ELECTRONIC FUEL INJECTION

PART IV

Used to lighten turbo wheels for faster response or port an intake system for maximum air flow, Extrude Hone Porting or Abrasive Flow Machining as it is also called, this 20-year old technology could be one of the major performance secrets of the nineties.

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By Richard Holdner

In previous segments of this series we have covered ECU's, injectors and various intake manifold combinations. While researching some of the information for our manifold section, Rick Navarro of Pacific Performance introduced us to a process called extrude hone porting.

Abrasive flow machining, as it is also called, is not new by any means. In fact at close to 20 years old, it belongs moderately to that association of technologies we sometimes refer to when we say, "If you want to know what is going to make cars faster tomorrow, just look up today." Hardly anyone would question the fact that when it comes to aerospace technology, America still leads by a long margin. Our only question is what will it take to put some of this technology on four wheels?

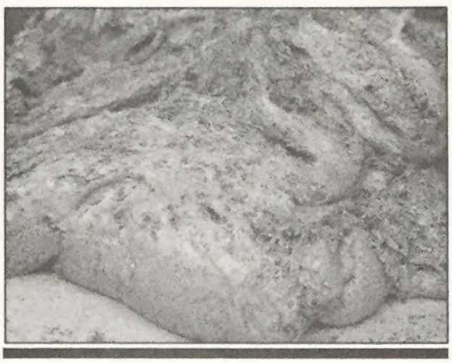
Our first visit to the Extrude Hone facility in Paramount, California, was impressive to say the least. Operated by brothers Bob and Ed Melendez, the Paramount facility has become in addition to a regular production shop, an R&D facility for the Pennsylvania based parent company. During our first visit we saw everything from snowmobile heads and manifolds to fuel lines for the space shuttle. One impressive item was a row of large aircraft turbine wheels from one of the largest turbocharger manufacturers in the world. Melendez explained that they wanted 2/100,000 taken off of one of the sections of the blade. To do this took the construction of special fixtures, as does virtually every application for this technology. In one corner of the building was a rather large stack containing hundreds of Oldsmobile Quad Four manifolds. When we questioned Melendez about them, he answered, "They belong to a customer."

They also noted that a well known European manufacturer was the first to take advantage of this technology and their company had set up a large machine capable of running four intake manifolds at a time in four minutes. The gain was a highly tested six horsepower, with no loss of fuel economy at part throttle cruise.

WHAT DOES IT REALLY DO?

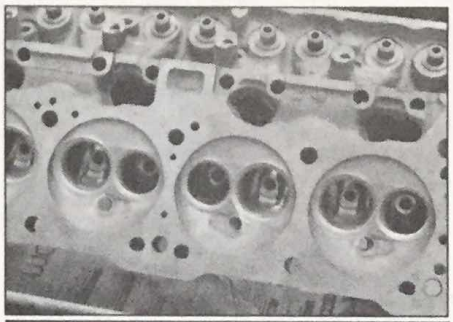
Abrasive flow machining basically uses a silicone compound that does not react to (moderate) heat and can be impregnated with different levels of carbide abrasives. By flowing this compound back and forth through or around any object at varying degrees of pressure (between 200 and 2000 psi depending on the application and materials) it can remove material and create a mirror like finish, even when using some of the more coarse abrasives.

The flexibility of this process becomes evident when the variables are taken into account. Several variables may be altered to achieve a desired result for a particular item. The pressure, process time, amount and consistency of abrasive material added to the compound all may be changed to produce quality results.



What looks like a scene from "The Blob" is actually the key to the Extrude Hone process. This silly putty-type substance is imbedded with small abrasive particles and forced through the necessary passages. The percentage of the abrasive material can be altered, as can the grit or coarseness of the added material to achieve the desired effect.

While we had a great many questions on how they could regulate how much was taken from where, after a few hours of reviewing different examples, we were satisfied that they had the technology and were proficient in its application. A basic answer was that the material would "attack" the points of flow resistance first. Since the flow of the media is similar to air or fluid flow, the reasons for the effectiveness become apparent. It follows the same path air would travel, but instead of going around an obstruction, the media takes small portions of the obstruction with it. This still left questions about certain shapes, or intrusions that might have to be protected from the flow of the material. Again we were shown how the area around the valve guides were both protected and shaped utilizing deflectors that fit into the guide itself, deflecting the abrasive around in such a manner to create the best flow and not remove needed material. According to Ed Melendez, even with the positive results that they have gained to date with automotive, motorcycle, snowmobile and jet ski engines, they are just scratching the surface of what this technology can eventually lead to.



