

How & Why to Sleeve a Coyote Block

We Show You How a Coyote is Sleeved



Mark Gearhart

August 22, 2018

Photos By: Michael Morgan

Ford has the Coyote engine platform scienced out. It irrefutably dominates the competition in terms of horsepower gained per pound of boost consumed. But like any engine, they have their inherent weaknesses.

The Coyote's Ti-VCT cylinder heads flow extremely well and have improved during their evolution over three generations. Stock cylinder head castings have powered Coyote engines to over 2,500 horsepower! From a short-block perspective, the six-bolt main caps and factory 4340 forged crank are virtually indestructible.

While we've seen people make 1,000 horsepower to the wheels on stock long-blocks, the reality is that's not a reliable, long term solution. Cast pistons, rods, and oil pump gears have gotten better over the years, but still fail when stressed beyond their limits. A set of forged rods and pistons are an easy answer but not the total solution when it comes to reliably making over 1,000 rwhp.

Ever picked up a Coyote block? They are very light and that's because there's not a lot of material in the casting. Ford has uses gray iron sleeves on the 2011-2017 and a plasma transferred wire arc on the 2018+ as a means of fortifying the cylinder walls. The factory thin wall, gray iron sleeves are only about 0.062-inch thick. Combine that with a minimal amount of material separating the bores from the water jackets, and the piston breaks through on the thrust side of the bore.

A mostly abandoned short term solution was to weld in a support brace on the thrust side and deck the block. When taking power to the stratosphere install a set of stronger ductile iron sleeves like ones sold by Darton International are a must.

Steve Demirjian owns Race Engine Development and is the head R&D guru for Darton. He's in charge of developing all the new engine applications and has been sleeving blocks since the '70s.

Flanged Vs. Flangeless

There's two different types of sleeves for Coyotes – flanged and flangeless. A flanged sleeve is easiest to identify when you can see a ring at the top of the bore and is designed to keep the sleeve from dropping the bore. “The non-flanged sleeves are cheaper to make and easier to install for folks having a regular boring bar only,” said Demirjian. “The bore center-to-center distance can be off, which makes no difference with a straight wall sleeve. With a flanged sleeve the flange is much larger in diameter than the sleeve body, which allows for a much wider seating width and area to keep the sleeve from sinking. Also, a flanged sleeve can be made longer to better support the piston at the bottom of the stroke since it is not dependent on a ledge in the aluminum block bore for seating.”

The downside to the flanged sleeve is you need to maintain the bore to bore spacing within +/- 0.001-inch to do the job correctly, which means you need a CNC to do the job right. You don't want a big gap between the sleeve flats, nor do you want the sleeve flats pushed up against one another.

However, does removing additional material from the deck for a flanged sleeve cause an issue? Demirjian proclaimed, “I have not seen an issue with machining the flange recesses in the Ford or any other block I sleeve. I think a lot of this not liking the flange is the extra step in machining for the flange and as pointed out above, one needs a CNC machine to do this correctly.”

Three Different Variations of Coyote Blocks

The 2011-2012 Mustang used long 12mm head fasteners that extend down almost to the crankcase. The new 2018 block uses the same long fasteners. “The long fasteners are absolutely necessary for any high-power build,” explained Demirjian. “They greatly strengthen the side walls of these thin cast blocks. The short 11mm fastener blocks, as used in the 2013-2017 Mustangs (race blocks included), will crack right at the bottom of

