# Reconditioning Hypereutectic Aluminum Blocks

BY **CHARLES L. NAVARRO**

As a follow up to the article, "Cylinder Bore Scoring in Hypereutectic Aluminum Engine Blocks" from the last issue of Engine Professional (Apr-Jun 2023), we will discuss specific methods to rebuild and service these engines properly.

The high cost of reconditioning aluminum engine blocks can be prohibitive, making replacement shortblock or longblock engines from the OEM often the most attractive option.

Unlike an aluminum engine block originally fitted with cast iron or steel sleeves from the factory which can be easily bored out and fitted with an oversized aftermarket piston, aluminum blocks require a special process before new pistons and rings can be fitted. Additionally, those pistons have to have a special ferrous coating or plating on the pistons to be compatible with the aluminum cylinder bores.

The majority of European automobile manufacturers using hypereutectic aluminum engine blocks rely on Kolbenschmidt's Alusil. Reconditioning requires the cylinders to be bored out, honed, and then have the silicon particles exposed. When honing, it is not specifically to generate a cross hatch in the bores, but rather to size the cylinder and remove any damaged silicon particles generated from the boring operation. There should be no visible crosshatch when this has been completed. The last step of exposing the silicon particles can be done either with a mechanical or chemical etching process and is critical to making this all work properly. Skipping this step will result in engine failure. Specialized tooling is required to carry out all these operations which can be sourced from Kolbenschmit, Rottler, or Sunnen. Once this is done, if the OEM does not offer an oversized piston, you can contact Mahle Motorsport as they can supply a custom piston with the required Ferroprint coating on the pistons suitable for use in this application.

A more common practice is to use Nikasil (scan the QR code at the end of this article to learn more about Nikasil) or equivalent plating to repair an aluminum engine block. The cylinder bores have to be bored out approximately .008" to .010" to allow for build up of the nickel silicon carbide electro-plating onto the cylinder walls. If there are deep gouges in the bores, it may be possible to go to the next oversize or to dry sleeve the block with an aluminum sleeve back to stock before plating, assuming Nikasil compatible rings are available. After plating, the cylinder bores would then be diamond honed to provide the required surface finish, which is significantly different than how you would hone

