About MAX BMW Motorcycles Machine Shop Articles: *2017 brings MAX BMW's Machine Shop to full operational status and a series of articles on our individual machines and operational practices. In this series, we highlight some of the specific equipment, tools and jigs we have developed to come to the exacting standards of ultimate quality, attention to detail, accurate measurements and swift turnaround of customer jobs.*

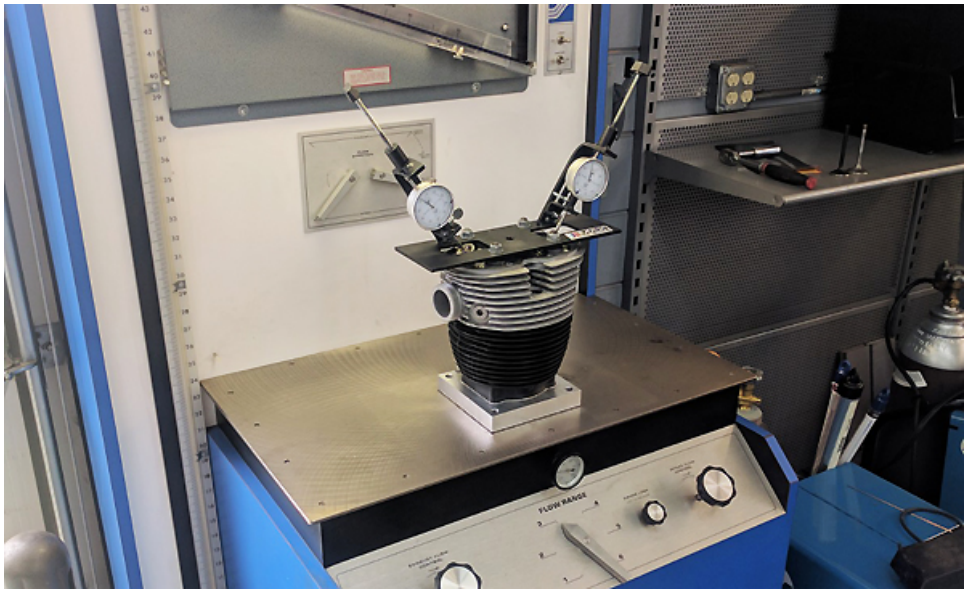
MAX BMW
Motorcycles

ARTICLE 3
April 21, 2017

Flow Testing and Evaluation

In this article, we are going to start looking at a few performance services that are available at MAX BMW. Specifically, we'll look at an overview of cylinder head performance through flow testing and evaluation.

With any machine shop work, the proper tools are essential when exacting results and a high standard of quality are required. One of those tools is our Super Flow SF600 cylinder head flow bench.

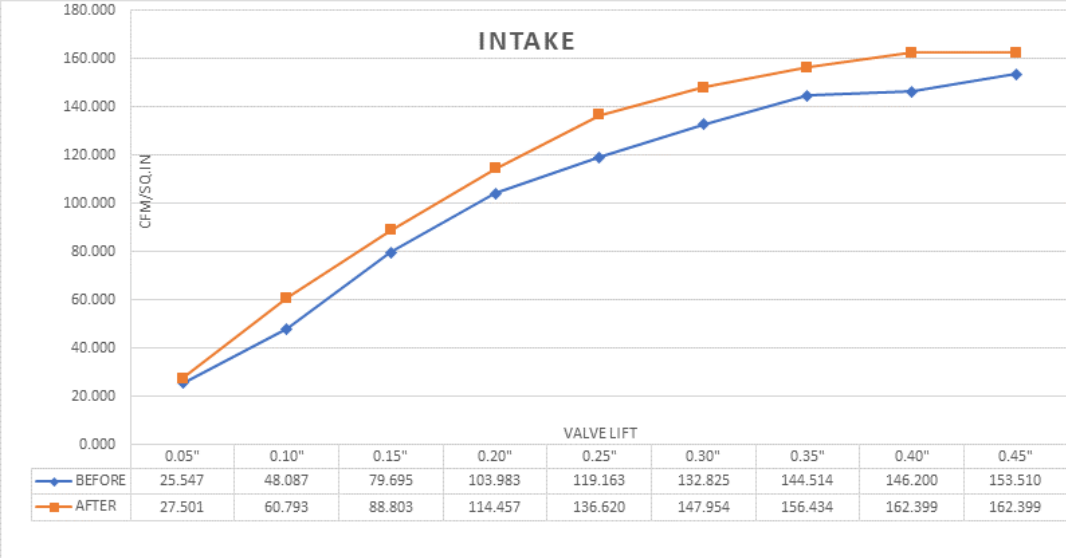


When building an engine where more power is desired, everything in the engine must be considered to be working together as a package. The starting point for any project is always understanding its intended use. Are you building a stock engine, a high horse power street bike or perhaps a track-only bike that sees sustained high rpms and loads? Once this is determined, the details to achieve these goals fall into place. Specifically, engine displacement, cam selection, cylinder head improvements such as valve size and material, valve seat machining and port design are all areas that can be modified and tuned for performance improvements. Even though there have been volumes written on air flow theory and port design, this will be a brief overview to help understand how it can all be measured, modified and tested to prove effective results.