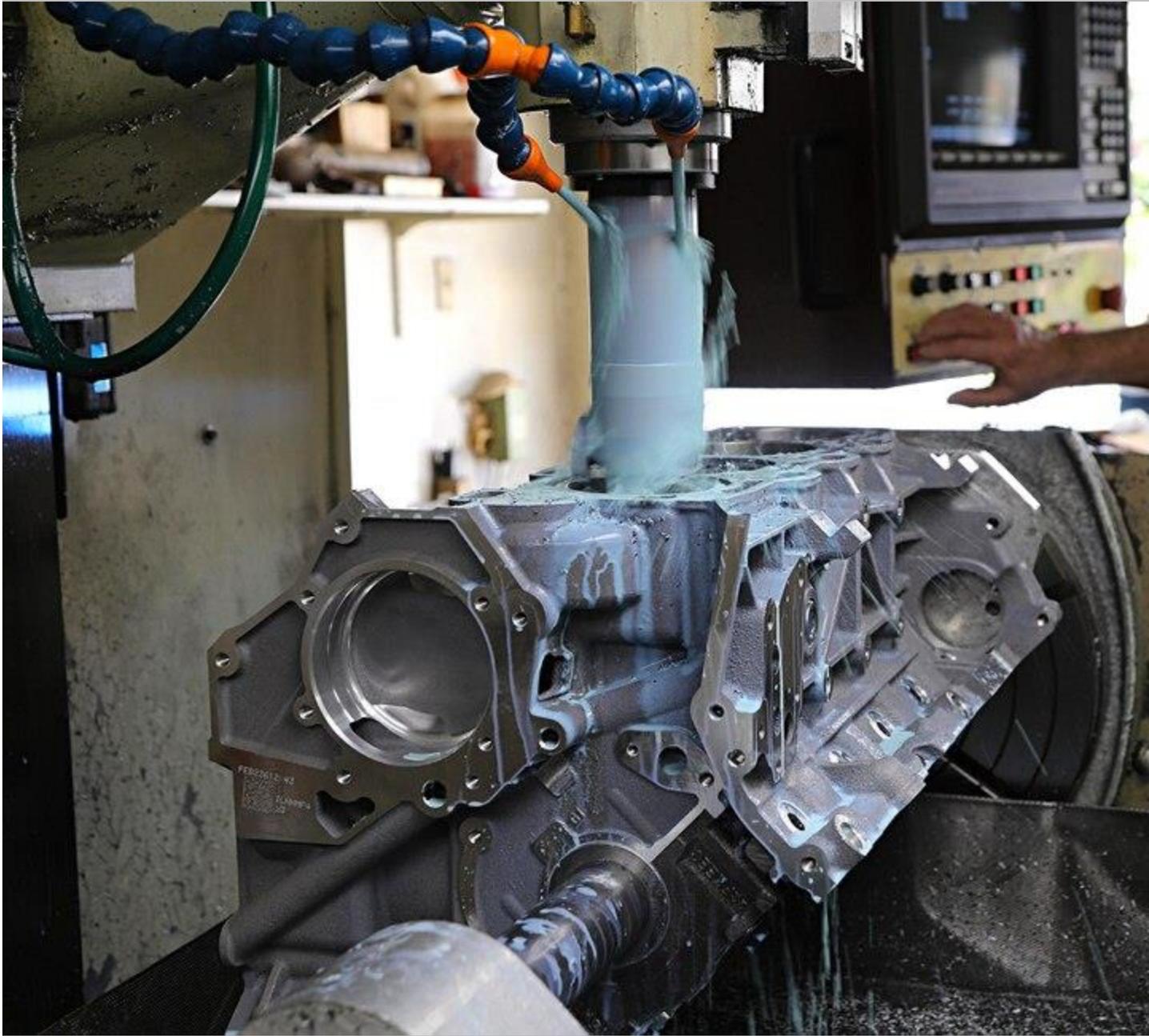
where the head bolt holes' end. They also crack in the valley, on the back wall of the block, and on the outside wall of the castings." All is not lost however if one owns an 11mm block. The 11 mm blocks are identical to the 12mm blocks in the head bolt areas and can be machined to accept the long 12mm fasteners.

The plasma spray wall blocks, found in the Voodoo 5.2 and 2018+ blocks, have coolant holes drilled between the bores. "These holes must be threaded all the way to the bottom of the holes and plugged with brass screws prior to machining for the sleeve install," said Demirjian "I have not had one break through during machining, though what's left is paper thin and will most likely crack from the block bore wall to the hole if not plugged. This will lead to coolant leaking into the crankcase. On the 2018 direct injection blocks, only the holes on the exhaust side of the block need plugging with brass screws. All of the cross holes must be plugged on the others."

