's practically a brand new engine for all practical purposes. The horsepower rating is raised only 5 hp, to 365; but that's not half the story. This thing is *strong*.

Milt Schornack, Royal Pontiac's performance chief from Royal Oak, Mich., had a prototype engine out on a Florida drag strip recently in a '68 GTO. Running 3.90 rear end gears, close-ratio Munci four-speed, Doug's headers, 8.50-14 M&H Super Stock 7-inch cheaters—plus the usual Royal tune-up on the engine—he got down to a *12.77 e.t.*



Heads have huge round exhaust ports with 36 percent more area and no siamesing of center ports.

Exhaust valves are tulliped under head to reduce weight from 120 grams to 117 (valve on right).

New intake valves have same 2.11 diameter but are tulliped to cut weight from 138 to 132 grams.

*at 111.23 mph trap speed*, after two hours of tuning and experimenting! You have to remember that this is without any chassis modifications for maximum traction (special shocks, raised front, hard rear bushings, Air-Lifts, etc.) and the engine had *not* been blueprinted. It was right out of the crate except for: CC'd heads, blocked heat risers, rocker stud nut adjustment for higher revs, thin head gaskets, richer carb jetting, and faster centrifugal spark advance at low speeds for better jump off the line (with vacuum advance disconnected). These mods do a lot for performance; but this way by no means an all-out drag strip engine.

And yet here we have a 12.77 at 111 mph. Milt figured this would be about 2 mph faster and 2/10ths second quicker than the same car and setup, but with the original '67-'68 Ram Air equipment. According to my slide rule this would make the new goodies worth roughly 25 hp extra. In other words I figure this engine they tested put out about 450 hp at 5200-5500 rpm with open headers. An equivalent '67-'68 Ram Air, with the Bobcat goodies, should have put out 425 horses or so. Blueprinting should add at least another 25 horses in either case. This is getting right down where the big boys live.

If there's any secret to the new modifications, it's *exhaust breathing*. Pontiac engines have had pretty decent breathing on the intake side for a long time; but the engineers figured it was time to clean up the exhaust side. The new cylinder heads feature huge *round* exhaust ports that are 36 percent larger in area and much straighter clear into the valve. Also the two center exhaust ports are no longer "siamezed" into one large manifold port. They are separate ports that go into separate holes in the exhaust manifold. This not only reduces interference between the gas flow from the two ports, but the "tuning" effect of bouncing pressure waves in the exhaust header tubes is much more effective when the exhaust pulses from separate cylinders are completely split. (Remember Olds got much this same effect by putting deep "blocker dams" in the center exhaust ports of their '68 Force Air 4-4-2 engine.) The new Ram Air

exhaust manifolds are actually the same layout as the former design; but the ports that mount to the head are made round and split in the center to fit the head ports. This was a pretty decent manifold to begin with.

However it is to be expected that this new Ram Air engine will respond better to tuned steel tubing headers, because of the larger, round ports and center split. Right now, of course, none of the header manufacturers have production designs to fit the new heads—and it will be a few months before the ball gets rolling. The headers on the prototype that Schornack drove (owned by Royal Pontiac) were made special by Doug Thorley, of Doug's Headers, after a quick phone call from the Royal guys. They sent Doug a blueprint of the new heads, and he whipped out a set of headers in his California shop to fit a '68 GTO chassis and adapt to the new head ports at the top. Milt had the headers back in Michigan in five days, which must be a record of some sort. They fitted to a T—and really ran. This should give Thorley a toe in the door when it comes to production headers for the new Ram Air engine. We understand he is putting in production tooling now, and should have them for sale by June. Incidentally, Doug is using a little larger primary piping—two inch—for the headers because of the freer breathing through the round ports. And three-inch collectors for a velocity scavenging effect. Schornack says the new headers really turn on, and give a terrible sound.

Otherwise the new cylinder heads are not changed much. Valve sizes are the same—2.11 inch diameter on intakes and 1.77 on exhausts—and intake ports are the same size and contour. Apparently the intake side wasn't the big problem. The combustion chambers are opened up a little around the edge of the exhaust valves to further help breathing. Compression ratio remains at 10.75-to-1.

But this isn't the whole story on breathing. Look at the new hydraulic cam-shaft. Timing and life are changed entirely. Intake duration is extended from 301 to 308 degr., while the exhaust duration is lengthened even more, from 313 to 320 degr. And the all-important intake-exhaust overlap is drawn out from 76 to 87 degr. (Actual timing is 42-86 intake and 95-45 exhaust.) And the valve lift has been increased radically from .413 to .480 inch. Essentially what this does is to increase the mid-range torque of the engine but without sacrificing at the top because the exhaust breathing is improved so much. The higher overlap permits the outgoing jet of exhaust gas to help suck fresh fuel-air mixture from the intake valve at high revs. The higher lift is dynamite in the mid range. This overbalances the effect of the longer intake duration—which tends to *reduce* mid-range torque—and we actually get a net increase in the

## If there's any secret to the new modifications it's exhaust breathing


Car ran consistently in high 12's at 111 mph with only a simple Bobcat tuneup. That's Milt Schornack driving and Dave Warren at the clocks.

