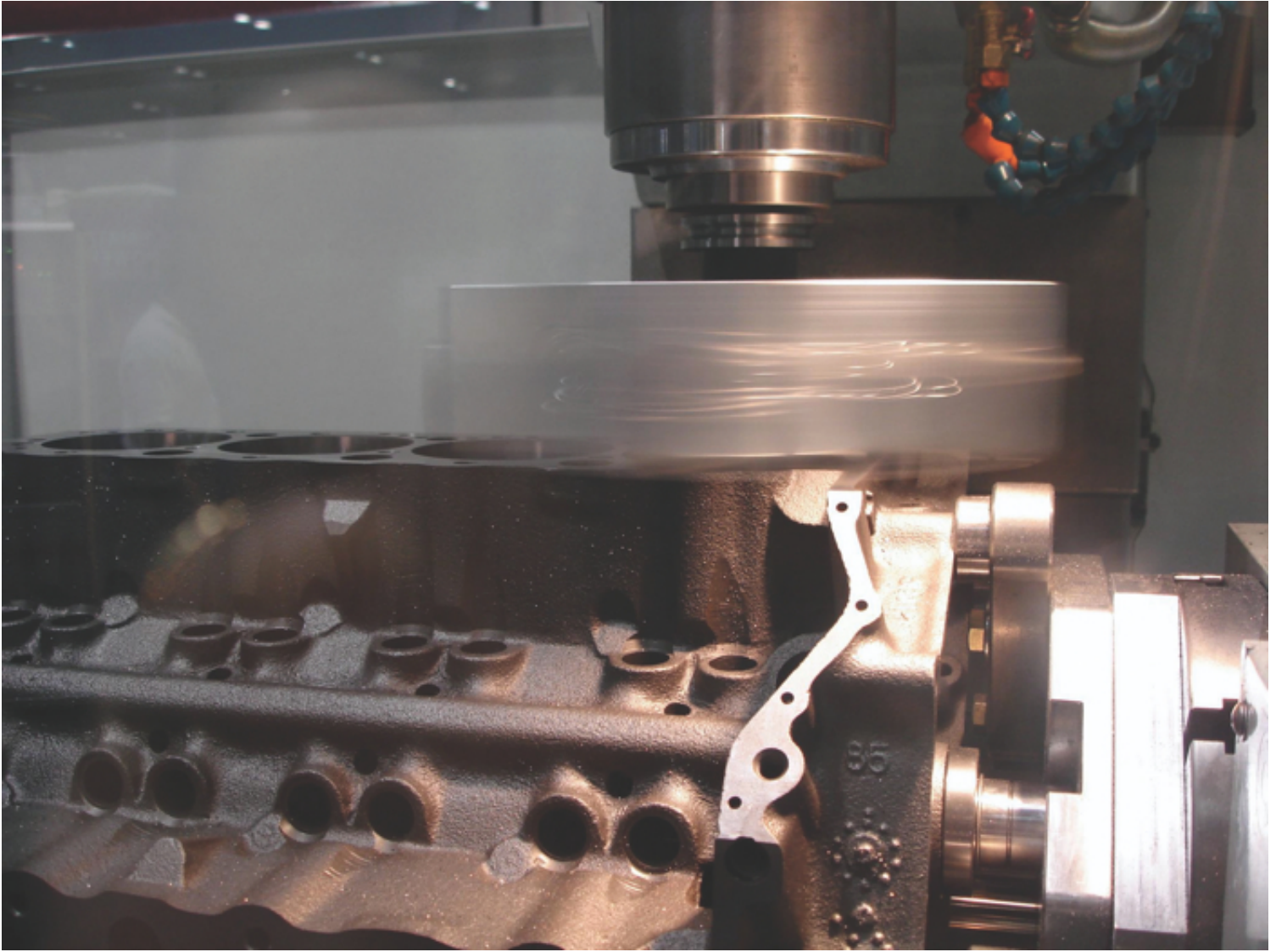


Head and Block Resurfacing Equipment

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Regardless of what type of engine work you do in your shop (stock, performance, diesel, marine or anything that comes in the door), you need the ability to surface heads and blocks. Deck surfaces on high mileage heads and blocks are often corroded, pitted, scratched and/or out-of-flat – especially if the engine blew a head gasket or overheated.

Surfacing is usually necessary to restore surface finish and flatness – both of which are essential for late model engines with MLS (Multi-Layer Steel) head gaskets. Surfacing is also a must with new blocks to establish the desired deck height and piston clearance. Likewise, new heads may need surfacing to achieve the desired compression ratio and to make sure they are flat.