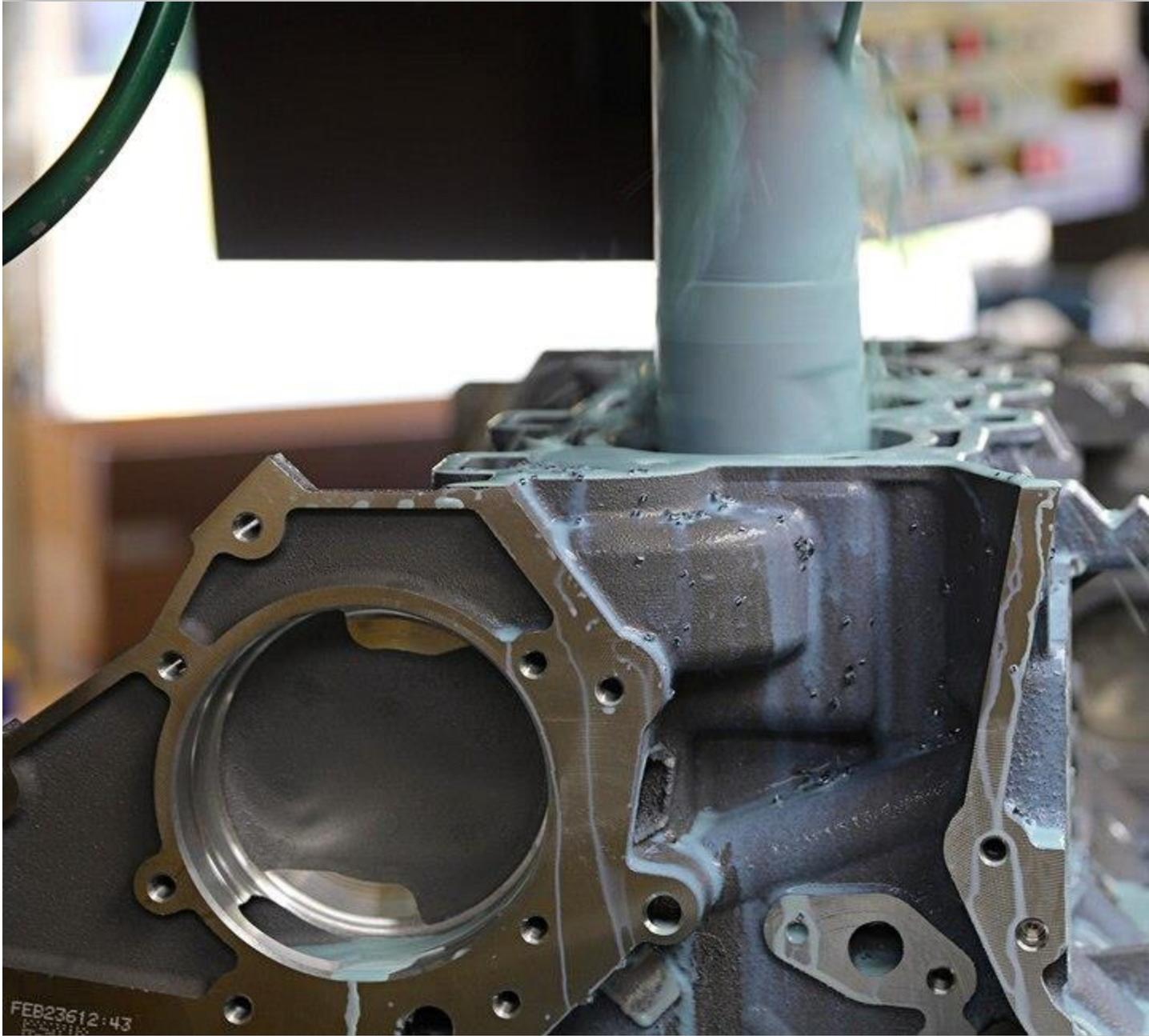
Rolling Up Your Sleeves

Darton's Coyote sleeves are 0.098-inch thick at stock bore size and the ductile iron material. What that means is that it's more than three times stronger than the stock gray iron sleeve. Demirjian recommends a maximum bore size of 3.700-inch, leaving a sleeve wall thickness of 0.0625-inch. Top Fuel Funny Car and Dragster vehicles rely on these types of dry sleeves so their engines can produce over 10,000 horsepower.

