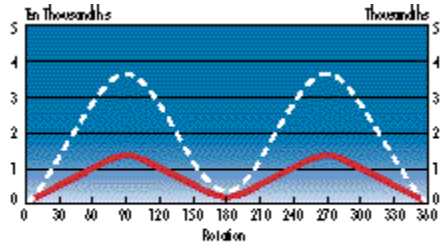
# Everything you wanted to know about On-the-Car Brake Lathes!

No brake job is complete and professional unless the brake rotor has a true flat surface and a surface finish within manufacturer's specifications. A true flat surface and a good surface finish cannot be achieved without turning the rotor on a quality brake lathe. Mounting new brake pads on an unmachined rotor is like installing new piston rings in a cylinder without first boring and honing the block.

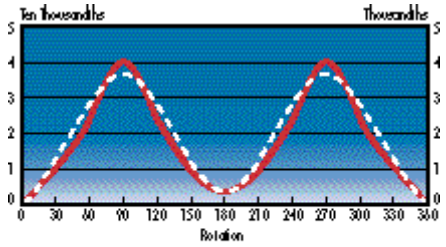
Most technicians are very familiar with the operation of a quality bench-mounted lathe. They have been used extensively by most shops in North America for more than 40 years. Take the rotor off the car, mount it tightly on the arbor shaft of the bench lathe, set feed and speed, and in most cases a satisfactory result will be achieved.

In the 1970's, several manufacturers began building cars with "trapped" rotors that were not easily removed from the car. Hence, the use of a bench lathe on these cars was and is impractical. Removal of the rotor with a slide hammer results in the car needing a wheel alignment and possibly a wheel bearing replacement, in addition to the brake job! The first "On-the-Car" brake lathes were designed to eliminate the need to remove the rotor, by turning "On-the-Car." The use of trapped rotors however was limited to a relatively small percentage of the total cars in North America, and the use of "On-the-Car" lathes was not widespread.

The most important change in vehicle design related to brakes, developed throughout the 1980's. Because of the need to increase fuel efficiency, vehicle

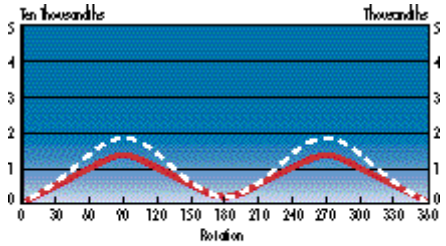



R/O and DTV after brake job
Typical Average—Bench Lathe Without Compensation Process

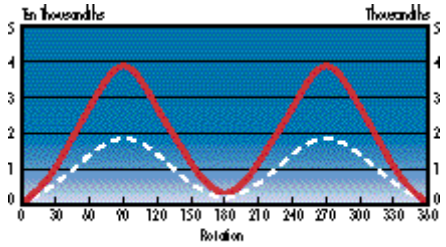



R/O and DTV 3000 miles later

DTV — — — R/O




R/O and DTV after brake job
Bench and/or Hub-Mount Lathe With Typical Compensation Process



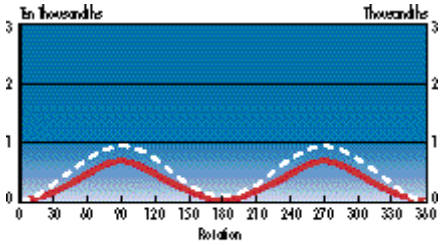

R/O and DTV 6000-9000 miles later

manufacturers began making cars lighter, with more attention to the precision wheel alignment in order to reduce drag. The design change that accomplished both objectives was the use of "pre-loaded" front wheel bearings. Such bearings are significantly lighter because they do not have to absorb the "shock loading" caused by the bearing end play in older type adjustable bearings. They also allowed the front wheels to be aligned with less toe-in, keeping the wheels straighter and hence reducing drag.