While the Extrude Hone process works well on cylinder heads it is probably not as cost effective as manual porting. Care must be taken to protect the valve guides from the abrasive media flow. All chamber work will still have to be performed in the normal manner.

After seeing a variety of import and domestic intake manifolds, we elected to set up some tests, utilizing their flow bench. One particular manifold which receives a lot of attention is the Ford 5.0, which due to its configuration requires cutting, porting, then welding the sections back together and honing the area around the weld. It would be an ideal candidate for this procedure.

We contacted Chris Kaufmann of Kaufmann Products in nearby Downey to obtain three sets of Ford upper and lower manifolds. The first being the stock configuration, the next being a manually ported and welded set and one of the new GT-40 set ups. The test for these would be to flow the stock upper and lower as separate items and together, the manually ported and the GT-40 in the same manner. We would then run all of these components through the Extrude Hone process and retest them for air flow. A subsequent test would also include a GM Tuned Port intake and plenum set up.

Now that we had heard the promises and studied the technology, its was time to see the results, which provided some interesting information. First it must be noted that the tests for the upper portions and the lower units were done differently. Due to difficulties in setting up the airflow tests, air was forced through the upper portion while it was drawn through the lower portions. This difference in procedure may account for some of the differences in air flow figures for the upper and lower units. The procedures were consistent for all of the upper and all of the lower units. The air being forced through the upper plenum is similar to the forced induction of either a turbo or super charger set up, so the results are

definitely useful.

First of all it should be obvious from the results that there are several areas of inefficiency in the 5.0 lower intake manifold . Air flow numbers of runners one and five on the lower intake are consistently lower than the others, even in the case of the GT-40. This stands to reason when the manifold is scrutinized. These runners have to make the sharpest turns and therefore represent the greatest air flow restrictions.

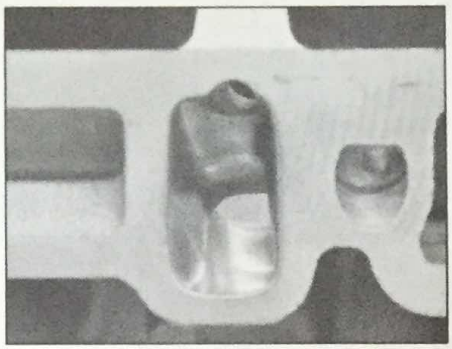
One surprise is that the upper and lower tubes of the GT-40 upper plenum varied by nearly 10 percent from one to another. The upper tubes were nearly all 80 percent while the lower ones were nearly all 70 percent. Since we did the upper GT-40 tests first it was speculated that the lower portion would yield similar patterns, but in reverse to compensate for the fluctuations. This was not the case. The lower portion, while it did fluctuate, did not compensate for the differences in the upper plenum. Could the Extrude Hone process equalize these differences?

It should be noted that the Kaufmann Products upper plenum with extensive manual porting flowed much better than the stock unit. The manually ported lower intake showed an even more impressive gain from the stock unit. This verified that greatest gains are to be had in the lower intake. Kaufmann Products' hand ported upper and lower intakes flowed much better than stock and would be a welcome addition to a stock or mildly modified motor. Would the Extrude hone process be able to increase the air flow of the ported units?

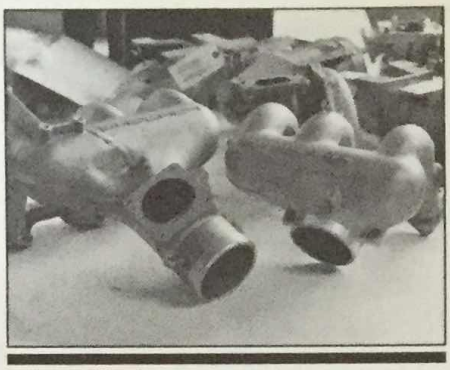
Yes and yes. The Extrude Hone process increased the flow of the stock units to surpass the figures generated by the hand ported manifolds. In fact they came very close to the stock GT-40 flow figures. A bundle of money can be saved by porting the stock units and not stepping up to the more expensive GT-40 unit, for a mildly modified motor. Not only did this process increase the flow figures as expected, it was able to even out the poor flow distribution patterns of ports one and five in the lower intakes (see graph).