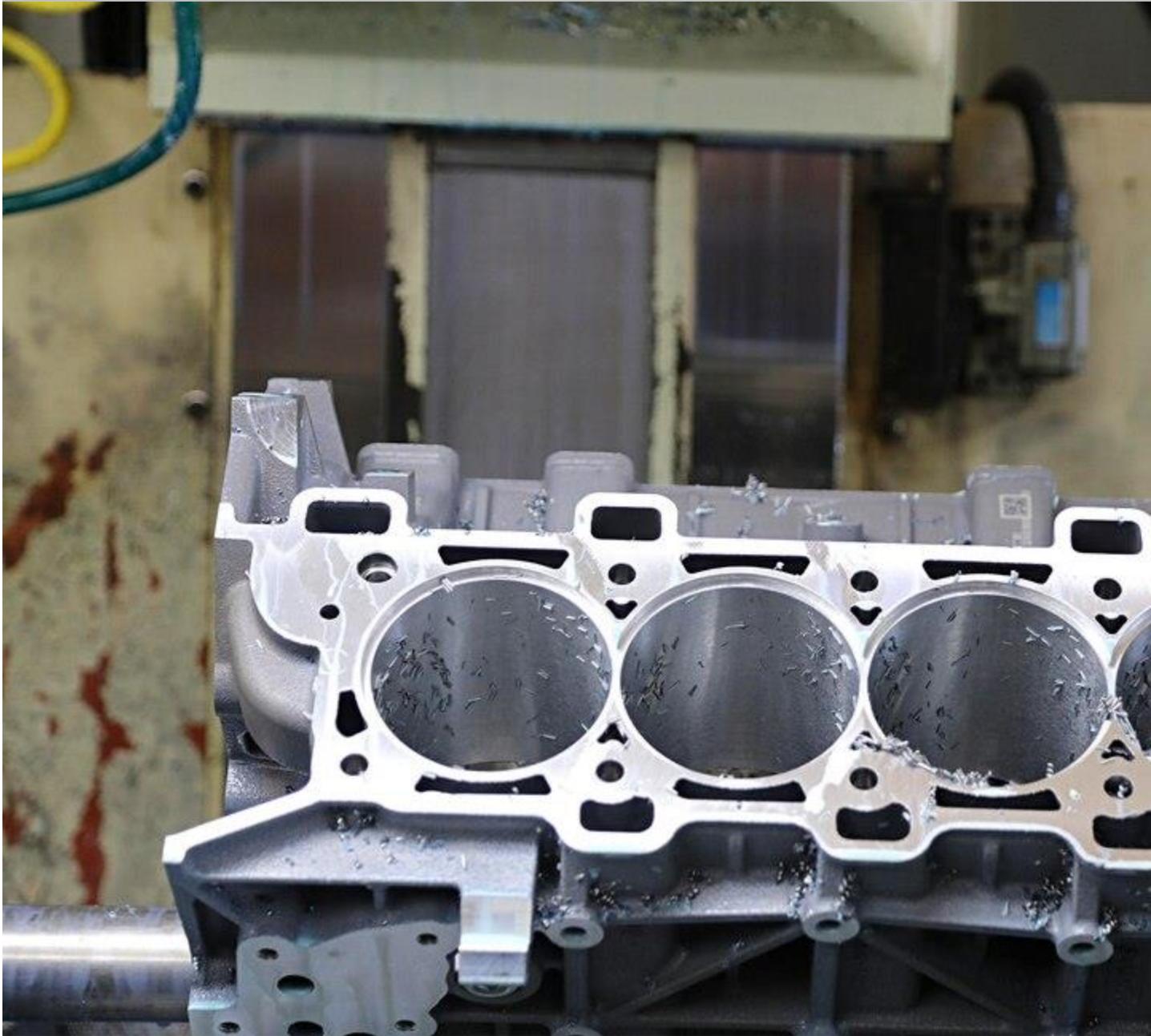
Ductile iron is a cast ferrous alloy that contains carbon in excess of 1.5 percent. It also contains silicon usually from 1.0 to 4.0 percent and manganese up to 1.0 percent. To obtain the needed properties, both phosphorus and sulfur contents must be low. Phosphorus content is usually less than 0.1 percent, preferably less than 0.05 percent. Sulfur content must be less than 0.02 percent. One more element, magnesium, is always present in ductile irons. Its concentration normally ranges from 0.02 to 0.08 percent.



1. The factory gray iron sleeves must be cut out to make way for Darton's sleeves. Finding the true bore center is absolutely critical when working with flanged sleeve. Utilizing a CNC work offset table, Demirjian uses a Blake Co-Ax indicator and manually adjusts the axis to get the bore centerline.



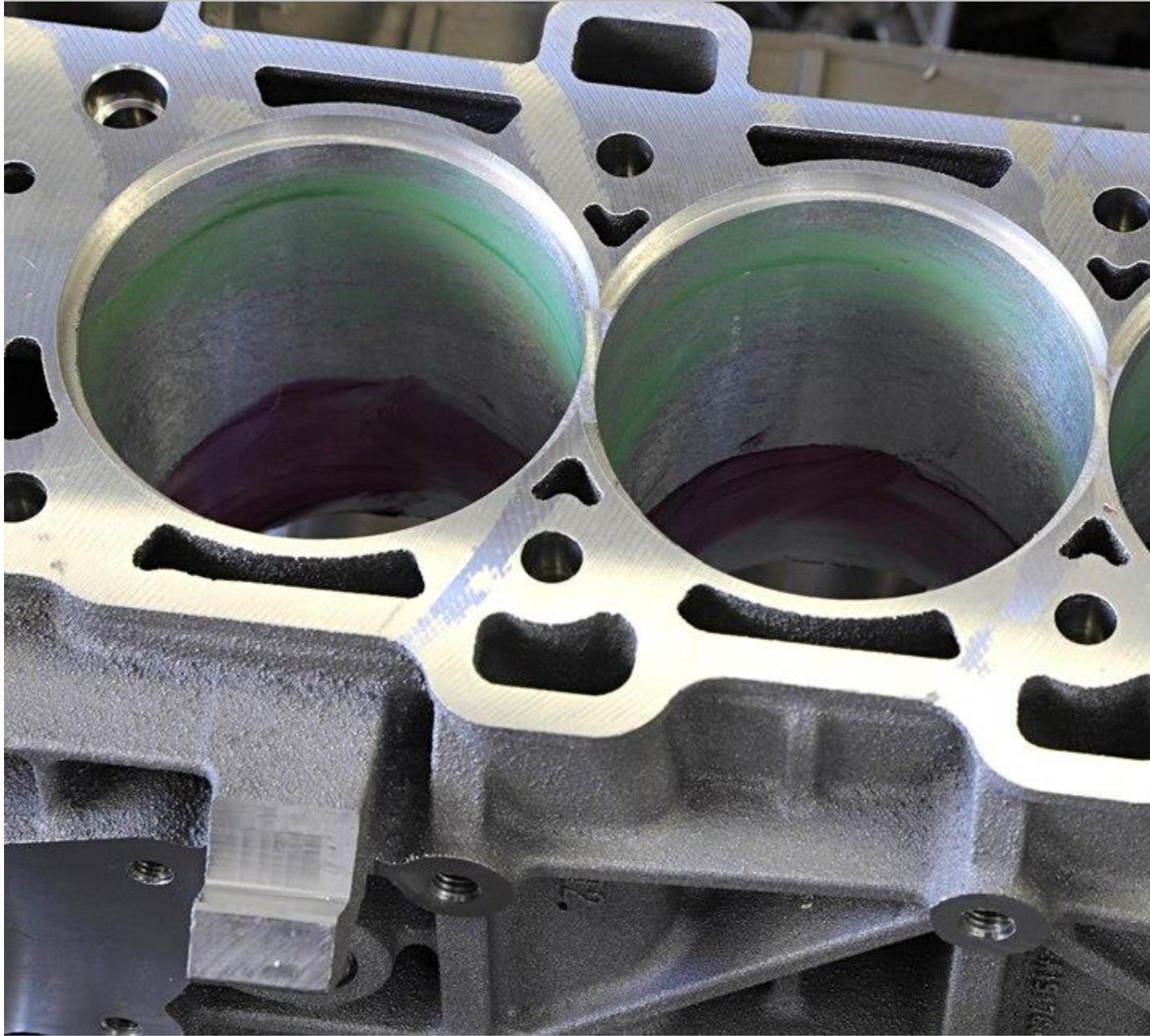
2. For best results, aluminum blocks should be machined on a flood coolant CNC to keep the block temperature stable during the machining process. Aluminum expands when heated and keeping the temperature of the block consistent is very important. Doing so will keep the bore-to-bore tolerance and hole bore sizes consistent.