Given the fact that surfacing is a requirement for all types of engine work, the question is what type of surfacing equipment should you have for machining heads and blocks? Grinders and belt sanders are very much old school compared to the needs of today's engines. Wet grinding can achieve high quality surface finishes but it's a messy process compared to dry milling, and it works better with cast iron. Aluminum tends

to load up and clog the stones.

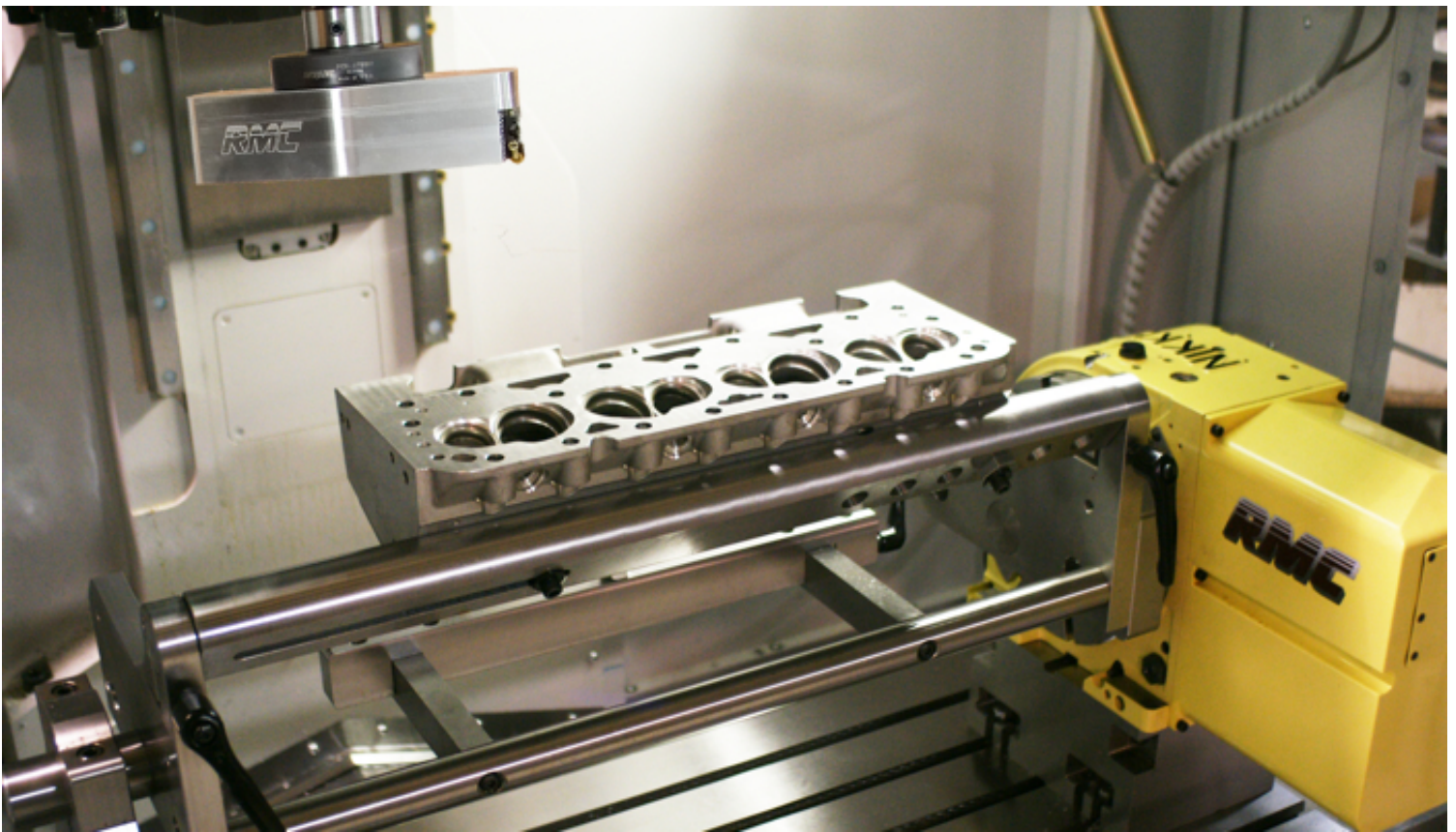
As for belt sanding, you can't achieve the mirror-like surface finishes that many customers expect on late model heads and performance heads. Also, the quality of the finish is highly dependent on the skill of the operator with a belt sander. That's why engine builders have moved away from these old school surfacing techniques and have mostly gone to dry milling. It's a relatively quick, clean process that is capable of delivering consistent, high-quality finishes.

