21st Century Rotors

Do you use an on-car lathe? Do you turn new rotors? After pulling the calipers, is the first thing you do to remove the rotors and chuck them on a lathe? If you answered, "No, yes, yes," you're not alone, but you're living in the past!

Using outdated service procedures is an easy trap to fall into, because most at-the-wheel brake components appear as they "always" have. But, despite their misleading appearance, foundation brake components have evolved steadily since the early 1970s, when disc brakes first caught on. As a result, rotor-servicing procedures have evolved, too. While many of the changes were specifically aimed at enhancing performance, several were driven by other priorities. Trying to achieve conflicting goals gave engineers fits, since meeting one goal often made it harder to accomplish another. And, if you don't use up-to-date methods to service rotors and drums you should prepare for some major aggravation (unhappy customers) yourself.

Machining in Place

Based on your phone calls to the Bendix Answerman, Bendix has found that on-vehicle (OV) lathes are still relatively rare. That's too bad, though. Understandably, no decent lathe is inexpensive, so bench lathes remain popular because they work with both drums and rotors. But today, any serious brake shop needs to invest in a good on-car lathe. You can't afford not to, in terms of avoiding time-consuming (and customer-alienating) comebacks.

An OV lathe can often save you time up front: Rotors that pass specification checks and need resurfacing but are tough to take off don't have to be removed. But the fact is that many automakers – not just the Japanese imports whose manufacturers have long promoted on-car machining – have jumped on the OV bandwagon.

The reason for the jump is **customer satisfaction**. Although a driver may not notice a small amount of lateral rotor run-out in the brake pedal, even minor run-out causes brake pads at rest to intermittently hit the passing "high spots" on each side of a rotor that's less than true. Over anywhere from 3,000 to 7,000 miles, those hits thin out the points of contact. Then, during stops, the pads and caliper pistons move closer together as the thin spots pass between them; as the thick spots go through, they knock the pistons back into the bores and the driver feels it as pulsation in the brake pedal.

Anything that prevents rotor trueness can be expected to cause disc thickness variation (DTV) over time: Incorrect or uneven lug nut torque is one common cause. So is run out that can result when a rotor that's been correctly bench-resurfaced is installed on a hub that's a smidgen off, or that has something caught between the rotor and the hub. OV resurfacing can compensate for a certain amount of hub run out. And since rotor removal isn't needed if the rotor's not being replaced, on-car resurfacing can also prevent getting anything caught between the rotor and hub.

By the way, OV resurfacing still has to meet the same standard as bench turning: smoothness remains necessary. If your OV lathe isn't set up for delivering a non-directional final finish, we suggest using an orbital or dual-action sander with 180/220-grit paper for one minute on each rotor surface. The backside is accessible through the caliper mounting area.

Domestic Converts

As we hinted, imported brands aren't alone in recommending on-car lathes. General Motors and Chrysler have both expressed a preference for the OV turning method. According to GM's "Brake Rotor Warranty Service Procedure" issued in 2000, (and applicable to all passenger car and light truck models back to 1995) if indexing a new rotor (trying it in each possible mounting position on the lug nuts) doesn't produce 0.080 mm (0.003 in) lateral run out or less, the rotor "may be machined using an approved on-car lathe." DaimlerChrysler is so insistent that OV turning be employed on Grand Cherokees with pedal pulsation complaints, that it calls for installing a new rotor in cases where an on-car lathe isn't available and run out exceeds 0.025 mm (0.001 in.)

To Turn, or Not to Turn?

Many technicians still turn rotors that should be left alone. Consider these facts: A typical modern rotor is noticeably lighter than its 1973 counterpart. It's thinner, so there's less metal available for removal by machining. Also, because it has less mass it's less able to tolerate and shed unwanted heat, even though it's often used on a higher-powered vehicle than before – one that's likely to be driven at higher average highway speeds. But, it does look much like yesterday's rotors, so it's easy to keep servicing it the same way.

Not only could yesterday's thicker rotors tolerate more machining, older brake pads would often tolerate freshly-turned rotors that we'd consider rough nowadays. But modern pads – which also closely resemble their older counterparts – are fussy about what rotor surfaces they'll work with. This is because of changes that were necessary to make them accomplish three things:

- Work with lighter-weight (hotter-operating) rotors
- Work without substances (like asbestos) that were removed to get them away from the environment and the workplace
- Deliver excellent stopping performance

Quality, modern brake pads can deliver stellar stopping ability, but the rotors have to be "just so." Simply put, using a set of 21st Century brake pads with rotors that aren't smooth, true and thick enough is a prescription for trouble: Expect noise, rapid wear, erratic performance, pulsating pedals and crabby customers if the rotors aren't right.