3. At 3.750 the sleeves are gone and we are getting into the aluminum. A 3.826 by 5.295-inch length bore is where we stop. The sleeves have an outer diameter of 3.825, allowing for a clearance of a mere one thousandth of an inch. A 0.200-inch deep counter bore is milled for the flange at the top of the bores to hold the sleeves in place.



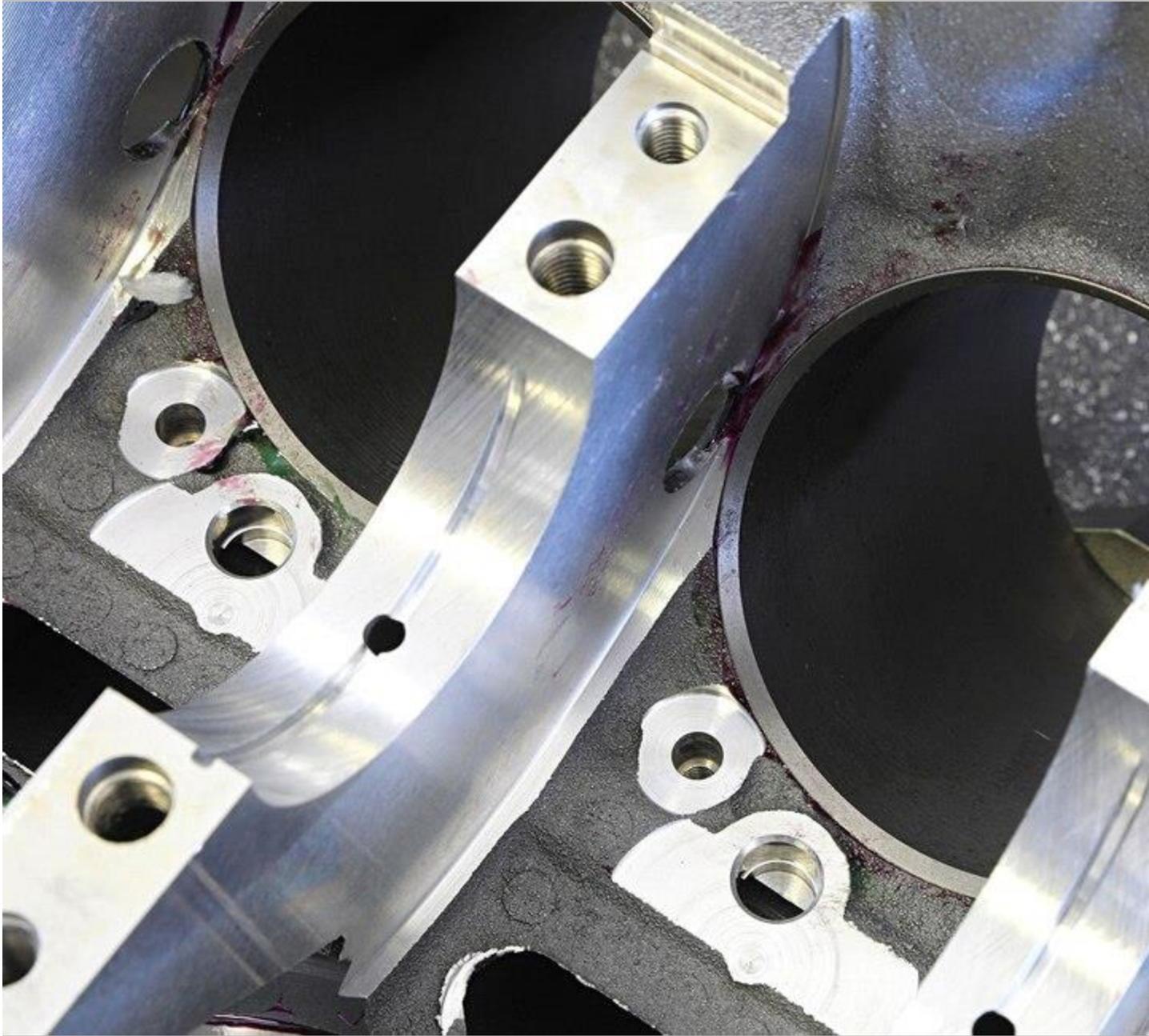
4. Here you can see the flange at the top of the bore. The stock Coyote sleeves seat at the bottom and are flangeless.