EQUIPMENT OPTIONS

So if dry milling is the way to go, what type of surfacer should you get? The basic choices boil down to buying or leasing some type of dedicated surfacer, or moving up to a multi-purpose CNC machining center that can surface, bore, drill, tap, chamfer and clearance – and also port cylinder heads if you opt for a full 5-axis CNC machine.

Multi-purpose machining centers obviously have a lot of capabilities and eliminate the need for multiple machines to perform separate functions like surfacing and boring. If you are installing wet sleeves in blocks and need to counterbore the cylinders, a multi-purpose machine can be a real time-saver. With a multi-purpose machine, you mount the block once to perform multiple machining operations rather than moving it from one machine to another. This saves setup time and improves accuracy by leaving the block mounted in the same fixturing. A multi-purpose machine can also free up valuable floor space in a crowded shop.

But there are some tradeoffs with multi-purpose machines to consider. A big one is that they cost a lot more than a dedicated surfacer. Depending on the brand of the machine, its features, controls, tooling and fixturing, you can spend anywhere from \$80,000 up to \$280,000 or more for a multi-purpose CNC machining center. By comparison, a brand new dedicated surfacer from a major supplier will cost from \$30,000 to \$45,000. On the other hand, if you also need the ability to bore blocks, a boring machine would be an additional expense. So when you consider the fact that a multi-purpose machine replaces the need to buy a surfacer and a boring machine, the price difference isn't that great.



Something else to consider when deciding which way to go is that a multi-purpose machine can only do one job at a time. In a busy, high volume shop, relying on one machine to do it all may create a bottleneck. On the other hand, if you have a relatively small shop with a limited production volume, buying a multi-purpose machine may be a smarter move than buying a separate surfacing/milling machine and a boring machine. Of course, you will still need a honing machine for finishing cylinders (unless you are manually honing blocks the old-fashioned way with a drill and honing stones) and a valve-and-seat machine for machining valve guides and seats, and a valve grinder for refacing used valves (unless you are buying new or reconditioned valves).

Your equipment buying decision often comes down to what you think can afford. You'd love to have a top-of-the-line CNC machining center with all the bells and whistles, but can't justify investing six figures for the volume of work you are currently doing. Even so, sometimes you have to think outside the box and project where you want your business to be five years from now.

A top-of-the-line 4- or 5-axis CNC machining center might seem like an expensive luxury for your business now, but such a machine might help grow your business in new directions by opening up market opportunities like head porting, diesel work and even non-automotive machining.

We ran an article several years ago (May 2013 issue of *Engine Builder* magazine) about CNC machining centers and how shops are using this type of equipment to make money. Many of the shops we interviewed told us that over half of their business is now custom CNC fabrication or machining, including such things as custom motorcycle parts, emblems, engine valve covers, gear shift knobs to non-automotive items such as industrial and mining pumps, marine parts and even components for guns. This type of work often provides substantially better margins and higher profits than traditional automotive machine work. But it also requires thinking outside the box to expand your customer base beyond those who you are serving now.



NEW OR USED?

Buying a used surfacer or machining center will usually save you a lot of money compared to buying new equipment – assuming the equipment you buy is in good condition and can do the kind of quality work your customer's expect. You don't have to look too hard to find a good used surfacer for \$12,000 to \$20,000 – or

even less if you are lucky enough to be the only bidder at a going-out-of-business sale. Of source, there are risks with buying used equipment. There may be some uncertainty regarding the true condition of the equipment and it's ability to deliver a high quality accurate finish. Play in the spindle bearings is a common issue with older used equipment. You may also encounter some problems obtaining replacement parts depending on the age and brand of the equipment. So let the buyer beware if you are shopping for a used surfacer.

If you have decided to buy new equipment (which will make our advertisers happy), our advice is to buy a quality machine from a brand name supplier who has an established reputation in the industry and who will be there to provide customer support if you need parts or service later on.

Watch out for the low-priced "economy" surfacers that are being imported from China and other offshore manufacturers. According to one supplier we interviewed, these low priced surfacers utilize out-of-date technology, cheap components and lightweight construction, and are essentially "junk" compared to what's available from established suppliers.