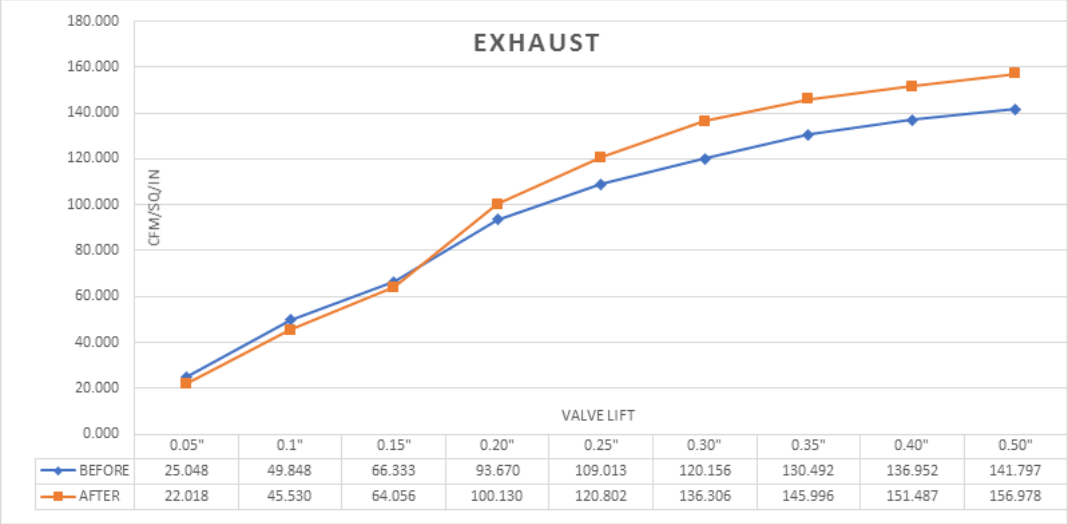
The flow bench is designed to provide an accurate measurement of airflow through a cylinder head's intake manifolds, intake ports, intake valves, valve seats, combustion chamber and then out through the exhaust seats, valves, ports and manifold. The process of "flowing" a head obviously doesn't make more power since nothing is being changed, but it provides the information needed to correctly modify these areas to add the desired benefits and then recheck to see how those changes affected the flow of air through the head. This also has to be undertaken with the end use in mind because more "air flow" doesn't always translate to more power or a better riding bike.

The flow bench is capable of several precise measurements such as CFM (cubic feet per minute) of air flow through an orifice; Air Speed utilizing pitot tubes; and several other variables. CFM is the main thing people look at for an idea of performance potential and how one head might be accurately compared to another. Typically, a head that flows more CFM has the potential of making more horsepower, however, air speed has a very large influence of how well the cylinder will fill with the incoming air charge. Air has weight. Once the column of air is moving, it takes a certain amount of force to slow it down or stop it. If a port can be made to accommodate a larger/heavier column of air, yet flow at a high enough speed, the valve can be closed later in the intake cycle before the rising piston overcomes the inertia of the incoming air charge through the port and into the cylinder. Even with the same valve opening and closing events, a fast moving air charge allows for a denser volume of air to enter the cylinder. Thus, cam sizing and timing are another area that can be better understood through the use of a flow bench.

Determining valve angles and height (angles machined into the seat ring for the valve to seat against) is one of the trickiest places to address when porting heads. It's very easy to lose flow or disturb the air in such a way that it becomes turbulent when flowing past the valve and into the chamber. At the same time, great improvements may be obtained when the correct valve job has been applied. Things we look at include the number of angles (three and five are common), angle degrees, angle degree widths, radii, diameter and venturi. In the graphs below, you can see the difference in air flow on the exhaust side when changing from a 30° to a 45° seat and changing the angles but leaving the diameter of the valve unchanged at 40mm. Also, the significant gains made when going from a 42mm intake valve diameter on an R100GS to a 44mm diameter along with a good valve job. No extra porting was done except the blending of the valve job into the bowl area (the area from the valve angles toward the valve guide). This improvement along with a 1070cc big bore kit will provide significant horsepower and torque gains and serve this customer very well.



	0.05"	0.10"	0.15"	0.20"	0.25"	0.30"	0.35"	0.40"	0.45"
BEFORE	25.547	48.087	79.695	103.983	119.163	132.825	144.514	146.200	153.510
AFTER	27.501	60.793	88.803	114.457	136.620	147.954	156.434	162.399	162.399



	0.05"	0.1"	0.15"	0.20"	0.25"	0.30"	0.35"	0.40"	0.50"
BEFORE	25.048	49.848	66.333	93.670	109.013	120.156	130.492	136.952	141.797
AFTER	22.018	45.530	64.056	100.130	120.802	136.306	145.996	151.487	156.978

There may be compromises to consider when modifying an original design to meet your tuning goals. Often, a positive change in one area can lead to a negative result in another, so it all needs to be considered before randomly making changes. For example, you may need to port the head in order to increase flow for a larger displacement or to maintain effective performance in a higher rpm range, but that could be sacrificing idle quality or off idle/low rpm drivability at the same time. Knowing this, the best combinations can be applied to achieve the results you're looking for. Of course, MAX BMW understands that this can be a challenge. We have the experience and tools to help you make the best choices with performance parts and upgrades so your tuning projects are successful and you get the power, performance and efficiency you're looking for.

Our machinist, Nathan, cut his teeth in the machining industry starting with a degree in Automotive Restoration and in High Performance Engine Machining. He worked in Tennessee and North Carolina building 900+ hp dirt race engines as well as working a stint in the world of NASCAR. Coming to MAX BMW has allowed him to further focus his skills by taking advantage of specialized BMW training. Pursuing his love of these bikes inspires Nate in developing custom adapters and fixtures, unique to MAX BMW, aiding in broad restoration abilities and enhancing the high-performance side of BMW Motorcycles.

See our Machine Shop page at: https://www.maxbmwmotorcycles.com/max-bmw-machine-services.html