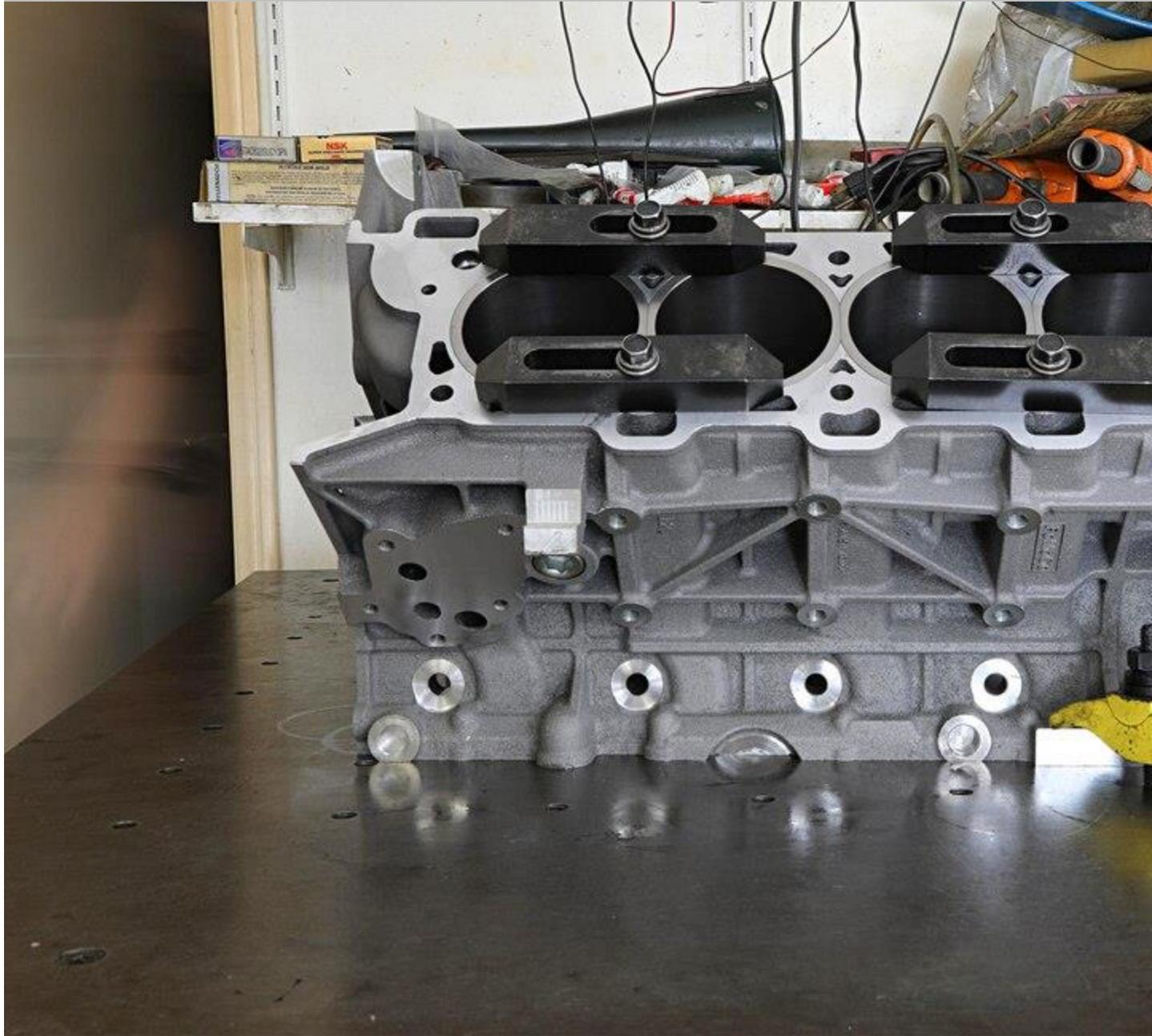
5. Loctite 515 (purple) on the bottom of the bores keeps oil from coming up while Loctite 620 (green) is the sleeve retainer that holds everything in place. The 620 also acts as a heat transfer agent between the bore and block. This is important because aluminum and iron expand at different rates.



