MAX BMW
Motorcycles

ARTICLE 1
March 30, 2017

The foundation of the cylinder heads:
Valve guides and the valve job

The valve guides are an important factor for any engine, but particularly on BMW's airhead engine. Due to the cooling demands of the engine and the design of the valvetrain, the valve guides should be closely scrutinized and addressed if needed.

With a rocker type valve actuation and the low valve angle, the guides tend to see a bit of abuse compared to an overhead cam engine or even a pushrod engine with a flatter valve angle (that is the valve being more straight up in the head compared to the piston). The rocker arm and the low valve angle design, puts more side load on airhead valves and guides than other types of engines. We find many heads coming through the shop have a pronounced "bell mouth" shape to them and many times even though the top of the guide may measure within spec, the bottom; closest to the combustion chamber, will have 2-3 times more clearance than the top, sometimes more.

The inside diameter of the guide has some areas that must be carefully looked at. Not only does the size have to be within spec for the application, but the amount of taper within the guide from top to bottom has to be nominal. Racing or sidecar bikes will have different clearances than a conventional street bike.

When we measure our guides after we final fit the valves, we are looking for around .005mm (.0002") of taper or less. There are certain tools that are required to measure this accurately. MAX BMW uses a Sunnen GRM 3000 dial bore gauge with every different tip needed for any BMW job that comes through our shop. This gauge measures in increments of .002mm (.00007") ensuring precision results. It's critical to obtain these results for proper oil sealing and preventing cylinder pressure loss without having a tolerance too tight which could lead to sticking valves.

To achieve these tolerances, we have a hone specifically for made for sizing valve guides. This hone uses a diamond abrasive which is more rigid and less apt to wear than a traditional stone abrasive and leaves a better surface finish than that of a traditional stone. A common mistake often made in re-sizing guides, is to use a reamer. Most reamers that people buy will be HSS or High Speed Steel. These work well on cast iron guides but on a bronze type guide they will create a tapered bore every time. Typically, the reamer will be passed through from one side and then the other in hopes to cut out the taper but this practice inevitably leaves the guides tight through the middle and too loose on the top and bottom of the guide (picture an hour glass shape). This creates guides that wear out prematurely. There is really is no practical alternative other than going to a full carbide reamer or using a guide specific hone as we have here at MAX BMW.

Once the ID of the guides are round with straight bores and the correct clearance, we can move on to cutting the seats in the head. In the past, there have been several different ways to do this. Older practices used stones that would grind the seat material to one specific angle than other angles would be used to set the width of the seat angle. There are a few things that can happen when employing this method. First, the way the stone in loaded either by hand or with a grinder is very seldom consistent which more times than not leads to out of round seats or seats with undulations. Either of these situations progress very quickly to worn valves that don't seat fully and guides that wear quicker due to the valve being "shifted" over to mate to the seat. This side loads the valve in the guide causing more rapid wear. Grinding the seats also tends to "work harden" the seat ring which in turn makes it very difficult for the valve to "seat" or wear-in properly once installed. The valve itself will work harden the seat ring and that is what we want to achieve for best results.

