

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 2
April 6, 2017

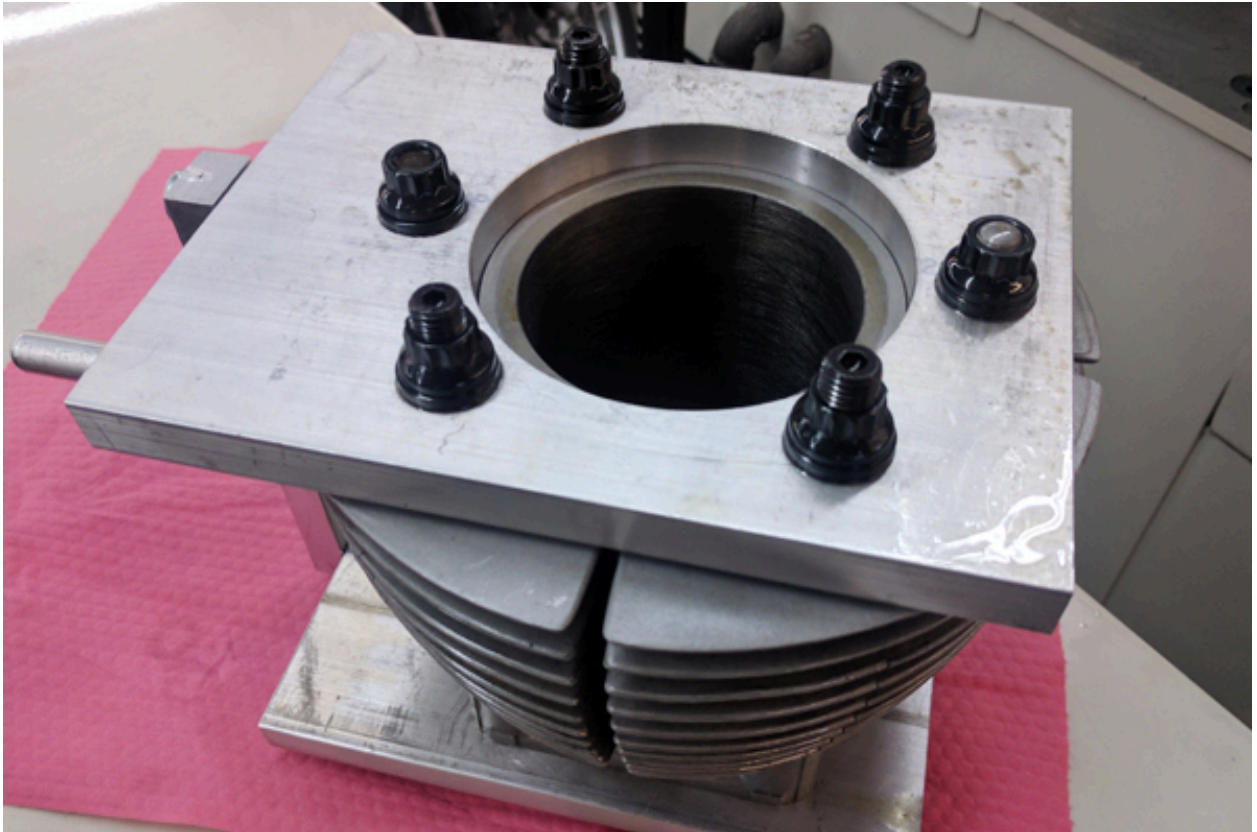
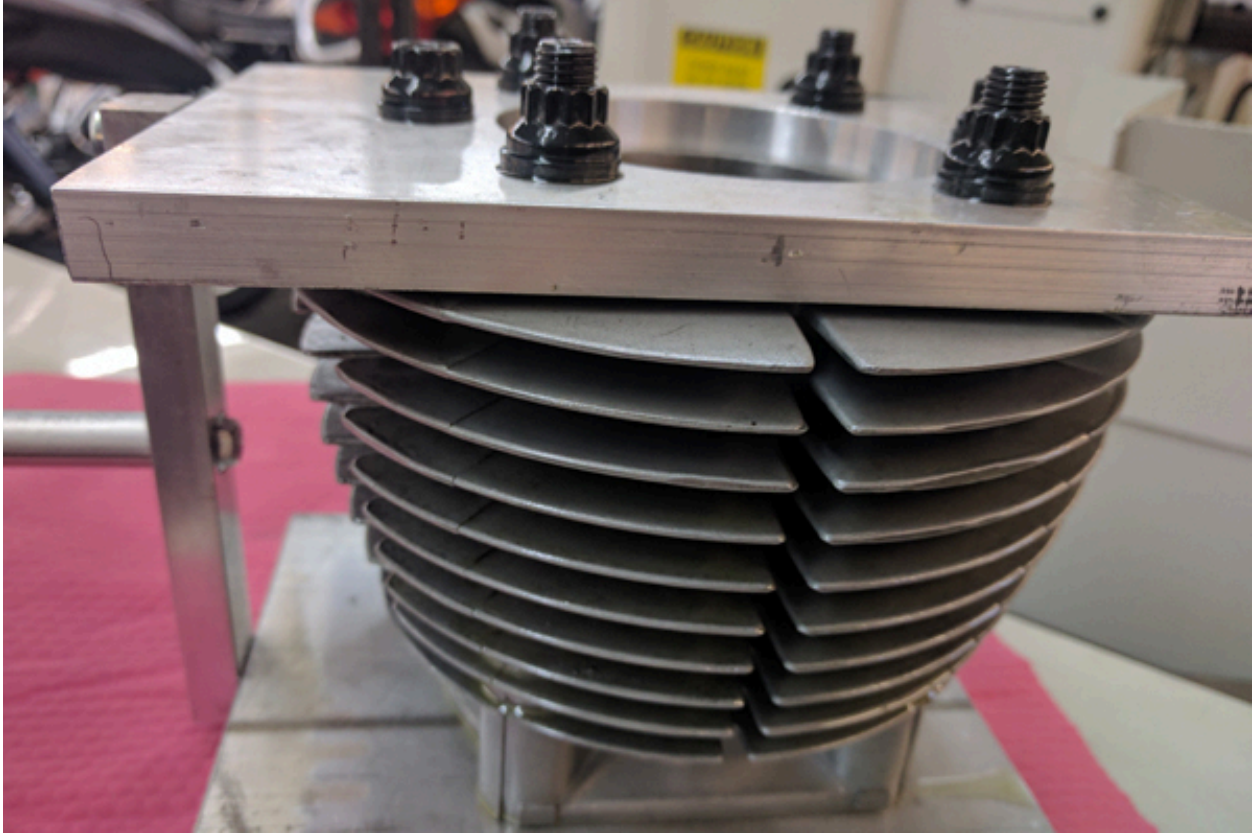
Cylinders, Pistons and Rings