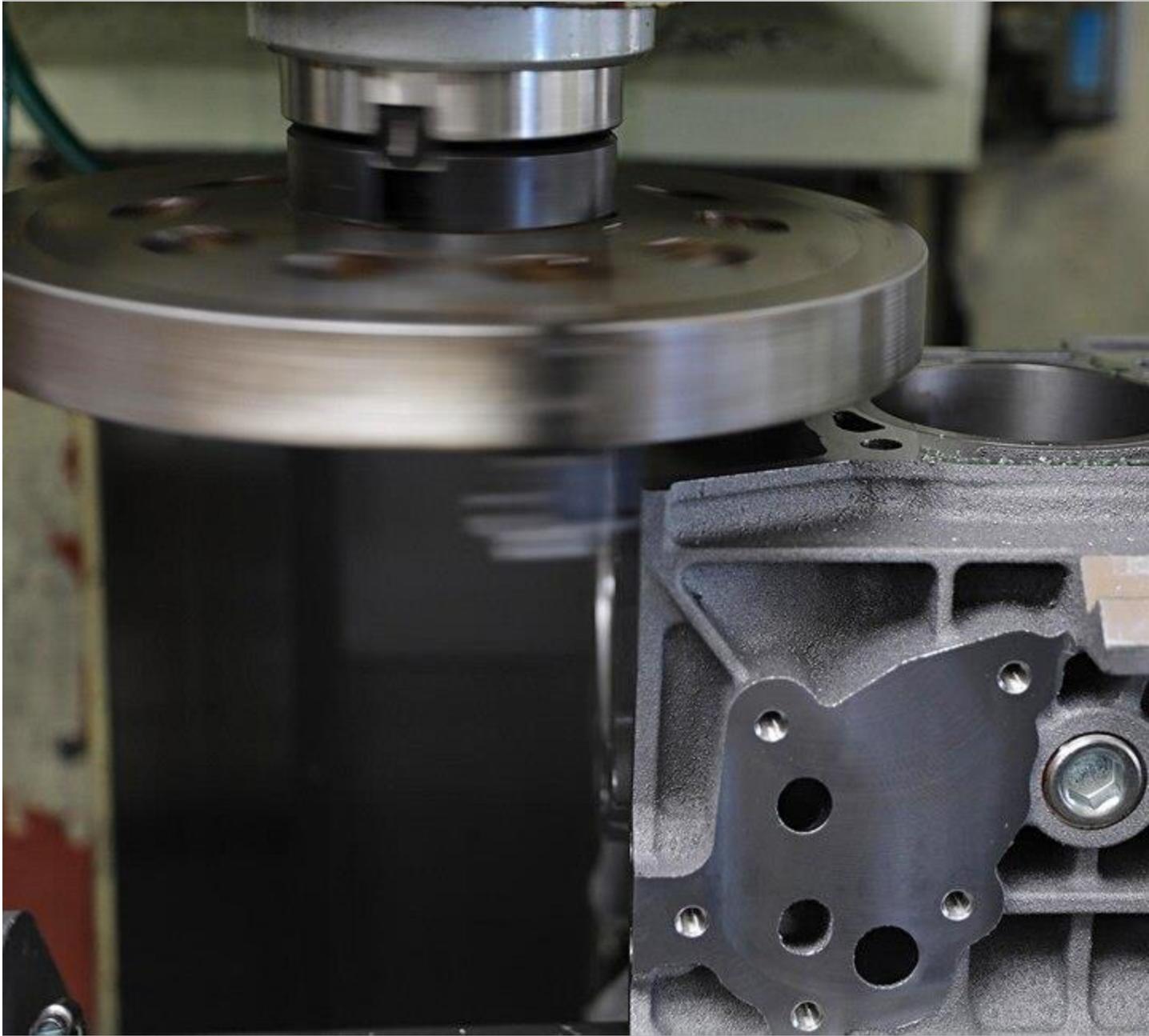
6. The block shouldn't be heated when installing the sleeves. With 0.001-inch of clearance, they mostly slide in but do require a little mallet persuasion to get the sleeves fully seated.