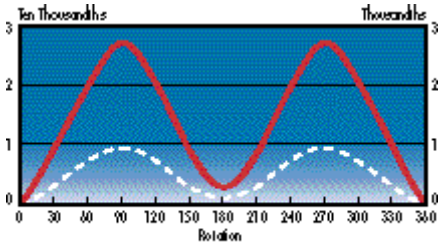
The use of "pre-loaded" bearings with no end play has become the standard today. Other than large pickup trucks, and some 4WD vehicles, most cars manufactured since the mid-1980's have used pre-loaded front wheel bearings. Today, even many rear wheel drive vehicles are being produced with pre-loaded front wheel bearings.

Pre-loaded wheel bearings have no end play to "absorb" hub and rotor run-out. Hence, almost 100% of any axial run-out of the hub and brake rotor are transmitted to the brake pads. This axial run-out or wobble in the rotor causes the brake pads to wear the rotor unevenly over time, producing two sections of the rotor, 180 degrees apart, where the rotor thickness becomes thinner than the other two sections. This difference in thickness is called Disk Thickness Variation or DTV.

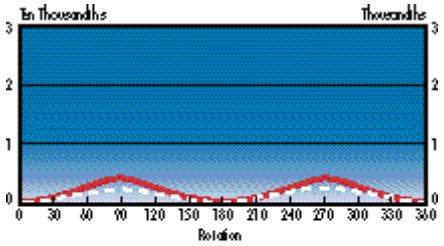
Most technicians are familiar with the problems caused by "out of round" brake drums. The brakes shudder and the brake pedal pulsates. The industry term for this problem is brake drum "ovalarity" and is commonly checked on a brake dynamometer. DTV is the same problem associated with brake rotors. DTV causes shudder and brake pedal pulsation. To




R/O and DTV after brake job
Bench and/or Hub-Mount Lathe With
5-10 minute/wheel Compensation Process




R/O and DTV 6000-9000 miles later




R/O and DTV after brake job
RTI BRC3E Caliper-Mounted "On-the-Car" Lathe
No Compensation Process Needed!
Essentially no change in DTV over time!

DTV — — — — R/O

eliminate "ovalarity" the brake drum is turned on a lathe. In order to avoid DTV on cars with pre-loaded bearings, the rotor must be turned on a lathe to produce two parallel surfaces, but it must also be turned so that the total run-out of the hub and rotor assembly, with the wheel installed, is no more than 0.0012-0.002" (30-50 microns).

The maximum run-out depends on the particular car. But, in general, any run-out greater than 0.002" (50 microns) will lead to an increase in DTV of about 0.0004" (10 microns) in about 3000-5000 miles. In most cars, when DTV reaches 0.0004" (10 microns) or only 4 ten-thousandths of an inch, the driver will complain of pedal pulsation, steering wheel shimmy, or brake shudder. The most important fact to consider here is that the installation of the wheel will almost always increase hub/rotor run-out by 0.001-0.0015" (25-40 microns), even if the lug nuts are carefully torqued. For this reason many experts recommend that the front rotors be turned "On-the-Car" with a lathe that will produce "near zero" run-out on any car with pre-loaded bearings.

**First question**. Can you produce "near zero run-out" with a quality bench lathe? The answer is "yes" but only if you are careful and follow a somewhat time consuming "precision compensation" process. This "compensation" process requires that the technician measure and record the hub/rotor run out on the car with a very precise dial indicator, marking the high spot and rotor mounting position before removing the rotor. Then, this run-out is artificially introduced on the bench lathe before the rotor is turned. The bench lathe will then turn the rotor with near zero run-out as measured on the lathe, and when the rotor is reinstalled in the correct position, the

hub/rotor run-out is also "near zero."

**Second question**. Is "near zero run-out" needed for rear brakes? Passenger cars typically use a 70-30% or 80-20% brake balance meaning that the rear brakes are only 25-40% as powerful as the front brakes. For this reason, DTV is not amplified as much and pedal pulsation is less likely. Therefore, most rear brake rotors can be turned on a quality bench lathe. Hub/rotor should still be checked before the brake job, but typically as much as 0.005" (125 microns) of run-out, with the wheel installed, or 0.002-0.003" (50-75 microns) with the wheel off is acceptable.

