Understanding and stopping brake judder

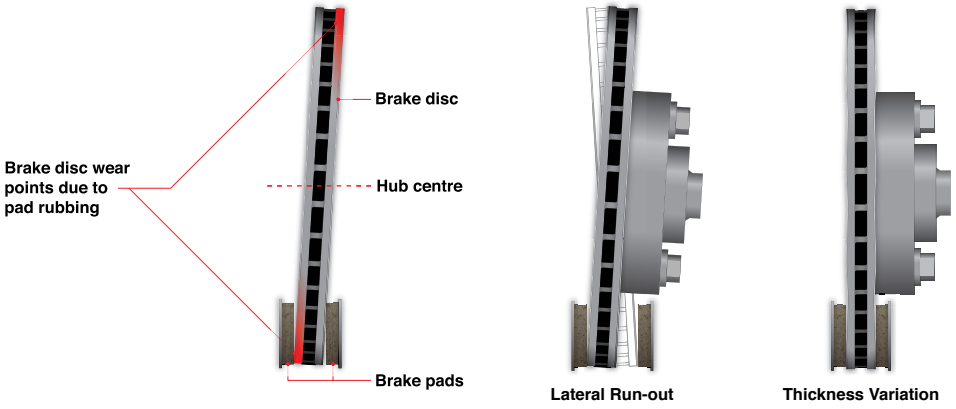
Brake judder manifests itself in vibrations that can be felt through the steering wheel, the pedals and potentially through the seat. Depending on the severity, a vehicle's chassis may even start to pulsate. Apec explains the source of judder, and how to reduce the possibility of it occurring.

Customers affected by brake judder often jump to one conclusion; that they are experiencing a side effect of warped or distorted brake discs. Although brake discs can warp, DTV (Disc Thickness Variation) is the most common cause of judder.

While DTV is not always the root cause of brake judder, its prevalence suggests it's a good place to begin an investigation. Depending on the age and time of the previous disc and pad replacement, brake judder could be a cause for concern for garages, who may ultimately have to foot the bill for warranty repairs.

The truth about the true causes of brake judder are complicated. In the majority of cases, warped discs have nothing to do with disc manufacture or quality, and everything to do with fitment or driver behaviour. In most cases, brake judder develops or worsens over time, this is vital to understand from a garage and technician's standpoint, as it highlights that when fitted the brake disc was within manufacturer tolerance, and thus aggressive braking, or a fitment issue, is the root cause of the problem. Any disc, regardless of quality or materials, can warp given the wrong conditions.

One of the major causes of DTV is lateral run-out caused by improper cleaning of the hub surface. Similar to the butterfly effect, even the most minute particles of rust caught between the disc face and hub, (measuring as small as 0.04mm), can lead to lateral run out (where the turning disc starts to deviate from its axis) in excess of 0.1mm when measured at the centre of the braking surface. The important point to note is that while this deviation may not immediately induce brake judder, it has provided the foundations for a vibration that will eventually lead to it, and potentially irreparable damage to the braking disc. This may take as many as 2000-5000 driven miles.



There are many causes of DTV, all of which will cause brake judder

Secondly, it is essential brake discs and pads are "bedded in" properly, and customers need to be aware of the potential damage caused by excessive heat build up. During the first 100 miles, the driver should drive and brake normally, avoiding excessive braking which elevates the temperature of the disc and pads. All Apec brake pads go through a 'High Pressure Treatment' process, burning off many of the resins and gases at the factory, giving a good initial braking performance (green performance).

Remove all of the contact and surface rust from the hub

During the bedding process, a layer of friction material is evenly distributed across the brake discs. Too little heat during bedding keeps the material from transferring to the rotor face, so avoid feathering the brake pedal. Overheating the brakes can generate uneven pad deposits due to the material breaking down and sticking to the disc, causing a Stick/Slip situation.

Once this has happened, heavy braking will lead to uneven heat build-up due to the uneven distribution of friction material across the disc, with high-spots heating excessively in comparison to the rest of the disc. If the temperature at these high-spots exceeds 650°C, the cast iron of the disc changes structurally, transforming into an immensely rigid substance called Cementite. As the disc