The process of boring a cylinder to an oversize seems straight forward, but just like working with cylinder heads, there are a few things that need to be looked at closely. First, the cylinder bore needs to be accurately measured and the total piston to cylinder wall clearance (or skirt clearance) determined. The cylinder must also be examined for out of round and bore taper. The most wear is typically at the top of the ring travel. This is where the bulk of the work is being done by the rings when sealing the combustion gases and pressure. A straight and round cylinder is important for correct piston to cylinder wall clearance since too much or too little may cause a knocking noise or even seizing. It is also critical for the rings to seal consistently against the cylinder wall during the stroke of the piston.

Many newer engines have a very small "ring pack". This is the thickness of the ring where it contacts the cylinder as well as how close the rings are together and how high up on the piston the rings are placed on the piston. These small ring packs have a few advantages over the older engines. One is an obvious weight savings which reduces the reciprocating weight of the engine, lessens the effect on the bearings, and aids in increased RPM limits. Another significant benefit is that the smaller thickness of the ring allows for the ring to change shape slightly and conform to the cylinder wall as it changes shape while the engine is running due to heat and load. This aids in the rings sealing causing less oil consumption, better and more consistent cylinder pressure, and longer life to the rings and cylinder. For those with an older BMW that may not have the incredibly thin rings of something like the S series bikes, there are still actions that can be taken to give the best possible wear and sealing as well as a quicker ring break in.