All of the intakes and plenums took to the process very well. The GT-40 outflowed them all after the process. The flow figures indicate that this intake and plenum combination would feed a very healthy 5.0 motor. It could take a high winding or turbocharged 302 that would need such an intake. It's difficult to say at this time how this intake would perform on a stock or mildly modified motor with this much air flow, it might lean towards "overkill." The ported GT-40 intake and plenum will be tested on a modified supercharged 5.0 Mustang to be raced in the Silver State Classic road race in Nevada. We will keep you posted.

While Extrude Hone themselves are mainly an R&D company and a distributor for the actual equipment and are not actually set-up to do retail business, they are setting up stocking dealers that can provide them with a supply of cores on a turnaround basis. Kaufmann Products now offers these Extrude Hone ported 5.0 manifolds and Pacific Performance is stocking several different TPI setups. At the time of this writing several others dealers for different model products were giving this process a hard look. •



The port of the 5.0 Ford intake manifold after the Extrude Hone process. The media follows the path of the air flow. It removes material where it receives the most resistance (where the greatest flow obstructions occur).



There are any number of manifold and plenum combinations that can benefit from Extrude Hone porting. These Porsche manifolds are difficult to port by hand due to their one piece design, but lend themselves well to this process.

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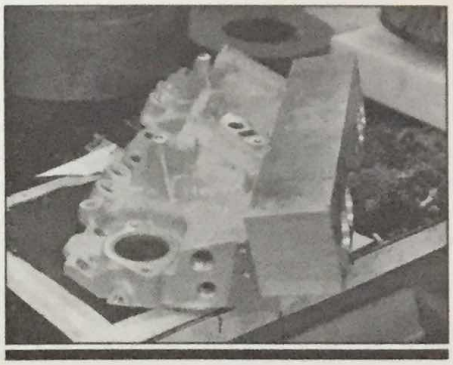
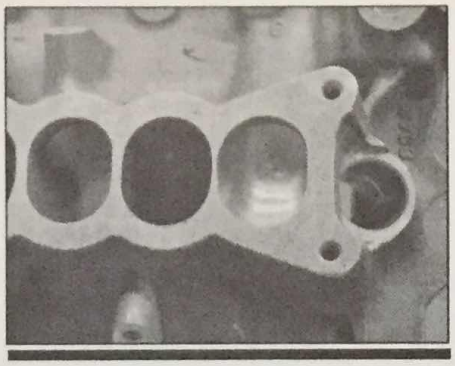
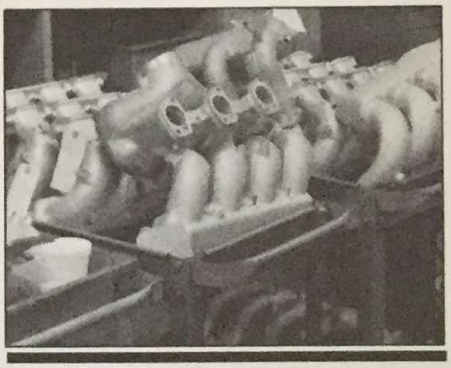


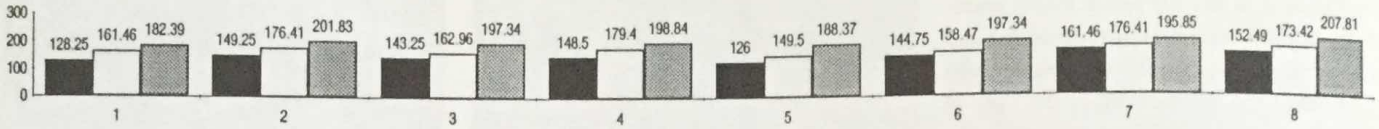
One of the reasons for this process consuming a considerable amount of time, is the fabrication of necessary templates for the porting process. This template is used on a tuned port Corvette manifold. A new template must be machined for each new item to be Extrude Honed.



A 5.0 Ford lower intake after Extrude Hone porting. Note the overall conformity of the walls with no grooves or troughs left from the process. The media flow is in the same direction as the normal air flow. It does not leave radial grooves that often occur in hand porting.

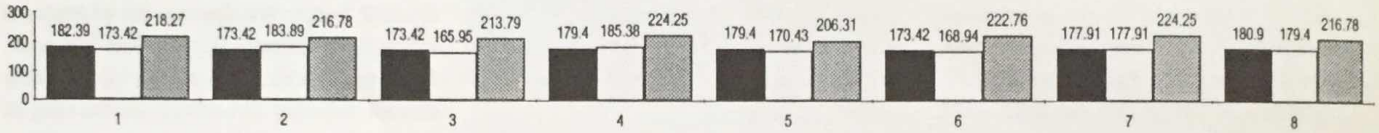


A vast array of Oldsmobile Quad 4 intake runners awaiting the porting process. Mixed in with the many Quad 4 units are various Porsche intakes and jet ski impeller housings. Each benefits greatly from the process.