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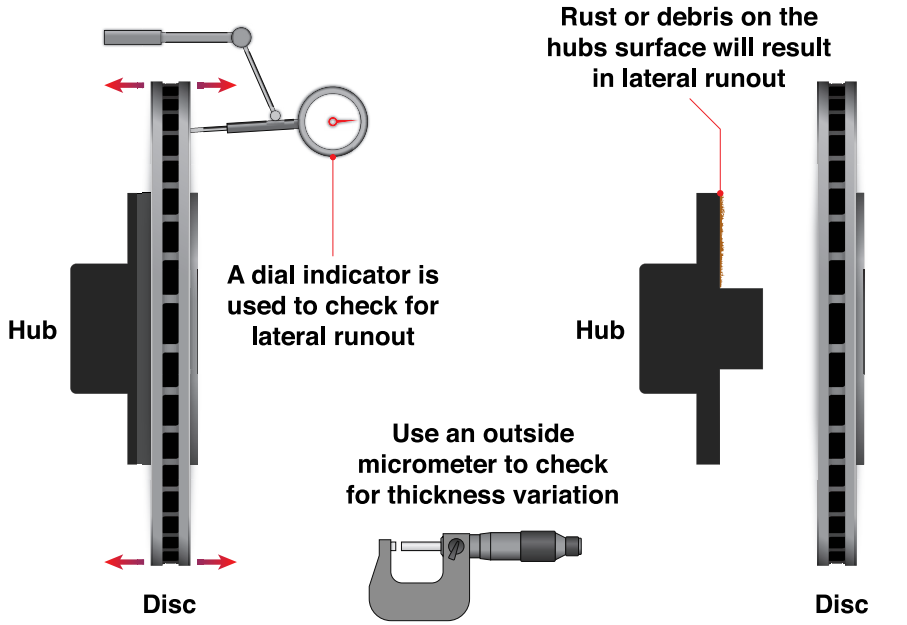
is then composed of varying materials of different strengths, judder will progressively worsen, which explains why customers often return with their vehicles months after installation. This can be caused by the driver using the brake pedal to slow the car rather than engine braking on steep inclines, excessive aggressive braking, or repeated emergency stops without adequate cooling time.

Outside of DTV, brake judder can also be caused by uneven torque on wheel bolts and problems regarding floating, fixed and sliding calipers. Fixed calipers have pistons on both sides of the discs, due to the stationary caliper housing. Excessive run out will cause piston movement and can result in pedal pulsation and binding pads in the caliper. Sliding or floating calipers that have seized will prevent caliper housing from moving. Check the slider bolts for movement and corrosion, and replace if necessary, as any run out can cause pulsation. Always replace springs where a floating caliper is fitted.

Poor quality pads may also be a root cause of brake judder, as the friction material can overheat quickly, particularly if the brakes are used often and aggressively. It is also possible to warp a vehicle's hubs, which will always result in brake judder. Again, the root cause of a warped hub is excessive heat build-up caused by excessive friction. Excessively worn or poorly fitted wheel bearings may also cause run out at the hub.

On occasion, manufacturer error is the root cause of brake judder, but with modern machining and production lines, this is increasingly unlikely as discs are so uniform.



Disc and hub runout should be checked during every brake service to spot problems that will cause brake judder

Steps to prevent brake judder

Technicians must check disc thickness before refitting a disc. If the disc is outside manufacturer tolerances, it has to be replaced. Technicians are advised to pick eight equidistant points around the perimeter of the disc and to never base a determination of thickness on a single spot. Any variation in disc thickness will translate into brake judder.

Technicians must always check lateral run-out, even when fitting new discs. Using a dial indicator, use 0.05mm to 0.10mm as your maximum run out limit. To check run out of the discs independently of the hub, mount the disc on a lathe and perform a dial indicator reading. In an effort to remove variables from the equation, make a run out reading of the hub flange itself, without the disc in place. If the flange itself is causing the run out problem, you'll be able to isolate the cause.

Finally, it is imperative when refitting wheels, that bolts are checked and in serviceable condition. Check the condition of the bolts thread as well as the blots integrity. Never use fasteners that are suspect. Make sure all threaded locations are clean and free of dirt, grime or other contaminants as poor quality or unclean threads can result in incorrect torque readings. Never use an air gun to fully tighten a wheel nut or bolt, this could distort an alloy wheel. The final tightening should be done with a torque wrench in the correct sequence.

A torque wrench should be used for the final tightening of a wheel nut or bolt

Good Practice should always prevail. Always service the caliper ensuring that the pad abutment points are lubricated, sliders are serviceable and working correctly and replacement springs are fitted.

Although it can be time consuming, it is vital that the measures outlined above are taken and heeded by technicians. It is also essential that the importance of correctly bedding in new discs and pads is emphasised to the customer, because that conversation is nowhere near as expensive as replacing an unhappy customer's discs and pads.