

Warped Brake Rotors?? Not likely!

The typical situation: New pads are fitted to a new pair of brake discs. Sometime later there's a vibration or "judder" when the brakes are applied. The brake rotors are warped? No, in reality this is almost never the case.

The diagnosis may be verified by measuring the surface of the discs to see if they vary in thickness.

The fact is: The discs were never warped at all. Every warped brake disc that we've investigated with the assistance of our suppliers shows uneven patches of friction material from the brake pads on the surface of the disc. These patches cause variation in thickness (run-out) and the vibration under braking. Brake manufacturers have been struggling to deal with this situation for years because warped discs are so readily incorrectly blamed for brake-related vibrations.

The Short Version

Glue and binding agents used in the making of all modern brake pads often get deposited on the brake rotor surface during the first trip after installation if they a break-in procedure is not followed. Then for the next 1000-3000 miles the brake dust accumulates on the glue imprint of the brake pad making a thick spot on the rotor which feels like warped rotors. Proper breaking in of the pads known as "Bedding" is required on every brake job with today's brake pads.

Why now and not for the last 20 years you've been doing brakes? You ask. Thank the EPA and how they are constantly requiring certain materials that are bad for the tech or the environment to be removed from brake pad friction material blends. Copper was the most recent to be removed to save the fish.

You may have noticed in just the last few years the "imprint" of a brake pad on the surface of a brake disc. This is the glue and pad dust building up we are talking about and it usually turns into a pulsing pedal although not always severe enough to mention. Note- not all rotors that suffer from DTV "Disc Thickness Variation" will have this imprint visible. But you've seen it.

The long winded Version:

To understand what's taking place, let's look at what happens when we step on the brake pedal. The pads press against the surface of the disc, converting the energy of motion into the energy of heat through friction. What you may not know is that there are two kinds of friction at work: abrasive and adherent.

Feeling some shudder in the steering wheel when applying the brakes? Conventional wisdom says that the rotors are warped, but really you might have a problem with friction material transfer. Don't worry, though, as the fix is relatively simple.

Abrasive Friction: According to Carroll Smith, author of “The Warped Brake Disc and Other Myths of the Braking System,” abrasive friction involves breaking the crystalline bonds of both the pad material and the cast iron of the disc. Breaking these bonds generates the heat of friction. In abrasive friction, the bonds between the crystals of the pad material (and to a lesser extent, the disc material) are permanently broken.

The harder material wears the softer away, meaning the disc wears the pad. When we see the word friction, it is abrasive friction that comes to mind.

Adherent Friction: When brake pads press against the surface of the steel disc, some of the pad material transfers directly to the surface of the disc forming a thin, uniform layer. The surface of the steel disc and the surface of the brake pad become identical in composition. As the disc moves between the pads, friction material transfers in both directions, breaking and reforming bonds at the molecular level. This transfer of material in both directions is a normal and essential part of braking friction.

Pad Material: Brake pads all use a combination of abrasive and adherent friction during braking. Pad material differs based on the manufacturer’s specifications, which are always attempting to balance performance, wear, noise, and to a lesser extent, dust. There must be enough abrasive elements to keep the disc surface clean, and the pads must provide uniform adherent friction material transfer to the disc within the intended temperature range.

Uneven Friction Material Transfer: Pads that are used beyond their intended temperature range will cause problems. Pads can be heated to the point where they transfer friction material to the disc in random, uneven patches. The thick and thin layers are not generally visible, but the driver can feel vibration and measure it with a dial indicator. Modern brake pads are engineered with the best possible combination of features, but they are still limited to their intended range of operating temperatures.

Pad Selection: Generally, there are street, performance and racing brake pads, and most quality pads have broader temperature ranges than pads made 10 years ago. However, no street pads are suitable for racing, and no racing pads are suitable for the street. Performance street pads are a compromise—they’re more effective at low temperatures than racing pads and they can operate at higher temperatures than street pads.

Where to Start: If you have vibration under braking with new discs and pads, first eliminate the obvious by making sure that the hub and wheel flange are flat, clean, and rust free. A miniscule amount of run-out here will be magnified at the edge of the brake disc. Verify that disc mounting hardware is in good condition, installed correctly, and tightened in the correct order according to the recommended torque specification.

Bedding-In Your Brakes

When new pads and brake discs are fitted, the most important thing you can do to prevent problems is to properly bed the brakes. This critical step is the initial transfer of friction material from the pad to the disc forming a smooth, uniform layer. It establishes a foundation that’s

essential for proper brake performance. It minimizes the chance of laying down uneven, random patches of friction material which will be felt as vibration when the brakes are applied.

All high-performance discs and pads should come with installation and break-in instructions. The procedures are similar for all major manufacturers.

Since you don't come to a complete stop during pad or disc break-in, you have to plan where and when you do this procedure for safety purposes. If you come to a complete stop before the break-in process is completed, there is a chance that nonuniform pad material transfer or pad imprinting will take place, resulting in an irritating vibration during braking.

Basic Bed-In Procedure! If pad manufacturers instructions are not available or clear.)

- 1. After installing new disc rotors and/or brake pads, perform eight to 10 slowdowns applying moderate pressure from about 30 to 40 mph (50 to 60 kph) without coming to a stop. Keep it rolling up to traffic slowly rather than stopping which causes glue transfer.*
- 2. Make an additional two or three slowdowns applying heavy pressure from about 40 to 45 mph (60 to 70 kph) without coming to a stop. Don't let the glue attach to a stopped rotor.*
- 3. DO NOT DRAG THE BRAKES.*
- 4. Allow at least 15 minutes for the brake system to cool down.*
- 5. While the car is at rest during cool-down, DO NOT APPLY THE BRAKES. If you do, material will transfer from the pads to the rotor and probably give you braking vibration.*

After Brakes Are Bedded-In:

At this point, your new disc rotors and/or pads are ready for normal use with a thin, uniform coating of Friction material on the rotors. But the full process of building up the friction layer can take 190 to 300 miles (300 to 500 kms) depending on your driving style. There are two situations you should try to avoid during that time, as they can ruin that fragile friction coating, requiring another round of bedding-in.

Properly bedding in a new set of brake pads involves several hard brake applications followed by a cool-off period.

First, if you drive gently over a period of time with little heavy braking, you can actually strip off the necessary thin layer of friction material on the surface of the disc. This makes your brakes vulnerable to problems again. You can restore it by repeating the bedding-in procedure.

Second, if you have an incident where you are driving at high speed and have to brake hard coming to a complete stop with your foot on the brake pedal, the pads will imprint on the disc surface, transferring what seems like a hunk of friction material. This uneven material will cause vibration.

You can generally get rid of the excess material with abrasive friction by repeating the bedding-in process. If it's a bad imprint and you can't get rid of it this way, it will need turning on a lathe. This process returns the discs to dead flat and then you can re-bed.