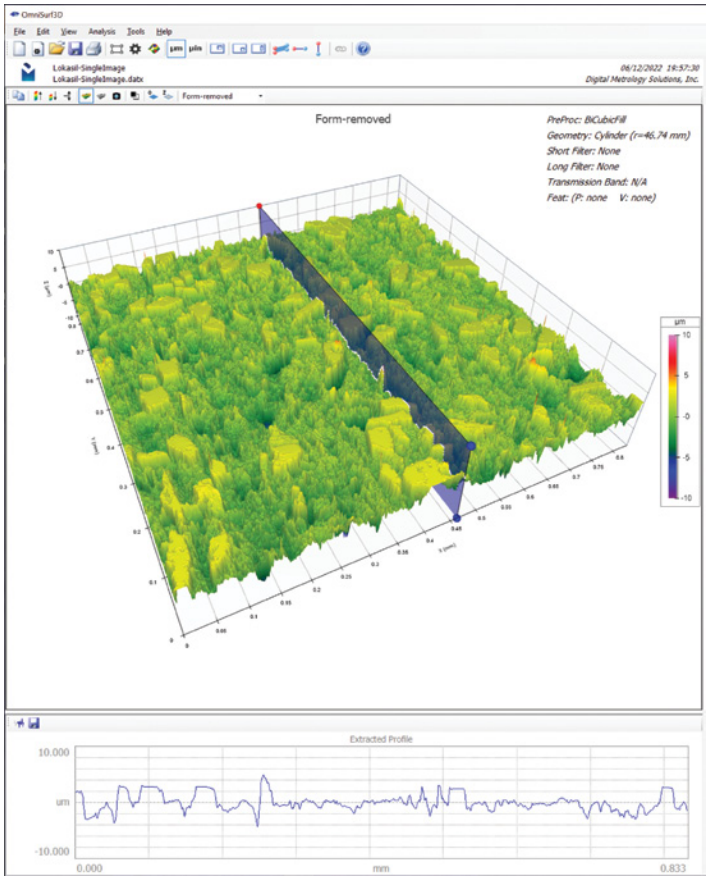


**Figure 1: Alusil/Lokasil Cylinder Surface Topography**

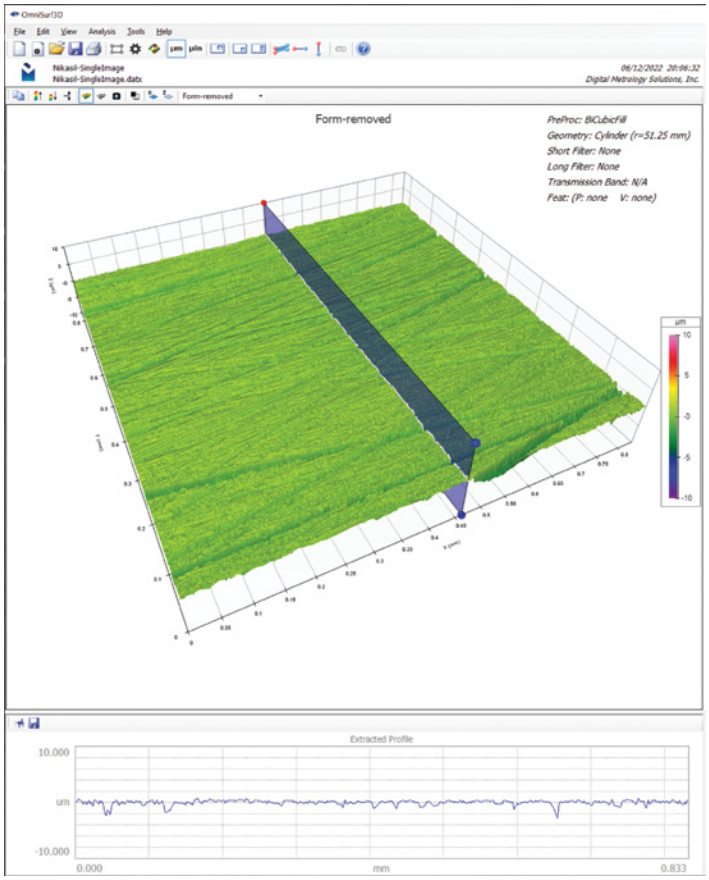


**Figure 2: Nikasil Surface Surface Topography**

a conventional cast iron or steel cylinder bore. Total Seal is a good source for Nikasil compatible piston rings and for recommendations for appropriate ring end gaps; contact Total Seal first before making any plans for cylinder bore sizing or before ordering pistons. Another consideration is the availability of head gaskets if enlarging the bore size – Cometic can often supply gaskets with custom bore sizes and thicknesses (in case you need to resurface the deck).

When it comes to the piston, once the cylinder bore has been Nikasil plated, you are now free to use an aftermarket piston as long as you ensure the correct Nikasil compatible rings are used. If undamaged, the original piston can sometimes be reused if the iron clad coating is removed and pistons are recoated, but often a new aftermarket piston is the best choice. We would recommend sending a sample OE piston to whomever you use to make your pistons. It is critical that the correct piston to wall clearance is observed as traditionally most all aluminum engines run tighter clearances (and ring end gaps) than an engine with cast iron or steel