No-Turn Rotors

Today's rotor surface-finish requirements are strict, but not every rotor needs to be turned. New rotors, for instance, should be ready for use as they come out of the box. After all, you don't hone new master cylinders, calipers or wheel cylinders before installation and you shouldn't need to machine new rotors or drums, either. If they need resurfacing, they were either damaged in handling, stored improperly, or they came from a questionable supplier. Machining new rotors also shortchanges the customer, because removing metal from a modern, lightweight rotor can noticeably shorten its service life.

Here's the lowdown on storage: Rotors (and drums) should never be kept on end, and when stored flat should never be stacked. Any other storage method is likely to warp them.

Old Smoothies

Many used rotors don't need to be turned, either. In fact, really good, un-machined used rotors are desirable. This is because during stops some friction material transfers from the pads to the rotor working surfaces. This form of conditioning is a part of the normal break-in process, and it improves a rotor's friction coefficient. Good, used rotors are already conditioned this way. This can be especially significant with certain vehicles that tend to stop less than spectacularly when new brakes aren't yet broken in. They'll actually stop better during the break-in period with matched pairs of good, used rotors installed than with new or resurfaced ones.

Make no mistake, ***all*** new brake pads need breaking in because the procedure allows the heat of the first several moderate stops to gradually set the pads' resins as their surfaces properly mate up with the rotors. Panic stops should be avoided during break-in, though, as the high heat they generate makes pad resins come to the surface and glaze the pads.

There are three standards a used rotor must meet before it can be put back into service as-is: Call them "**SST**." ***S***urface condition, ***S***pecifications and ***T***rueness.

Assaying surface condition starts with an eyeball check: Are they smooth or not? If you see roughness, machining is in order – assuming rotor thickness meets specifications. Some manufacturers even allow scoring up to .060" (1.5mm) wide or deep. (GM suggests a simple test: If the edge of a dime won't fit into a surface groove it's not wide enough to be a problem. What if the dime fits in? If you can see all of FDR's hair, the scratch isn't deep enough to worry about.)

If you test-drove the car before starting work you may have an idea if the rotors could be suitable for reuse. If the pedal felt good, chances are that **disc thickness variation** (**DTV**) may meet what's allowed on the specification table (generally around 0.002" or 0.050mm). Leave the rotor installed and take thickness readings in at least 8-10 spots around its circumference to verify. Of course, if any are at, or below, the "discard" specification, toss out the rotor.

You'll also often find that run out meets specifications on a rotor that has delivered good service and doesn't cause the brake pedal to throb; verify with a dial indicator. Remember, though, that you can knock a hubless rotor out of true before or after screwing it down to run your checks; if you disturb it at all make sure nothing gets between the hub and rotor mating surfaces, and that they're clean. If everything checks out, leave the rotor alone.

You're expecting a big "**IF**?" There is one: You need as-is rotors on both sides, or neither. If you pair a good used rotor with a new or re-machined one on the same axle, the higher friction coefficient of the single as-is rotor will cause a pull in its direction.

Out! Out Damned Spot!

Good drums and rotors can handle intermittent temperatures as high as 1100° F, which can be reached in a panic stop. But certain extreme conditions, like heavily-loaded mountain driving, or a driver who "rides" the brake pedal, could cause extended high temperatures that may spot drum or rotor surfaces.

Simple discoloration (often blue) is no cause for concern; some manufacturers recommend not resurfacing discolored rotors and drums that are otherwise normal. But hard spots – which often appear to be raised up from the surrounding area, tend to be a dull gray and may not have clearly-defined edges – also shouldn't be resurfaced out. The reason is simple: They're going to come back, once again causing pedal pulsation. Hard-spotted rotors or drums need to be junked.

Speaking of Drums…

Drum brakes have seen fewer changes than disc brakes, but modern brake shoes should also be used with relatively smooth surfaces. Here's a trick that can help smooth the inside of a drum that's just been turned: Take a rubber-sanding block with a curved backside. Put 180/220-grit sandpaper on the ***back*** of the block and use it on the drum's inside surface.