"These machines lack the rigidity and quality to hold up in a high production environment. They're not going to last 20 years like a quality-made machine will, and they are not capable of producing the kind of high quality finishes that are necessary for today's engines. Good luck getting parts or service for these machines if you need it," he said.

Although some "reconditioned" used surfacers are sold with a limited warranty, the warranty usually won't be as good as that offered on new equipment. Customer support may also be limited or non-existent if you decide to buy used rather than new.



WHAT TO LOOK FOR

All of the suppliers we contacted for this article agreed that certain features are absolute “musts” for surfacing blocks and heads on late model and performance applications. A machine that has been engineered from the ground up to surface automotive blocks and heads will be better suited to the typical engine builder’s needs than a machine which was originally designed for general purpose industrial use or for grinding.

A quality surfacing machine will have enough horsepower for high speed surfacing with CBN or PCD. Older equipment designed for grinding may not do so well when converted for milling.

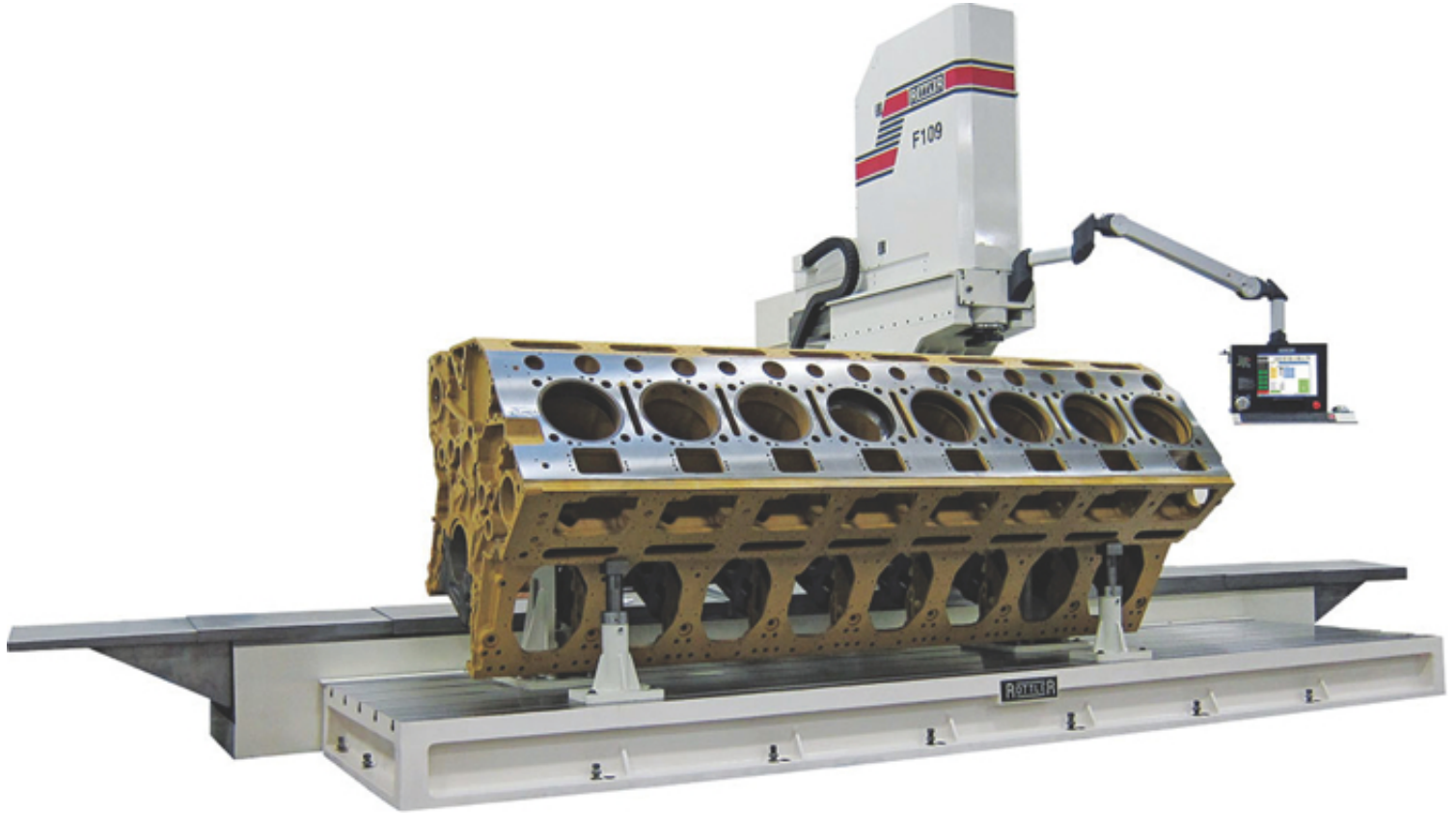
Most surfacers now have ball screw feeds to provide a smooth and steady movement of the work piece or cutter head.