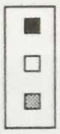


Before Extrude Hone Porting

	CYL 1	CYL 2	CYL 3	CYL 4	CYL 5	CYL 6	CYL 7	CYL 8	AVERAGE
COMBINATION STOCK	128.25	149.25	143.25	148.5	126	144.75	161.46	152.49	144.24
COMBINATION HAND PORTED	161.46	176.41	162.96	179.4	149.5	158.47	176.41	173.42	167.25
COMBINATION SVO	182.39	201.83	197.34	198.84	188.37	197.34	195.85	207.81	196.22
COMBINATION STOCK AFTER	182.39	173.42	173.42	179.4	179.4	173.42	177.91	180.9	177.53
COMBINATION HAND PORTED AFTER	173.42	183.89	165.95	185.38	170.43	168.94	177.91	179.4	175.67
COMBINATION SVO AFTER	218.27	216.78	213.79	224.25	206.31	222.76	224.25	216.78	217.90
STOCK UPPER	191.27	189.71	191.27	181.94	183.49	185.05	188.16	188.16	187.38
STOCK UPPER AFTER	206.82	205.26	203.71	191.27	188.16	200.6	203.71	206.82	200.79
STOCK SVO UPPER	251.91	214.59	245.69	217.7	248.8	217.7	251.91	217.7	233.25
SVO UPPER AFTER	251.91	217.7	245.69	220.81	248.93	219.26	251.91	217.7	234.24
STOCK LOWER	130.5	147.75	147.75	148.5	126	147	141	159.14	143.46
STOCK LOWER AFTER	179.4	176.41	177.91	183.89	180.9	179.4	176.41	176.41	178.84
STOCK SVO LOWER	179.4	203.32	201.83	200.33	186.88	198.84	192.86	207.81	196.41
SVO LOWER AFTER	215.28	221.26	222.76	231.73	207.81	222.76	224.25	222.76	221.08



After Extrude Hone Porting

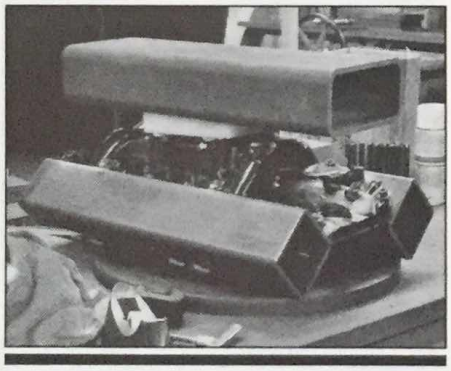


STOCK UPPER & LOWER

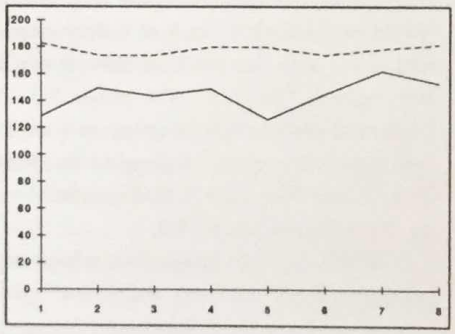
HAND PORTED UPPER & LOWER

SVO UPPER & LOWER

As shown in the accompanying charts and graphs, not only did the extrude hone process improve the overall flow in all cases, but it also evened out to a great degree the flow on a cylinder by cylinder basis.
Ideally flowing the entire intake system from the throttle body to the valves would be the ultimate program, but at this time it could prove a little costly. Perhaps with some of the car manufacturers looking at this process, who knows?



Ready to go, this shows the set-up work that must go into each different manifold configuration. As these machines get more prominent it will be much more cost-effective for a company to specialize in a limited number of manifold designs due to the R&D and set-up costs.



This chart shows not only the improvement of the overall air flow of the stock upper & lower combination (solid) to the Extrude Hone ported combination on a cylinder by cylinder basis. Note how much smoother the solid line is reflecting more even air flow to each cylinder.

From left to right a stock Kaufmann Products ported intake, a GT-40 intake and a stock (unported) intake.
Extrude Hone's Superflow 600 was used for all of the flow testing.