

Choosing Heads

Aluminum vs. Iron... which do you need?

BY DAVE HUGHES

To get an idea of which type of metal gives the best performance, we talked to Dave Hughes, a longtime AERA member in Washington, IL and the owner of Hughes Engines, Inc. Dave's business started in 1969 as Hughes Engineering to build stock and super/stock cylinder heads for NHRA class racing. Since then he has grown into a complete custom engine building facility and boasts as being one of the first all ASE certified engine machine shops in the nation. During his over 40 years working in a machine shop, he's specialized in Mopar wedge type engines the last 20 years. The information in this article is a result of those many years of trials and tribulations spent learning what works best.

With the current availability and popularity of aluminum heads for both big and small blocks as well as in almost all current production engines, the question of which type to use is more pertinent now than in the recent past. Since they port, test and sell about an equal number of each, Dave can offer some unbiased opinions and information. With the number and types of aluminum heads now available, the Mopar racers need to understand all of the quirks about them and terms used with them.

There are several types or levels of heads available and there is a lot of confusion over what is what. This confusion is in part created by the terms "bolt-on" and "stock replacement". They are used indiscriminately and interchangeably, but no one has stepped forward to either clarify or classify them. We will try!

A "stock replacement" head is one that has the stock location of the ports and rocker arms. These original

components will, along with the rocker covers and other odd brackets, attach like they did on the original iron heads. No spacers, oil lines or other adapters are required.

"Bolt-on" can generally be interpreted, with cylinder heads anyway, to mean that they will have the head bolt holes located in the same "location" as the stock ones. So they will "bolt-on" with the correct bolts, which may or may not be the same ones used as stock, usually not. It does not mean that they are a "stock replacement" head and you should not expect all original components to fit. This "bolt-on" type head will be a race, performance type head. It generally will have the ports raised and relocated from the original location. Doing so requires special intake manifolds or spacers and special exhaust components and many times special rocker arms and maybe even external oil lines.

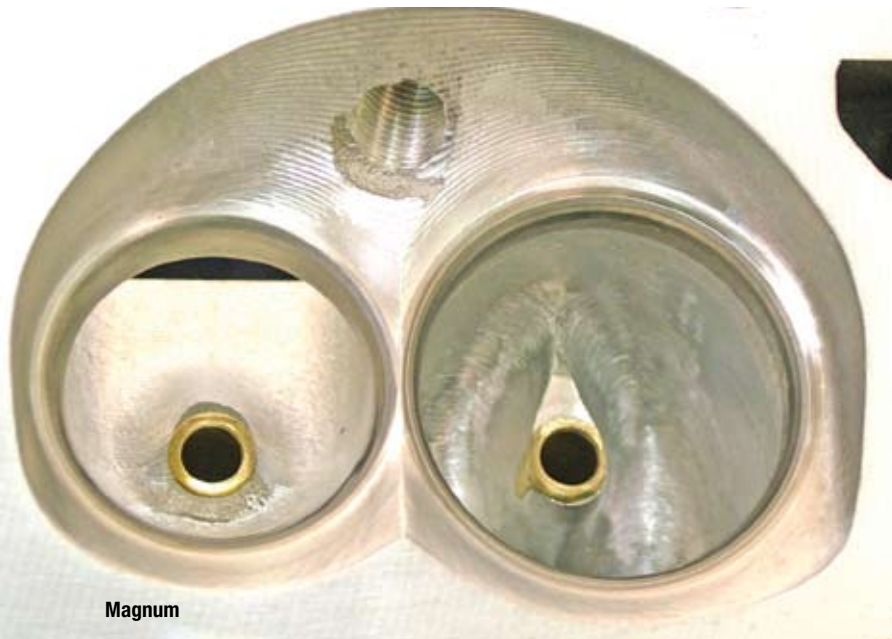
The difference in cost between the two is very significant also, as many who have called our shop will testify. They have been sold as so-called stock replacement heads (by other sources) that "bolt-on" but need many expensive parts to complete the job correctly. That takes them out of the "stock replacement" group no matter what you call them, because you can put lipstick on a pig, but she's still a pig. And no, we don't know of any lower cost way out of that dilemma, except to send the heads back and get what you wanted in the first place.