A surfacer should be large enough to handle all automotive and light truck heads and blocks, as well as some heavy-duty diesel heads. If you’re doing heavy-duty diesel blocks and heads, buy a machine that has the extra capacity to handle oversized castings.

Look for fixturing that allows you to quickly, easily and accurately mount heads and blocks for surfacing. Time is money, and if you have to fiddle around for 30 minutes or more mounting and leveling a head or block on the machine, it’s going to hurt productivity and profitability. The basic fixturing that comes with

some European surfacers work well with OHC heads but not so well with American pushrod V8 and V6 heads. You may have to buy additional fixturing to clamp the different types of heads and blocks that come into your shop.

Fixturing is just as important a consideration when making a purchasing decision as the machine itself. Block decks have to be surfaced parallel to the crankshaft main bore centerline just as OHC heads have to be cut parallel to the OHC cam bores. The fixturing must handle a variety of different castings, and hold those castings securely so that they can be surfaced accurately and with a high degree of precision.



Surfacers come with various types of cutter heads. Vehicle manufacturers typically use surfacing equipment with multi-bit cutters to reduce machining time. However, most aftermarket engine builders use a simple single bit cutter to mill heads and blocks even if the cutter comes with two bits. Why? Because it is faster and easier to adjust or replace a single bit than it is to replace and level two bits. A cutter head with a single bit can do just as good a job as a cutter head with two or more bits provided you are using the right cutter speed and feed. Many of today's high speed surfacers can do a cylinder head in less than two minutes.

Most suppliers recommend using CBN bits on cast iron and PCD bits on aluminum. CBN can cut both types of metal as can carbide, but aluminum tends to stick to both CBN and carbide. If a chip sticks to the tool bit and is dragged across the surface, it will mar the finish and may cause a sealing issue when the head is installed. Applying a light coating of spray-on wax or lubricant (such as WD-40) on the work piece prior to milling aluminum it can reduce the sticking problem with CBN or carbide, but using PCD will usually work better.

The best surfacing equipment in the world won't produce a high quality finish if the bits are dull or the feed rate is too high relative to the RPM of the cutter head. Aluminum can anneal and soften when it has been overheated, so it may not cut as cleanly as a new casting.

Most late model OHC heads can only be surfaced a small amount. Removing metal from the deck surface lowers the head on the block and retards cam timing. Surfacing also increases the compression ratio, which

may lead to detonation issues with some engines. Consequently, if a head is warped it should first be straightened to minimize the amount of metal that needs to be milled to restore flatness.

OHC heads that are warped are typically bowed up in the middle. The head can be straightened by placing shims under the ends of the head, then bolting the head down on a rigid steel plate until the cam bores are straight. Heating the head in an oven helps the straightening process, but don't get the head too hot (over 450 degrees) because doing so may anneal and soften the head. Once the cam bores are straight, the head can be unbolted from the plate and surfaced as needed.



The final finish cut on any head should not exceed .001" A rough surfacing step followed by a final surfacing step will produce a better finish than trying to take off too much metal in a single pass.

Many late model engines require a high quality mirror-like surface finish in the 10 to 30 RA range, and some may even specify a finish in single digit RA numbers. If your surfacing equipment can't achieve these kind of numbers, you need to upgrade your surfacing equipment.

Many aftermarket MLS head gaskets come with a thicker coating than original equipment MLS gaskets to accommodate finishes as rough as 60 RA. Even so, you should aim for the factory surface finish rather than relying on the gasket manufacturer to compensate for a poor surface finish.

If possible, try several competitive surfacers or multi-purpose machines before you commit to buying anything. Equipment salesmen are always anxious to close a sale, but they should also let you try out their equipment so you can decide for yourself whether or not it's right for you and your business. If the controls are complex or confusing to operate, if something seems awkward or difficult to use, if the tooling or fixturing can't accommodate the kind of heads and blocks you frequently handle in your shop, then maybe it isn't the right machine for you.

It's also important to ask about training (if needed), warranty coverage and customer support before you buy,

as well as financing options.



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