The Process of Plating Cylinder Bores

BY **JAY KINRADE**

Before getting into the process of Nickel Silicon Carbide cylinder coatings a brief history should be given on how and why the process began. Previous to plated cylinder bores most engine bores consisted of cast iron liners in an aluminum block or the block itself was cast iron. Then chrome bores came into play, firstly for aircraft then for chainsaws, snowmobiles, motorcycles etc. Chrome had the benefits of extreme hardness, has a low frictional coefficient and when plated on an aluminum block had a weight advantage over cast iron, however chrome had a major drawback for an engine bore coating, it prevented sufficient oil retention. A few specialized finishing techniques and cylinder wall inclusions of oil pockets were tried to provide a better surface to retain oil. Another drawback was the cylinders were non repairable as far as re chroming was concerned when damaged. The shortcomings of chrome plated cylinders began a search for a better coating.

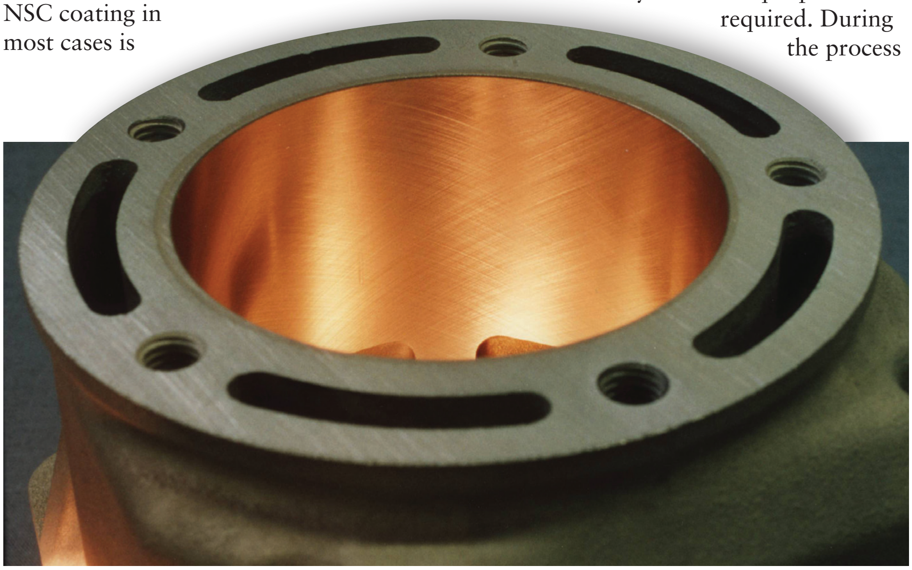
In the 1960's a Germany Company by the name of Mahle began to experiment with composite coating of nickel and silicon carbide. After years of engineering and development they trade marked their process NIKASIL. This composite coating went on to be used under license by Honda, Rotax, Polaris and several other engine manufacturers. This coating has several advantages over chrome in that the surface is "oleophilic" (retains oil) due to the silicon carbide. It's very wear resistant, retains hardness at higher temperatures than chrome and is compatible with most ring packages where chrome bores can only use cast rings.

So what are the advantages and disadvantages of NSC (Nickel Silicon Carbide)? There is a higher initial cost to repair these coatings in comparison to the traditional cast iron bore liners. While the NSC cylinder is more expensive the advantages outweigh the disadvantages especially in high performance applications. There is an average of 2% – 4% increase in horsepower over cast iron due to the increased lubricity of the coating. Heat transfer is greatly improved, up to 5 times greater than a pressed in cast iron liner and there is a weight savings since the coating is a lot lighter than a cast liner. NSC is also a lot harder, up to 10 times against cast iron. The NSC cylinder can be repaired and recoated several times taking it back to standard size.

Most companies that repair NSC cylinders follow the same procedure. First the cylinder is inspected, then all pieces are removed or masked so that the stripping process doesn't dissolve or destroy them. The cylinder is cleaned of any dirt and paint, degreased and chemically treated to remove all the old coating. At this stage of the process the cylinder is inspected for damage. Any damage is welded, bored and precision honed to a predetermined size so the coating can be applied. At this time cylinders can be bored for oversize pistons, big bore pistons and have any modifications done such as port timing changes (two strokes) etc.