We're dealing with two different types of heads from a performance standpoint as well! A stock replacement type head must have the port locations in the same position as the stock head,

so the manifolds etc. line up and attach. The "bolt-on" with additional modified performance, however, has drawbacks because raising the ports is one of the best ways to improve air flow but, with that alteration comes the use of special manifolds, spacers, headers, rockers, etc. putting the head into the raised port bolt-on group.

Dealers often get requests to compare these "stock replacement" heads to heads that have raised ports, in other words raised port, "bolt-on" heads. This question however is unfair and misleading, because, they are not a fair apples to apples comparison. The stock replacement heads are just that, a stock replacement head in a high performance version. The raised port, "bolt-on" head is a head designed for racing. If you need a "bolt-on" raised port head why would you even care about a "stock replacement" head? On the other hand, if you want a high performance "stock replacement" head, buying the raised port "bolt-on" heads can be an unexpected, expensive mistake.

As our dealers tell their callers, you must build your car/engine with a plan or a goal in mind. You can use horsepower, ET or money, they will all end up at the same point, but you must have a plan. If you are starting from scratch and need 750 or more horsepower and cost is not a problem, go with the fully ported, raised port, bolt-on heads, which should have the capability to develop the most power. Here you may run into another problem. Some of the more popular raised port bolt-on heads barely out flow a set of, well-ported, stock replacement heads until they are ported. Check carefully before buying. All "stock replacement" performance



Magnum

aluminum heads are designed to develop more power than the iron heads they are replacing. However, the gap between what was designed and advertised, and what they have leaving the factory can be worlds apart, especially with the imported cylinder heads.

When aluminum heads are cast there is a lot of core shift, more than with cast iron heads. That core shift ALWAYS reduces the airflow in the port. The question is how much flow is lost and is it significant to you in reaching your goal. We constantly check the “out-of-the-box” flow of heads that we are porting and find them to be down 15 to 30 CFM from what is advertised. The CFM from port-to-port can also vary 5 to 10 CFM on the same head.

Remember, you’re installing these new heads to make more power and heads produce more power with better air flow — not necessarily more, but a better flow curve.

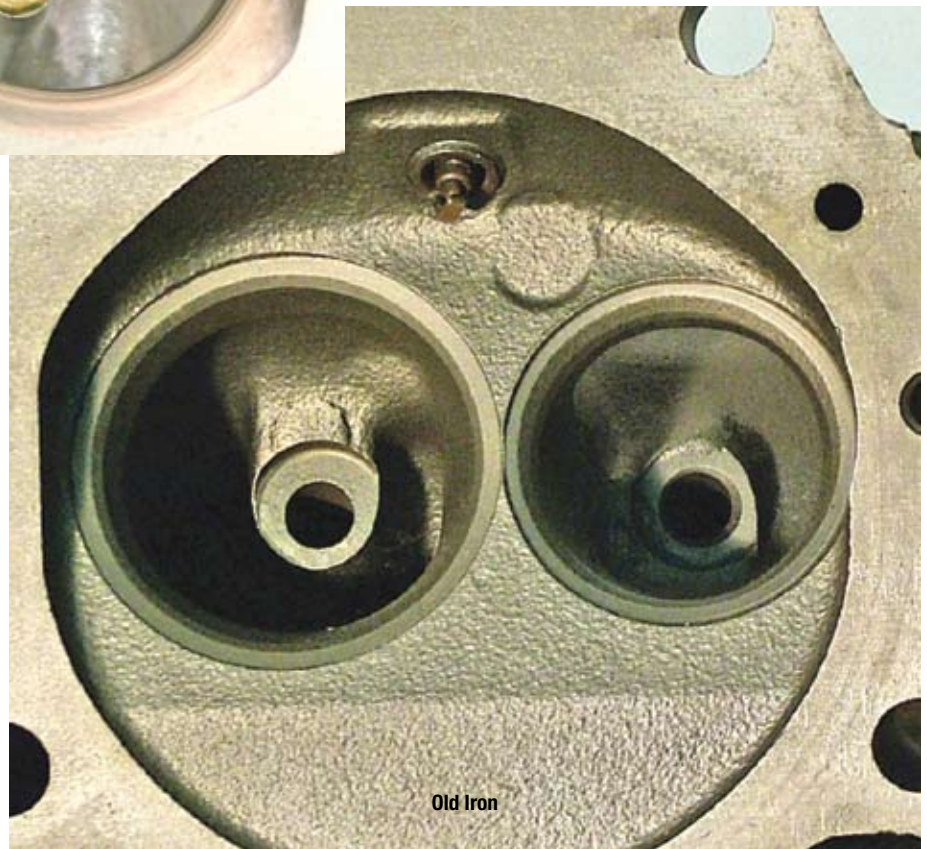
Now your next question is...

