Performance
Plating Process

BY DEREK CHURCHWELL

Over the past few decades many changes have taken place with regards to cylinder wall finishes. The technological advances in this area have progressed so much so, that more articles are being written about the subject matter. While the will to report and document on cylinder bores and their finishes have often taken a back seat to cylinder head technology, we are starting to see more coverage in this area of performance engine building. One reason for this change is the advancement in cylinder wall finishes, honing techniques and the importance of ring seal. Even though ring seal has often taken a back seat to cylinder head porting, which has often been considered a sexier topic amongst the horsepower gurus, now we know there is no performance gains if your top ring doesn’t seal to lock in the compression from the rest of the engine components. One of the most popular finishes we are seeing more and more of is a nickel plating combined with silicon carbide or more commonly known as Nikasil® plated cylinders.

Although Nikasil® has been around since the late 1960’s when it was first developed by the Mahle Corporation, it never fully caught on with the main stream OEM’s. Sure Porsche started using it in the early 70’s, but then it remained somewhat dormant until the 90’s when the likes of BMW, Jaguar and Ferrari started using it. Jaguar had a degree of difficulty with Nakasil® when a combination of heat and low quality gasoline with sulfur started breaking down the cylinder liners over time. Jaguar, of course had to replace a lot of engines due to these failures.

Now don’t give up on nickel plating just yet. Nearly all of the major power sport manufacturers have implemented some variation of nickel plated cylinder bore finish in their engines over the past twenty years. Not only does plating have several benefits, but a lot has changed in the automotive industry over the years with regards to plating and engine liners. Some benefits include improved heat transfer, better oil retention, improved gas mileage and the ability to run tighter clearances. However, the original benefit of plating was weight savings. By allowing pistons to run against an aluminum cylinder, there is no need for cast iron liners. A couple of companies have even developed chemical processes that allow cast iron liners to be plated over. This is a huge benefit to those with worn out liners in expensive or rare blocks. It allows the end user to save that special part by plating it back to its original size. One of the companies that developed a way to plate over a cast iron liner is Langcourt Performance in Auburn Alabama.

Langcourt has been a pioneer in electro plating finish with over twenty five years in this particular field. During that time they have made several changes to the chemical make-up of their plating process to perfect the procedure. This is where we will spend our time going over the steps to properly plate a cylinder from start to finish.

Cylinders ready for the plating process.

The first order of business with any plating company is to receive in the part in a way to follow it through the process. Once a tracking number is assigned to the part, it makes its way into the shop for a thorough cleaning. Cleaning is a word that will be repetitively used as this is one of the main ingredients in keeping the finish quality as high as possible. Once clean the part will go to the bead blast cabinet to remove any remaining residue. The part will be cleaned one more time and then off to a specific area depending on what needs to done. We will follow a damaged cylinder through the shop as to get a full perspective of how the plating process works. (See series of photos at right.)

This was not mentioned earlier, but another benefit of plating is in fact the ability to repair a damaged cylinder. Just about any aluminum plated cylinder that has been damaged has the potential to be repaired if the damage is not too significant. As with all plated cylinders, the damaged cylinder will be placed in a nitric acid tank to strip off the original plating. The stripping process takes about one to one and a half hours to strip depending on the thickness of the plating and the strength of the acid. Once the acid starts to break down it will develop a yellow film on top and will need to be changed.

After stripping the cylinder it will be washed again and then off to the welding area. This is where the damaged area can be tig welded in order to save the cylinder. After welding, the part moves on to the grinding area. Pneumatic air tools with special bits are used to grind down the welded area to allow for the next step - boring. Grinding is necessary to get the excess weld down closer to the original bore size so it does not upset the boring bit as it passes over the repaired area. The cylinder will also need to be bored to the proper size to allow for new plating. The cylinders can also be bored to an oversize if a larger bore
Damaged cylinder repaired start to finish.
is desired. At Langcourt, this is done on the new Rottler F69 ATC five axis machine. A probe is used to find the center of the bore to assure accuracy. The proper coordinates are entered and the cylinder is bored about as fast as it takes to bolt it in the machine.

After boring, the cylinder is cleaned in a water bath and then hot tanked with water. A pumice brush is used to wipe out the cylinder bore. The pumice rids the cylinder of water deposits from the detergents and it allows for pitting which will benefit the adhesion process during plating. Cylinders are then sorted by bore size and the length of cylinders. This is done to allow multiple cylinders to be plated at the same time. Like size cylinders are able to cook for the same amount of time and amperage. Cylinders are grouped in a polypropylene fixture to begin the plating process. The polypropylene will not ground out or react to any of the chemicals used during plating. The fixture is dipped in a water bath to “wet” the bores. Then it is dipped in a caustic soda bath. This is an alkaline stripping procedure to clean and open bore fractures to make the nickel adhere better. The caustic soda bath only takes a few minutes and then the fixture is dipped back into the water rinse station to clean off any of the excess caustic. The cylinders are then placed in a nitric acid rinse for three minutes.

The nitric acid rinse removes aluminum oxides and breaks up the surface area to prepare the cylinder for the next process. Then the cylinders are placed back into the water bath again for rinsing. The cylinders are then placed in a boric acid bath which acts as a pH buffer. If you do not have a buffer in the electrolyte it will go out of pH range which will result in insufficient plating. Litmus paper is used to check pH several times throughout the day. The fixture is then placed in a zincate solution. This chemically removes the oxide layer and applies a layer of zinc at the same time. The zinc protects the aluminum until it is ready to be plated. This also tricks the aluminum into thinking it is a different material so the plating will adhere. Now
the fixture is back for its last water bath before going into the plating solution.

The plating solution is kept at a constant 140 degrees. One anode per hole is placed in the fixture which will direct the nickel to the nearest ground.

When the anodes are placed in the center of the bores a negative charge will be placed on the cylinders and a positive
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charge is placed on the anode. The difference causes the nickel to plate on the surface of the cylinder catching free silicon carbide. Silicon Carbide is a very hard ceramic much harder than steel that can be dissolved in nickel. The nickel solution can then be electroplated onto the aluminum cylinder bore or cast iron liner. The piston rings then rub off the exposed nickel leaving a very hard layer of silicon carbide to protect the piston for the aluminum cylinder. Once the cylinders are submerged the rectifiers are turned on and then a quick voltage check is made of each anode. Each anode has a maximum or 10 volts and amperage is determined by the surface area. Once submerged the amperage is then ramped up over the final plating process which takes anywhere from 1 to 3 hours on most items.

After the plating process is complete the cylinders are surfaced to true then moved to the honing department for the final step. Diamond stones are used to cut through the plating to bring the cylinder to proper size. Langcourt will use their automated Rottler H75A CNC Honing machine to give the best possible finish. This last step is just as critical as the previous listed steps. In order to have proper ring seal you must have a perfectly sized bore with the correct cylinder wall finish. As we mentioned earlier, if there is no ring seal you will not be able to seal the combustion chamber to maintain compression. Don’t lose power, give performance plating a try on your next build.

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