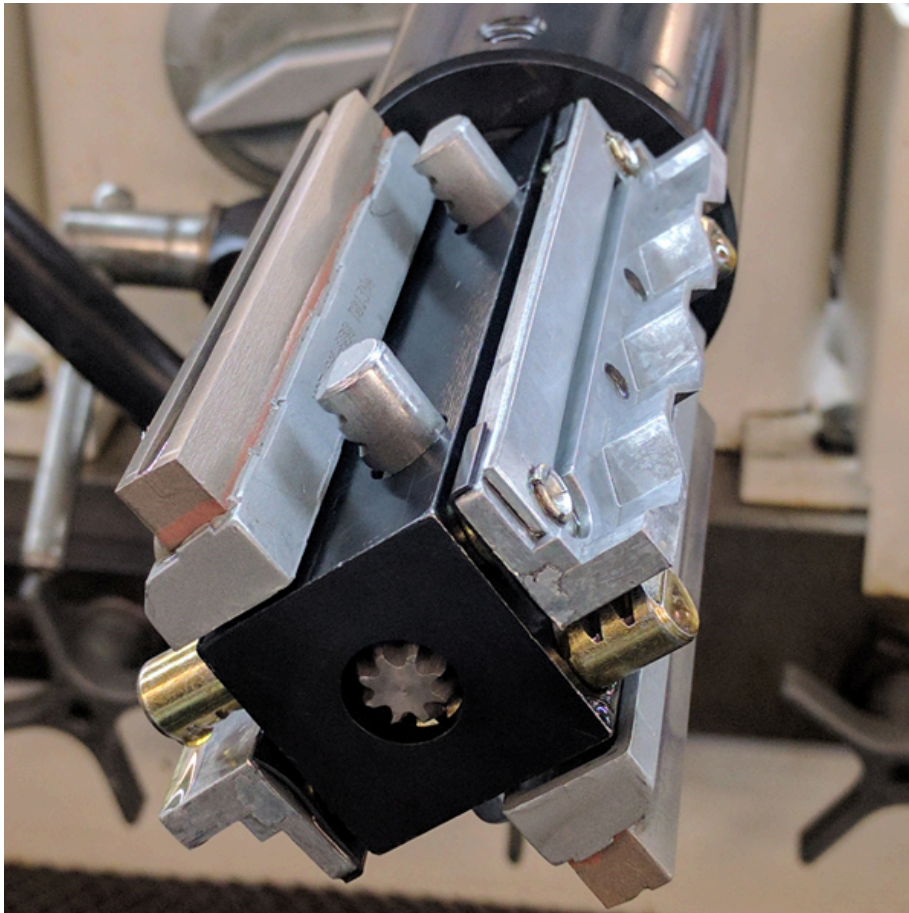


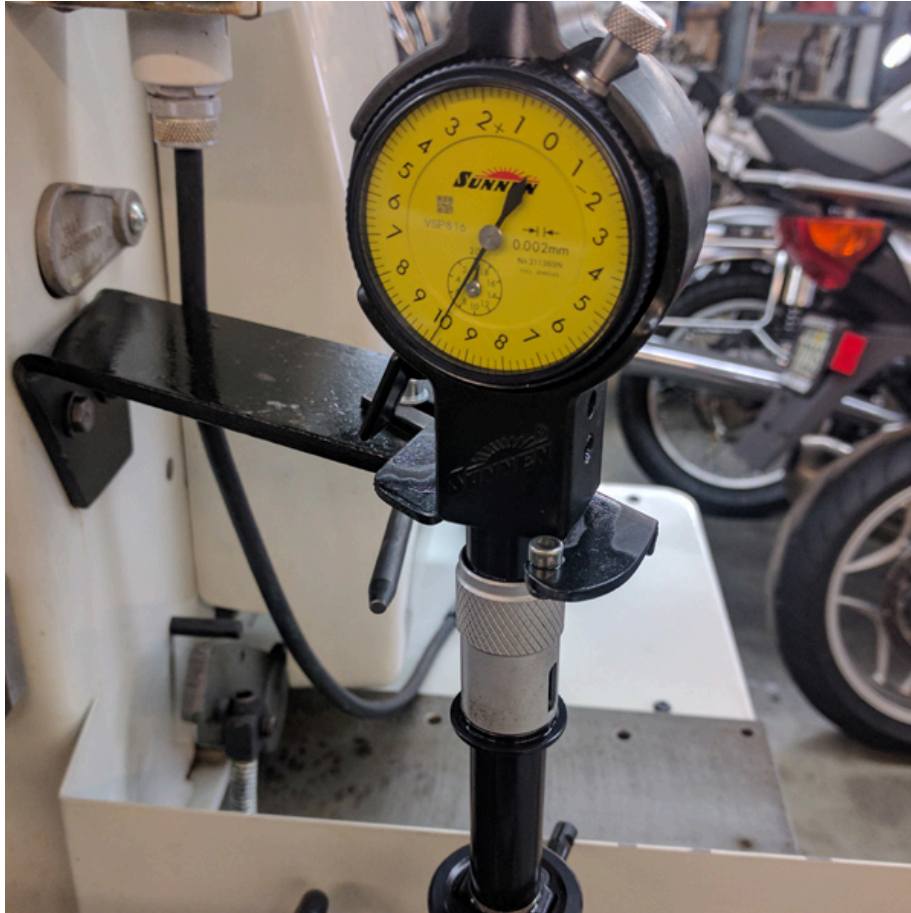
At MAX BMW, we final size all cylinders with Torque Plates. This has been done in the racing industry for decades and is also being done by the O.E. factories. A torque plate is a fixture that bolts to the cylinder just as the cylinder would bolt to the engine using the same torque specifications. This process stresses the cylinder just as it would be stressed when the engine is fully assembled. With the torque plate installed on the cylinder, the bore is then re-sized with all the proper clearances adhered to. This part of the machining process also helps with ring seal, initial ring break in and helps the larger ring pack of the older generation engines to seal properly.



The cross hatch and finish on the cylinder wall is also extremely important when sizing cylinders as the cross-hatch angle helps to either hold oil onto the cylinder walls or shed excessive amounts depending on the steepness of the angle. For street applications, we look for between 30-40 degrees of cross hatch. The actual finish is dictated mostly by the "grit" of the abrasives used and by the pressure applied during honing. It is also very important to ring seal and break-in. Using a plateau method of honing is the best way to meet our standards. This is when a rougher grit abrasive is used first, then subsequent finer grits used until the peaks and valleys caused by the abrasives are correct for oil retention as well as helping the rings seal by having a "plateau" instead of too sharp of a "peak" profile.