**Third question**. What is a "hub-mounted" type "On-the-Car" lathe? Essentially a "hub-mounted" lathe works exactly like a bench lathe. The only difference is that the "hub-mounted" lathe is portable and is bolted to the hub while still on the car, saving the time of removing the rotor. But, with a hub-mounted lathe, you must still go through the same "compensation" process described as necessary with the bench lathe. There is nothing that a hub-mounted lathe can do that a quality bench lathe cannot also do if the rotor is removable. For front brakes, without a very careful and somewhat time consuming" compensation" process to set up the hub-mounted lathe with zero run-out before turning, the result is no better than with a bench lathe.

Typically, most technicians do not take the time to produce "near zero" run-out during the "compensation" process using a hub-mounted lathe. In essence, most jobs with a hub-mounted lathe produce run-out in the range of 0.001-0.002" (25-50 microns) with the wheel off, and 0.002-0.004" (50-100 microns) after the wheel is installed. This is acceptable for most rear brakes, and some front brakes. But, for most cars with pre-

loaded front bearings, pedal pulsation will occur on many cars in 6000-9000 miles after the brake job.

**Fourth question**. What is a "caliper-mounted" type "On-the-Car" lathe? A caliper-mounted lathe essen-tially eliminates the need for the "compensation" process because the lathe is mounted to the caliper mounting locations, rather than directly to the hub and/or rotor. Because the lathe is "independent" of the hub and rotor's initial run-out, "near zero" run-out is achieved automatically. Another benefit is that the brake rotor is machined in exactly the same plane as the plane in which the pads operate. Bench lathes and "hub-mounted" lathes do not consider the caliper/pad geometry. Caliper-mounted "On-the-Car" lathes can produce results that are not possible using a bench or hub-mounted brake lathe. Without any special technician skill, with the RTI BRC35, run-out as low as 0.0002" (5 microns) is achieved automatically--pedal pulsation is eliminated for the life of the brake pads.

**Fifth question**. Do new rotors need to be turned? On front wheels with pre-loaded bearings, even new rotors should be turned most of the time. This is because, even with high quality rotors with "near zero" run-out "out of the box," the hub has run-out that must be eliminated. Cheap rotors are seldom "near-zero" run-out "out of the box." To determine if an "On-the-Car" lathe is needed for new rotors, the run-out should be first checked with a high quality dial indicator. If run-out of the hub and rotor assembly on the car is more than 0.0005" (13 microns) before the wheel is installed, the rotor should be turned--on cars with pre-loaded bearings.

**Sixth question**. Is an "On-the-Car" lathe useful for anything other than for cars with

pre-loaded bearings? If the wheel bearing is adjustable, and "pre-load" can be added temporarily before and during the machining process, a hub-mounted or caliper-mounted lathe can perform good results, saving the time necessary to remove the hub and repack the bearings. This is especially useful for 4WD cars and trucks.

**Last question**. Caliper mounted or hub-mounted, which is the best? If you can only have one, and since a bench lathe can do anything that a hub-mounted lathe can do, the shop's first purchase should be a high performance caliper-mounted "On-the-Car" brake lathe. Of course, the RTI BRC35 is the best in the world in terms of quality and performance. Nothing else comes close!

After the shop already owns an RTI BRC35, a good quality hub-mounted lathe can be used on certain cars to save time, when the precision of the BRC35's caliper mounting system is not needed. Caliper-mounted lathes do require a pre-loaded bearing; either the bearing is pre-loaded with no end play as designed, or the bearing must be adjustable to provide pre-load during the machining process. Hub-mounted lathes do not require a pre-loaded bearing, and therefore can be used where the high precision of a caliper mount system is not needed. For example, a hub-mounted lathe can save time on some 4WD vehicles where introducing pre-load may be time consuming and "near zero" run-out is not needed.

In late 1997, RTI plans to introduce an optional hub-mounted lathe power drive accessory that can be used with the present BRC35's precision lathe head as a complete time-saving system for high volume shops. The present BRC35 is the foundation product for modern high quality brake service. Every shop needs an RTI BRC35

caliper mount "On-the-Car" Lathe Now!