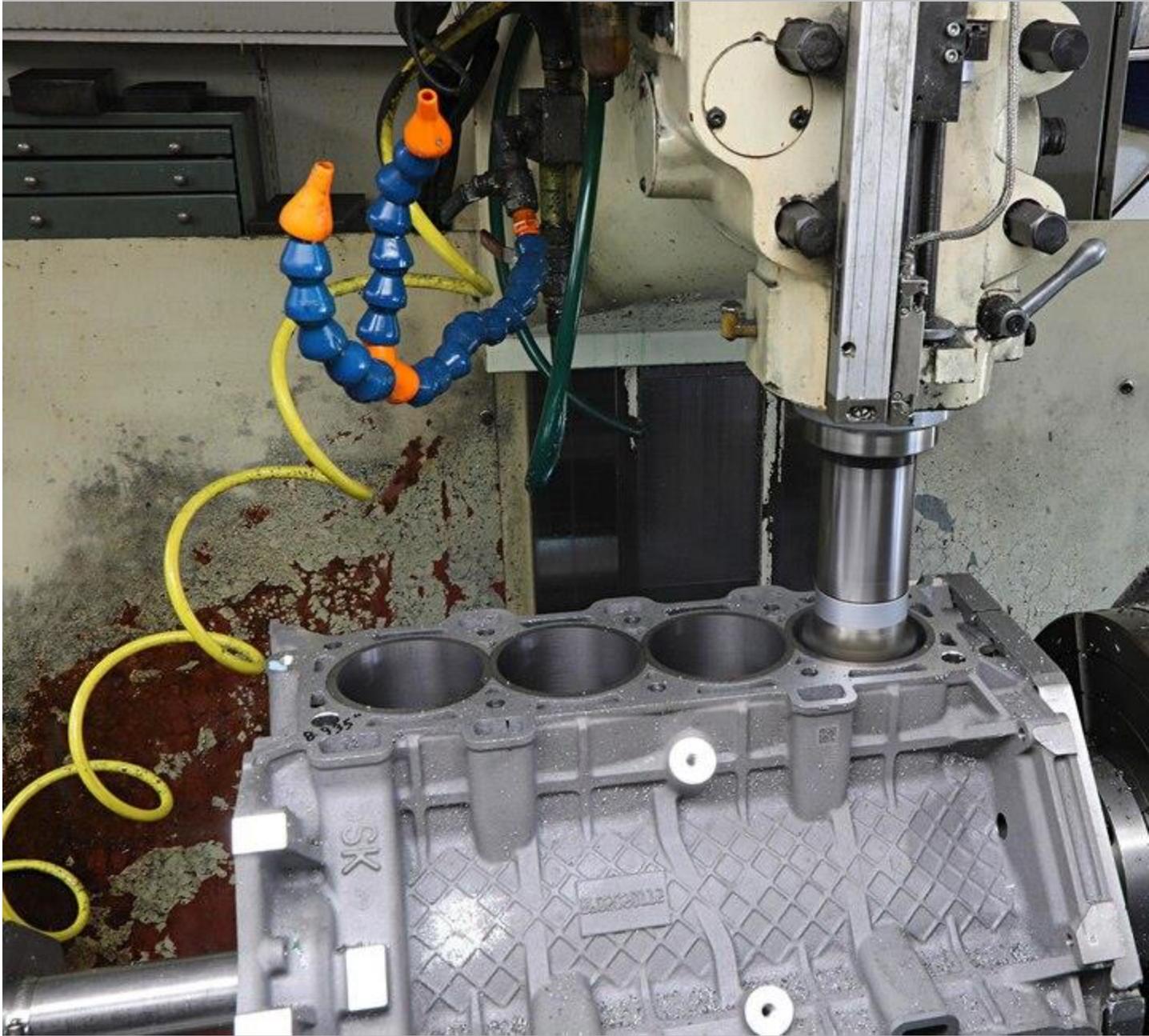
7. The sleeves are chamfered at the bottom to help on long stroke applications where a piston's sleeve might drop out of the bore.



8. It's important to allow the Loctite to cure with the sleeves clamped in place. After doing so, Demirjian secures the block to a vibratory stress relief table. Some brand's blocks are stress relieved twice during the process due to the larger amount of material removed in those castings. Without stress relief the block may distort when put into use resulting in out-of-round bores and tight cranks.



9. Returning the deck to a true flat surface is important for proper head gasket sealing. On high horsepower builds (1,500+ V8 applications) Demirjian will step deck the block where the sleeves will provide additional sealing power and act like a large o-ring.



10. One of the final processes is boring the block. Demirjian will bore to a customer's specifications or stop at 0.020 under the desired final bore so the engine builder can properly hone the block.



11. On the Voodoo and 2018+ Coyote blocks the coolant passages between the bores should be tapped and blocked off with a brass screw. The heads of the screws will then be cut off. This is designed to help stiffen the block.

Sources

Ford Performance
800-FORD-788
performance.ford.com

Darton Sleeves
Carlsbad, CA 92009
800-713-2786
www.dartonsleeves.com

Race Engine Development
760-630-0450
www.raceenginedevelop...