What will they flow on my bench?

The answer is that we don’t know. That is why we supply charts on the website (www.hughesengines.com/TechArticles. Select “Cylinder Heads” and then select “#310 Head Flow Comparisons Updated 11/2009”) — and again, all flow benches do not flow the same! Benches can show a difference of about 3 to 5%. 5% at 300 CFM is a difference of 15 CFM. We have seen benches off 6 to 8%. 8% at 300 CFM is a 25 CFM. An extra 24 CFM will really help a guy sell heads! How does this make you feel? I know, you feel cheated, so do we, but is this what we have to deal with in this business.



All stock replacement performance aluminum heads are designed to develop more power than the iron heads they are replacing. However, the gap between what was designed and advertised, and what they actually have leaving the factory can be worlds apart, especially with the imported cylinder heads.



Old Iron

So how do you go about determining a good port?

After 50 years of flowing heads the industry still does not have one single good answer to that question. Here are some indicators to help.

- 1. Know this for sure.** If most legitimate shops are getting 350 CFM airflow out of a certain head and someone suddenly starts advertising 390 CFM.....that is just what it is advertising (or misused a flow bench).
- 2. Clue to a good port.** The flow should rise very quickly. For example: Let’s take a head, which flows a maximum of 300 CFM. The lower the lift at which that number is reached, the better the port design. If the maximum flow is reached

at .500” lift the head will produce a better power curve than if the valve must be opened to .700” lift or more to get the flow. A head that flows well quickly is what we call our “Fat Flow” ports.

- 3. If the flow continues to increase above your maximum lift,** the port volume is too big and the port is poorly designed and will therefore have a lower velocity and poor power output.
- 4. The smallest port volume with the most flow** quickly reached is the best designed. Small holes with big flow.
- 5. The flow numbers above,** about 95% of your net lift, do a lot more for your ego than they do for your power curve... But, they look good in ads.

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6. Flow numbers by themselves are a poor way to judge a head. Important power producing features like velocity and wet flow cannot be seen in flow numbers.

7. Keep in mind that we are constantly working on head development and these flow numbers can change. We spend part of every week doing R&D on head porting and design all year long.

In an effort to reduce manufacturing costs on some "ready-to-bolt-on" heads, "finished" seat rings are installed in the heads by pressing or driving them in. This procedure causes the seats to go out-of-round. We have seen them out-of-round 0.014" to 0.016". The limit should be 0.002" or less. Seats this far out of tolerance will cause hard starting, rough idle, and reduced power output. Originally, way back, performance aluminum heads were designed for porting shops to finish and correct the manufacturing flaws before the head was installed. That way the problems of core shift and out-of-round seats never reached the end user. But today ready-to-run aluminum heads are available from

both foreign and domestic suppliers. As with all things, there are learning curves and some of the overseas suppliers are still in the painful part of the curve.

It's a fact that an aluminum head dissipates (gets rid of) heat much faster than an iron head, but that in itself does not make it better for everything. The rapid heat loss from the combustion chamber results in reduced combustion chamber pressures (heat equals pressure); similar to the effect that lowering the compression ratio lowers cylinder pressure. If you are only switching to aluminum heads you MUST raise the compression ratio to prevent a power loss. This is a good opportunity for our customers to take advantage of our computer calculated compression ratio service. This software assures them of getting the maximum power out of their purchase; it's a no-charge service for our customers.

Aluminum heads will not automatically create more power than cast iron heads unless they flow more air and are installed on a higher compression ratio engine. In cases where you have

a decent port job on a set of cast iron heads it is possible to bolt on a set of out-of-the-box aluminum heads and lose power. Aluminum is automatically lighter but not faster. Yeah, I've read all of those magazine articles that told you how they installed a brand X widget and picked up 500 HP and 4 seconds in the ¼ mile (we have even been the victim of these articles). What you must keep in mind is that those magazines are paid by the advertisers, not by that \$19.99 you send in once a year. So you can expect that advertised products always look good even when they mess the test up and the "results" are not what they should be, (been there, done that!). They are under a deadline and the rent has to be paid so the facts sometimes take a back seat. In some cases, the engine would have produced more power with a set of well ported, cast iron heads, and at a lower price. So, buyers beware of products bought simply on the basis of one printed article.