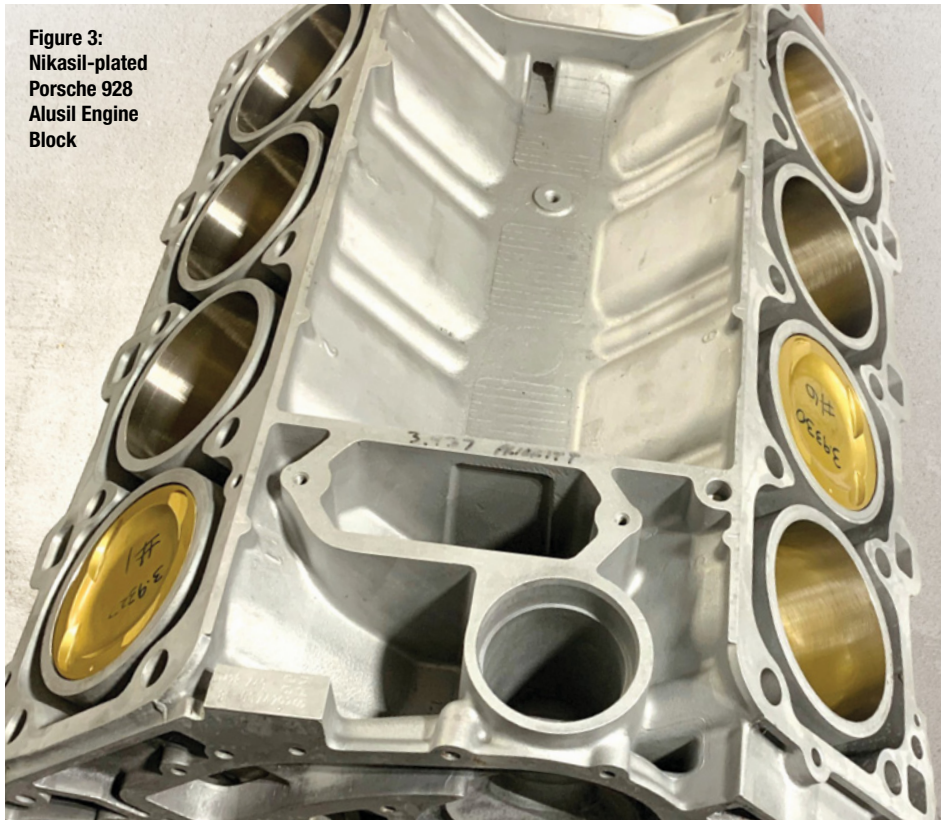

**Figure 3: Nikasil-plated Porsche 928 Alusil Engine Block**

sleeves. The choice of forging alloy also would affect this, as a 2618 forged piston often needs approximately .0005" more clearance than a similar 4032 forged piston which has high silicon content. A 2618 piston may be better for a performance application because it is stronger, but a 4032 piston will be closer to the OE piston in performance and longevity. Using an aftermarket piston may require slightly more clearance than what was specified by the factory, however, this should be discussed with your piston supplier to ensure you do not have excessive piston-to-wall clearance.

When it comes time for assembly, cleanliness is key to success. Any contamination in the bores can cause significant damage to the cylinder walls. Ultrasonic cleaning alone is not sufficient – we advise customer to use Kimwipes and denatured alcohol when cleaning their cylinder bores to ensure all foreign debris and contamination is removed from the walls. The Kimwipe should come out of the bores as white as they went in – only then do you know the bores are clean and ready for assembly. The appropriate assembly lube should be used on the pistons, rings, and cylinder bores and piston installation using a tapered sleeve ring compressor is recommended to prevent chipping of the Nikasil or broken piston rings.

The second most common error we see is the use of synthetic oil. Under no circumstances should synthetics be used anytime during the break-in process. Rings can be notoriously difficult to seat with Alusil or Nikasil bores, so a conventional non-friction modified oil must be used for break-in and for at least several thousand miles until the rings are fully seated.

For many rebuilders, once the engine is complete, that's where their job stops, but not their liability as the builder has to warranty their work when problems arise. Often many of the issues with rebuilt engines stem from improper installation or break-in as well as faulty ancillary components. Qualifying used components to be reused or mandating replacement of these critical items is equally as important as how the engine is broken in. Before initial start, performing a vehicle handover or system adaptation reset to clear all the control modules and ECUs in the vehicle is equally as important as any learned behavior prior to the rebuild may cause issues upon initial start on the fresh engine.

For newly rebuilt engines, over-fueling is big issue, especially during initial run in. Running rich is often considered safe, but remember this – fuel is not a lubricant,


**Figure 4. SJ-210 Profilometer Nikasil Surface Trace**

especially with modern ethanol enriched fuels. Cylinder wash-down is often the leading contributor to issues with Alsuil or Nikasil cylinders, so ensuring fuel trims and AFRs are correct is essential. Bad injectors, oxygen or MAF sensors, or vacuum leaks can all lead to over-fueling or cylinder wash down. Smoke testing the engine for vacuum leaks is also critical in this day and age of plastics being used throughout modern engines and should be carried out on any new engine installation.

Beyond initial run-in, when it comes down to maintenance, the importance of using Top Tier fuels and fuel system treatments including polyetheramine (PEA) as found in Driven Injector Defender ensure proper fuel system operation is as important as what oil is used and how often it is replaced. OEMs are pushing for lower viscosity oils to improve fuel economy and longer oil change intervals to reduce cost of ownership, both of which aren't necessarily best for the