One of the work horses of the MAX BMW machine shop is the Rottler SG7MTS seat and guide machine. This machine uses solid carbide pilots that fit tightly into the guide so the cutting head of the machine can be located to exactly match the angle of the valve to .05*. The cutting head is then centered by the carbide pilot over the exact center of the valve guide allowing the angles that are cut on the seat to hold a concentricity of .01mm (.0005") or less. The cutters used are of solid carbide as well and have all the angles pre-cut so that each cut is the same width, angle or radius every time! When cutting multiple valves or multiple heads we can make the valves the same depth in the head which keeps the utmost consistency from cylinder to cylinder. Greater reliability, longer lasting performance and ease of tuning are some of the benefits.
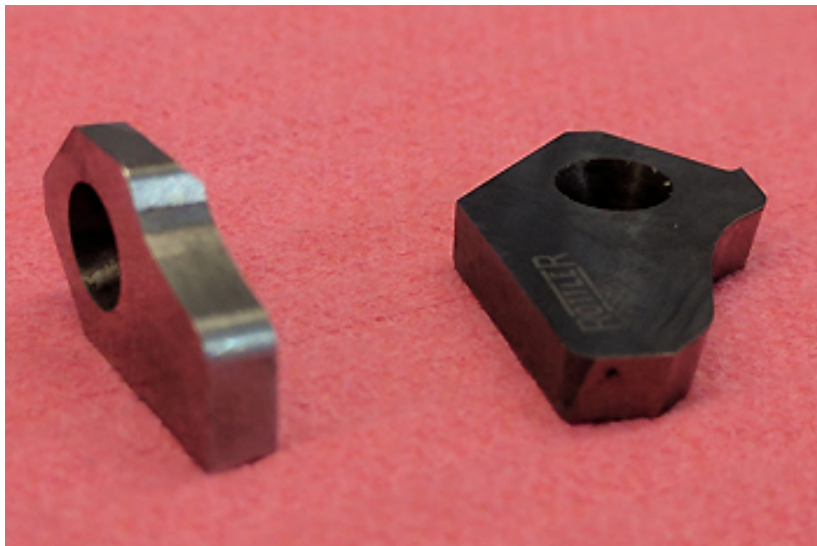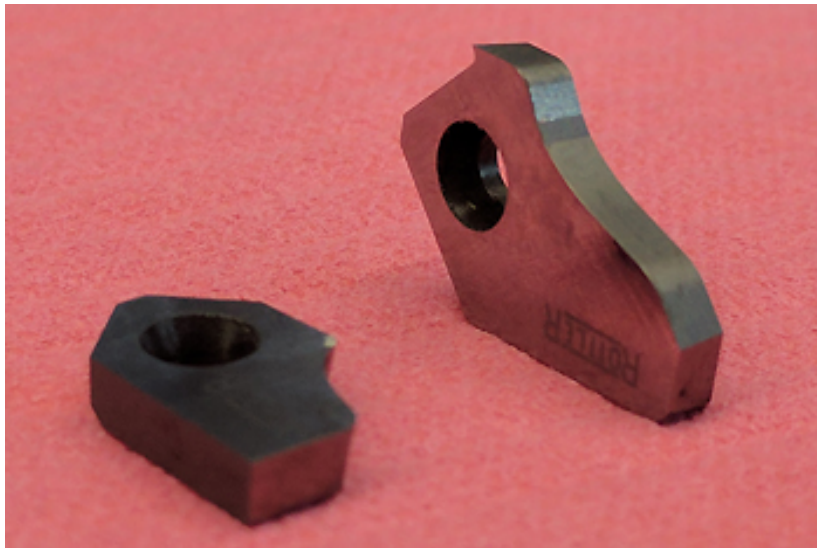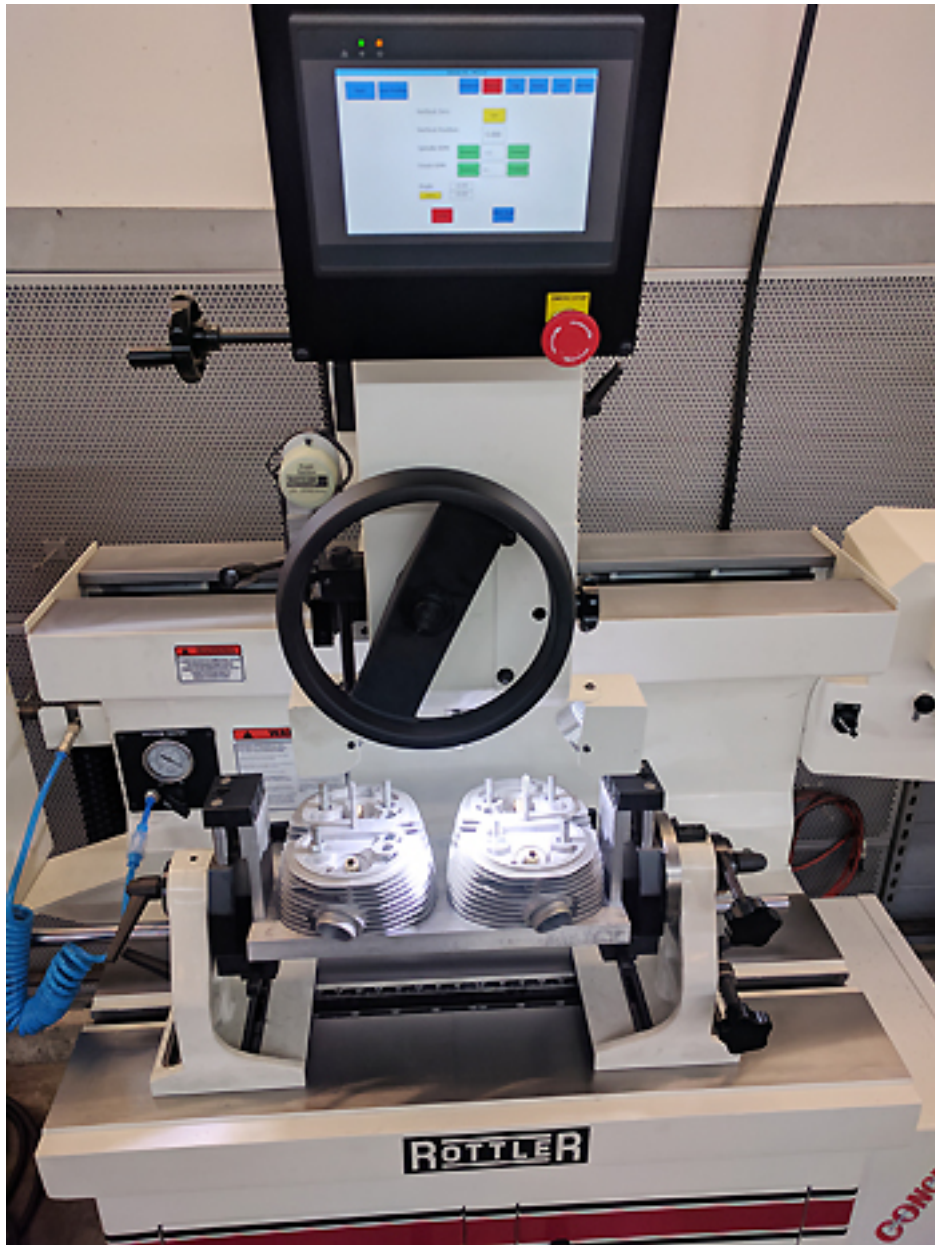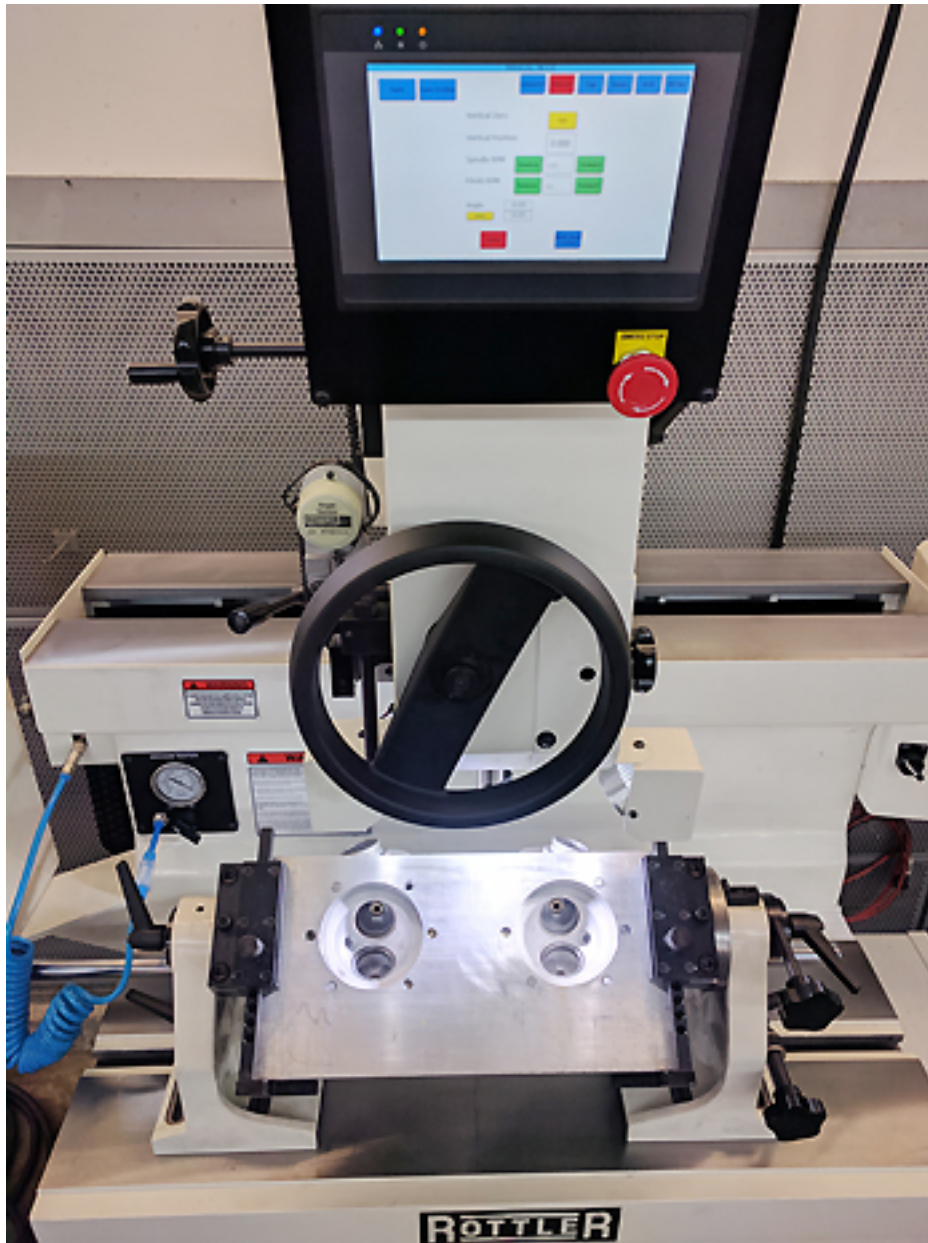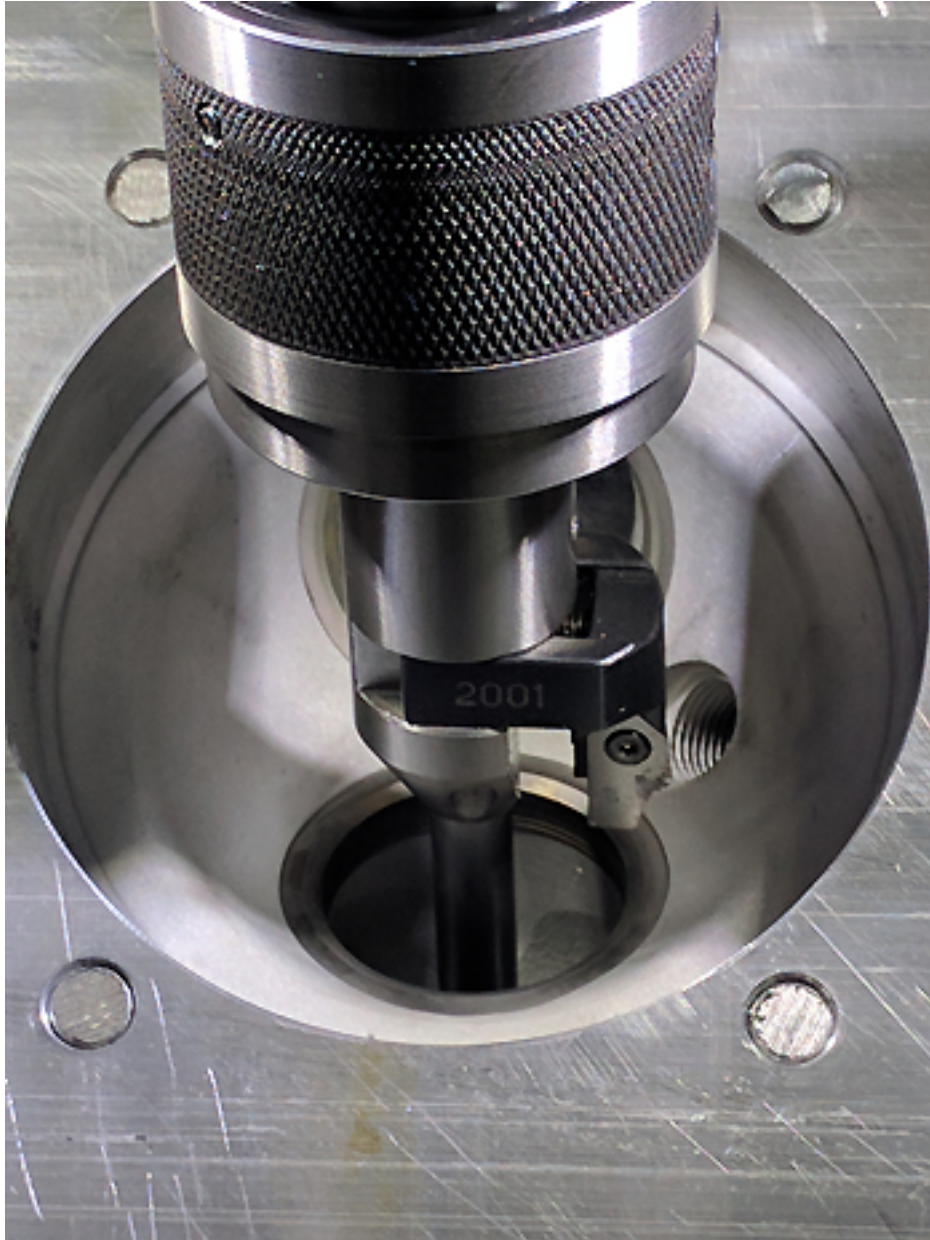
In our next articles, we will continue to look at our other machines and practices that make MAX BMW Machine shop the premier place for all your engine needs.

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