The abrasives themselves are something that we have put a lot of effort into selecting. We use a We use a ridge honing machine with diamond bond abrasive that has better consistency as well as better wear resistance. This yields straighter, rounder cylinders with excellent consistency. Most people are familiar with ball hones when they think of cylinder honing. The use of ball hones does not do a very good job of setting the finish that is needed and often dictated by the ring manufacturers. They also follow the shape of the cylinder that is already present. Any inaccurate geometry in the cylinder will stay that way with no correction. A ridge hone stays at a set size and advances the abrasives outward with the desired pressure set by the operator and removes material based on this setting not just following the shape of the bore. As always, the best results begin with accurate measurements. Being able to accurately determine the dimensions is critical in producing repeatable quality. MAX BMW utilizes some of the very best measuring bore gauges available such as our Sunnen GRM 2061 which can measure .002mm (.00007").





In the final results, we are looking for a cylinder that has been stressed during the machining process to mimic what will be seen after engine assembly, round and straight bores with a proper degree of cross hatch for the application, the correct surface finish to aid in ring break-in and correct cylinder wall oil retention and of course the correct piston to wall clearance for the application. When all these things have been given the proper attention, the result will be a smooth-running engine that uses less oil, has better ring wear properties, good compression and sealing as well as a quick ring break-in period.

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>