Now that the cylinder is straight, round and at the right size we are ready to apply the new coating. The cylinder goes through several pretreatments before it is put into the plating tank to have the coating applied. The NSC coating in most cases is applied using an electroplating process where a negative and positive charge is sent through the solution to the cylinder. The cylinder stays in the plating tank a predetermined amount of time calculated by a computer to put on the desired amount of plating. The cylinder is then removed from the plating tank, cleaned of any residual plating and measured. Then the cylinder is rough ground to remove excess plating around ports, cutouts, etc. The size of the bore is now undersize and needs to be brought back to the desired size.

Honing is the last step of the process. Honing a NSC coated cylinder is far more complicated than for a conventional cylinder. A cast iron cylinder is first bored undersize to allow a hone to remove a small amount of material and provide a cross hatch to the finish size. Coated cylinders cannot be bored due to the hardness of the coating. If you tried, the coating will probably destroy your boring bit and or possibly chip or peel the coating off. Honing can be up to a 4 stage process. To control sizing etc. precision measuring equipment are used which includes bore gauge, setting fixtures, ring gauges, temperature gauge and surface measuring instruments. For certain styles of cylinders torque plates are required. During the process



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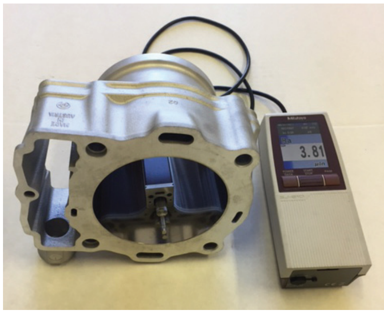
control of size, roundness, taper and surface finish must be maintained or oil retention, excessive ring wear, loss of power can occur. First the cylinder is rough honed using coarse diamond stones to a size within a few thousands of an inch to finish size. The cylinder is then removed, ports or cutouts chamfered, and cylinder surfaced. The cylinder is remounted and honed with a medium grit stones. Then the fine stones are used to reach finish size and surface finish. The final step is a plateau finish. This removes the sharp peaks and debris from the crosshatch of the bore which reduces ring and cylinder wear. The cylinder is cleaned and sent to quality control for inspection and measurement. The final wall thickness of the plating varies but is usually between 0.003" to 0.004". Thicker wall thickness can be made but as the coating thickness increases so does excess build up on port edges and lead in chamfers. There are technical reasons to avoid excessive thickness like brittleness etc.



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Some factory wall thickness are measured as low as 0.001”.

Once the cylinder has been reinstalled with new piston(s), rings etc, your engine needs to be broken in to have proper wear in and seal of all the parts. Follow the engine manufacturer’s recommendations unless the piston or ring manufacturer say different. If not, here are some tips for the first few hundred kilometers (or miles):

- Make sure engine is at operating temperature.
- No wide open throttle or redlining of the engine.
- Avoid short trips where the engine doesn’t get up to operating temperature.
- Stay out of heavy stop and go traffic. Even though your engine temperature is normal the engine oil temperature gets dangerously high especially during break-in.
- Vary the rpm and load by changing driving conditions.
- Don’t tow anything for the break-in period.

Jay Kinrade is the CEO of Mongoose Machine And Engineering Ltd. He has 45 years experience working in the powersport industry beginning with wrenching in 1971 and eventually moving to managing GA Checkpoint Yamaha’s service department for 10 years. He began working at Mongoose in 1988 and took over the business in 1994. Jay graduated as a welder at Selkirk College and is a journeyman machinist.

Mongoose has been in business since 1978 and provides machining, replating and parts distribution for the power sport industry. They rebuild cranks and heads and bore, sleeve and replate cylinders. Mongoose was one of the first in Canada to offer onsite replating of cylinders 18 years ago using the process developed by Langcourt Ltd. of England. For more information, please contact Jay at Mongoose Machine And Engineering Ltd., Port Coquitlam, BC, Canada. Call 604-464-3460, email jay@mongoosemachine.com or visit www.mongoosemachine.com.