(continued on pg. 44)

Joe Baker
Equipment Sales

ACF200 Head & Block Boring/Milling Machine



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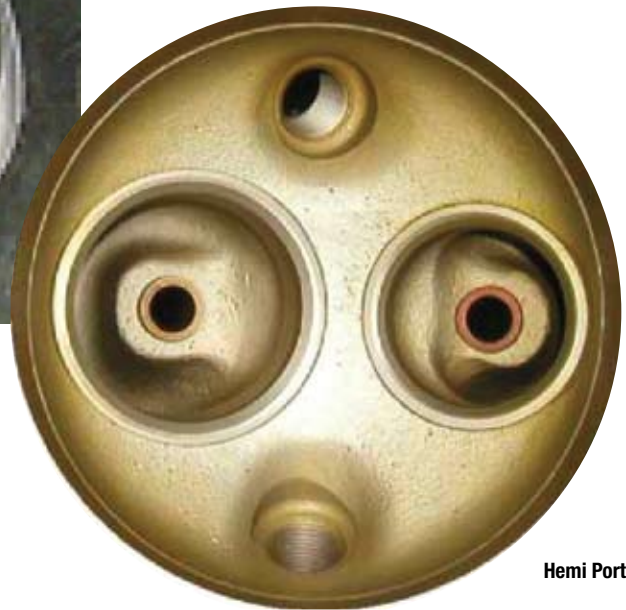


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Victor Ports



Hemi Ports

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Quick Facts: Aluminum vs. Iron

1. Weight: Aluminum heads weigh about 45 to 50 lbs. a pair, which is less than cast iron heads.

2. Durability: “Ported iron heads can crack if the engine is badly over-heated.” Yes this is true, but if the engine got that hot the aluminum head would have melted or been badly warped. The seat rings may have also fallen out, but the head might not crack. Anyone who lets his engine get that hot deserves to buy new heads or have an expensive repair bill.

3. Reparability: This is a trick question. Yes, aluminum heads are easier to repair if the damage is very bad and that is a good thing because they are much more fragile and more prone to damage than a hard, iron head.

4. Cost: Aluminum heads cost more, and then there may be the hidden cost of raising the compression ratio, when you switch to them.

5. Airflow: You get very similar airflow results from ported, stock heads and

“stock replacement” type heads. With raised port cylinder heads, the sky is the limit.

6. Power: Power depends on what you have to start with, or what else you plan to do to the engine. If you have low compression (9.5:1 or less) and are not going to change pistons or mill the heads to restore the cylinder pressure, save some money and go with the ported iron heads. If you are starting on a fresh engine with higher compression ratio pistons, want to lose some weight and the budget can handle it — go ported aluminum. There is another power consideration; most of the aluminum heads have a closed combustion chamber, which is far superior to the OEM heads with their open chamber design. However, if the piston is not at 0.000” deck, the chamber design has very little effect.

If all this sounds like Dave Hughes doesn’t like aluminum heads, the truth is quite the contrary. Aluminum heads are cleaner, easier to port and they look very trick when placed next to an iron head. If you make a mistake on an aluminum head, it is a lot easier to fix. If you drop it

on your foot it doesn’t hurt quite as bad. Porting aluminum heads also keeps the shop cleaner, what’s not to like? ■



Hughes Engines Inc. was formed in 1969 as Hughes Engineering, to build stock and super-stock cylinder heads for AHRA and NHRA class racing. Since then it has grown into a complete custom engine building facility. They were one of the first ASE certified engine machine shops in the nation. Dave Hughes has a long history of drag racing as well as writing tech columns and doing Q&A for several national magazines. Although Hughes Engines has built several national champions and record holders, the majority of their market is in the restoration, hot street, oval track and bracket racing area. Their shop has been strictly Mopar for many years now and they offer many very specialized parts and procedures that are either unknown or unavailable from other Mopar shops. For more information, contact Hughes Engines, Inc. at 309-745-9558 or e-mail information@hughesengines.com. Or, go online: www.HughesEngines.com.