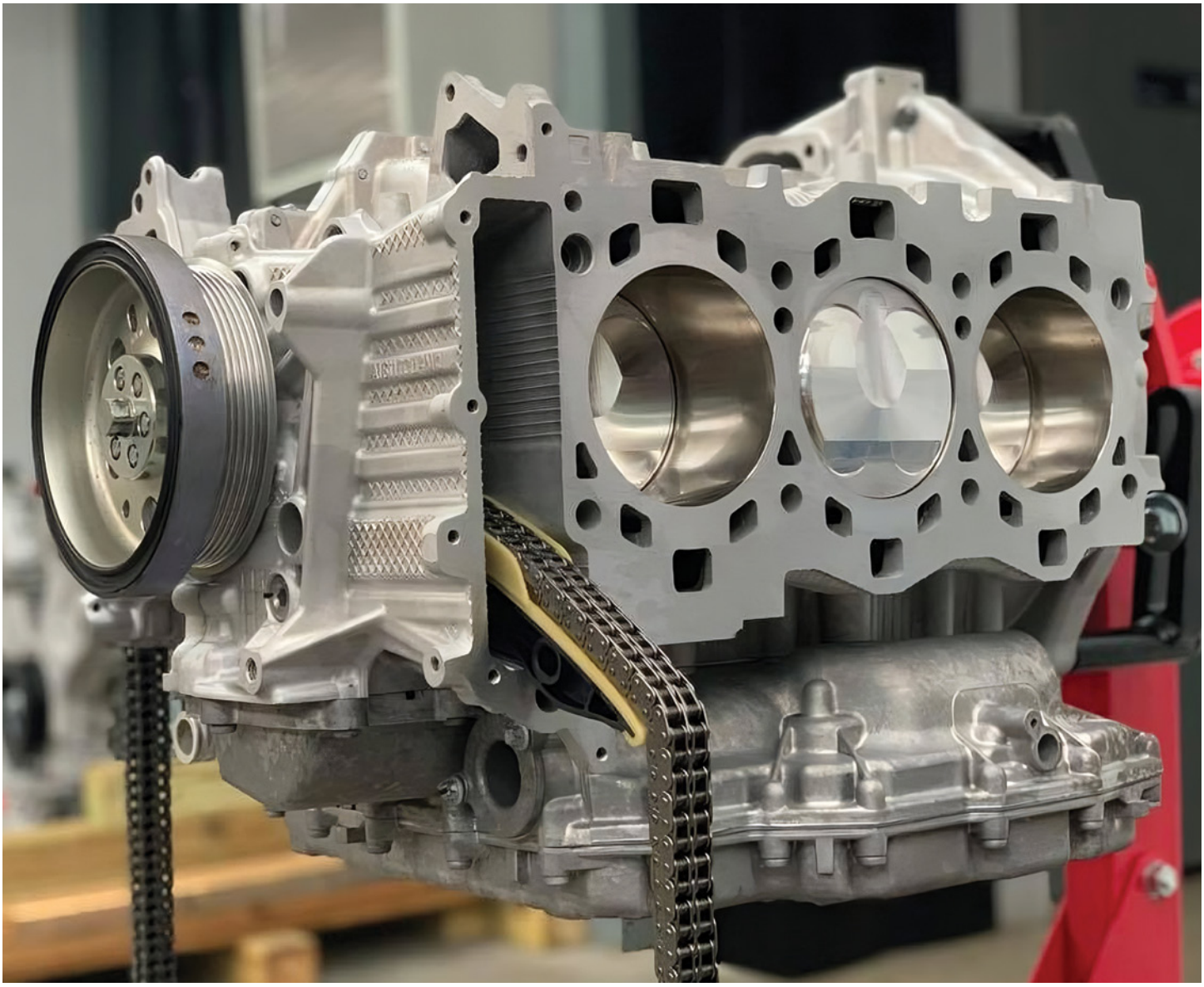

**Figure 5: Nikasil-plated Porsche MA1 (9A1) Alusil Engine Block**

engine. It is up to the builder to verify and set bearing clearances which ultimately will dictate the appropriate oil viscosity and to make a recommendation for what oil (we're partial to Driven Oils) is best for the engine and intended use, so don't blindly rely on OE guidelines for both. In our more than twenty years of experience with Porsche engines and with Alusil and Nikasil, we've learned what works and what doesn't. Hopefully we've shortened the learning curve for you and demystified reconditioning of hypereutectic aluminum engine blocks so you don't have to fear rebuilding a modern all-aluminum engine using these technologies.■

Charles Navarro is the co-founder and President of LN Engineering. LN Engineering is a manufacturer and supplier to the Porsche aftermarket specializing in reconditioning of Alusil and Lokasil engine blocks and Nikasil cylinders. To learn more, visit LNengineering.com.

*Special thanks to Mark Malburg at Digital Metrology for the OmniSurf Alusil and Nikasil topography.*

**Scan the QR code to learn more about Nikasil**