**Left, Doug Thorley whipped up a set of special headers for prototype engine in a few days. They have new round port flanges with tuned tubing fitted to '68 GTO chassis. Right, exhaust manifolds are same basic layout as '68 but with inlets adapted to round-port heads.**

## The new cam represents a kind of new design-philosophy at Pontiac

mid range. Meanwhile the longer intake duration helps the top end. So does opening that exhaust valve 95 degr. before bottom center. This relieves all exhaust pressure in the cylinder before the piston starts up on the exhaust stroke. Result: A fat bulge in mid-range torque and top-end both.

It's a tremendous new camshaft. And it represents a kind of new cam design philosophy at Pontiac. They've always been conservative on lift and duration. This is their wildest one yet. It will be interesting to see how it feels on the street, where low-speed action is felt. The idle is bound to be rougher. Incidentally, this is Pontiac's first camshaft that has been designed entirely on the computer. The lobe profile has no straight lines on it, as before. Valve opening and closing accelerations are smooth, gradual curves, calculated to reduce the inputs that previously triggered valve gear vibration and spring surge. This new valve gear is very stable up to over 6000 rpm.

In fact this problem of extending the useable rev range on the new engine is a story in itself. Pontiac engineers have been using dual valve springs and dampers for some time, in an attempt to control spring vibration or "surge" that limits revs. For the 1968 Ram Air engine they increased total spring pressure (with valve open) to 280 pounds. With spring surge controlled, this raised the maximum useable revs (with lifter plungers adjusted out) from about 5800 to 6200 rpm. Now these same springs, with the valves being opened farther by the cam, give a total pressure of some *310 lbs.* at full open! This is one of the highest figures in the industry for a street engine.

And of course this kind of spring pressure beings on other problems, like bent pushrods. Accordingly new pushrods are supplied that are 1/32 inch larger in diameter, to prevent bending. Another very important move for raising revs is lightening the valves. The new valves have their heads "tulliped", or hollowed out, on the under side to reduce valve weight from 3 to 6 grams. That's only three or four percent of the total valve weight; but it makes it possible for a given spring pressure to control the valves from "floating" at higher revs. The lighter valves plus the higher spring pressure plus the changes in cam acceleration rates and contours have combined to add another 150 to 200 rpm to the useable rev range of the engine.

Milt Schornack reports he could take the prototype Ram Air engine to 6400 rpm without trouble. However optimum shift points were 5800 to 6000 because the moderate intake duration seemed to hold the peak of the power curve under 5500 rpm. But having another 600 to 1000 revs in reserve above the shift point is good insurance against a missed shift, and wrecking the engine from a floating valve hitting a piston. It's always useful to extend the useable rev range, even if you don't raise the power peak.

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**68-1/2 PONTIAC** continued

And speaking of durability at high revs, another important addition to the new Ram Air engine is forged (impact extruded) pistons. There are two vital advantages: One, any forging is inherently tougher, and more ductile than a casting. It can absorb more impact and deflection before breaking. This is just what you want in a high-output engine. Also with the finer, more even grain flow of a forging you can reduce the *weight* of the part a lot without reducing the strength. The new forged pistons are 50 grams lighter than the old Ram Air cast pistons —and they're still stronger. And of course the lighter weight means less reciprocating inertia force in the engine and lower bearing loads. This is important when you realize that inertia forces increase as the *square* of rpm. They're more than twice as high at 6000 rpm as at 4000.

The Quadrajet carb on the new Ram Air engine had to be re-calibrated to allow for the reduced exhaust restriction at high revs. (You'd be surprised how much effect the exhaust system has on carburetion jetting.) Also the new engine seems to want a more gradual centrifugal spark advance at medium speeds than before—probably because the breathing is more efficient in the mid range with the new cam, and this has increased detonation tendency. The new distributor feeds in 24 crank degr. of centrifugal advance between idling and 5800 rpm engine speed, while the old one put in 20 degr. at 4600. However the Royal-modified distributor lighter springs to bring in full centrifugal advance at 2400 to 2800 rpm. Then they crank in 8 to 12 degr. initial timing for a total of 32 to 36 degr. at high revs. Works fine for drag strip work with open exhaust.

Well, there's your new Ram Air engine, guys. Looks good on paper —and the early drag strip times back it up. And certainly the bread-and-butter street performance, with stock exhaust manifolds and muf-

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flers, should be improved proportionally. This *might* just be enough to put the '68-1/2 GTO's and Firebird 400's up in front on the street and strip both. We'll see.