

## **TECHNICAL WHITEPAPER:**

### ***Pad and Rotor Bed-In Theory, Definitions and Procedures***

#### *StopTech's Recommended Procedure for Bedding-in Performance Brake Systems*

When a system has both new rotors and pads, there are two different objectives for bedding-in a performance brake system: heating up the brake rotors and pads in a prescribed manner, so as to transfer pad material evenly onto the rotors; and maturing the pad material, so that resins which are used to bind and form it are 'cooked' out of the pad.

The first objective is achieved by performing a series of stops, so that the brake rotor and pad material are heated steadily to a temperature that promotes the transfer of pad material onto the brake rotor friction surface. There is one pitfall in this process, however, which must be avoided. The rotor and, therefore, the vehicle should not be brought to a complete stop, with the brakes still applied, as this risks the non-uniform transfer of pad material onto the friction surface.

The second objective of the bedding-in process is achieved by performing another set of stops, in order to mature the pad itself. This ensures that resins which are used to bind and form the pad material are 'cooked' out of the pad, at the point where the pad meets the rotor's friction surface.

The bed-in process is not complete until both sets of stops have been performed. There's one exception, however. Some pad manufacturers sell 'race-ready' pads, which have been pre-conditioned by flame heat-treating or laser etching, to provide a mature surface on the pad face. If race-ready pads are being used, then the second set of controlled stops is unnecessary. Also note that the same circumstances exist when a system to be bedded has new rotors and used pads (a strategy that professional teams use to break in their rotors ahead of time) one only has to perform a single set of stops to transfer pad material uniformly onto the new rotor. Note that, if the brakes of a vehicle with high-performance or racing pads are not used continuously in an aggressive manner, the transfer layer on the rotors can be abraded (literally worn off). However, the transfer layer can be re-established, if needed, by repeating one series of stops in the bed-in procedure. This process may be repeated as often as necessary during the life of the pad.

This characteristic is useful when a system is already bedded-in with one pad friction and another is to be used going forward, like when changing between pad types for the street and

track (and then after a track event, back again). The procedure under this case is different, where the new friction is installed and the vehicle is first driven for 5 to 20 miles (8 to 33 Km) with light use, keeping the pad friction and rotor cold. This promotes the abrasive friction mechanism cleaning the rotor surface of the previous pad material before performing either one or two bed-in cycles as prescribed below. One set of stops as outlined, if the pads being installed are used, two if the pads are actually new

The bed-in procedures below outline the steps required to effectively bed-in performance brake systems. We strongly recommend that, in order to complete the bed-in safely, the bed-in procedures be conducted in dry conditions on a race track or other controlled environment, so as not to endanger yourself or others. Please note that we neither recommend nor condone driving at high speeds on public roads. While it is important to get enough heat into the system to effectively bed-in the brakes, it is even more important to exercise common sense at all times, and to conduct the bed-in procedure responsibly.

## **Bedding-in Street-Performance Pads**

For a typical performance brake system using street-performance pads, a series of ten partial braking events, from 60mph down to 10mph, will typically raise the temperature of the brake components sufficiently to be considered one bed-in set. Each of the ten partial braking events should achieve moderate-to-high deceleration (about 80 to 90% of the deceleration required to lock up the brakes and/or to engage the ABS), and they should be made one after the other, without allowing the brakes to cool in between.

Depending on the make-up of the pad material, the brake friction will seem to gain slightly in performance, and will then lose or fade somewhat by around the fifth stop (also about the time that a friction smell will be detectable in the passenger compartment). This does not indicate that the brakes are bedded-in. This phenomenon is known as a green fade, as it is characteristic of immature or 'green' pads, in which the resins still need to be driven out of the pad material, at the point where the pads meet the rotors. In this circumstance, the upper temperature limit of the friction material will not yet have been reached.

As when bedding-in any set of brakes, care should be taken regarding the longer stopping distance necessary with incompletely bedded pads. This first set of stops in the bed-in process is only complete when all ten stops have been performed - not before. The system should then be allowed to cool, by driving the vehicle at the highest safe speed for the circumstances, without bringing it to a complete stop with the brakes still applied. After cooling the vehicle, a second set of ten partial braking events should be performed, followed by another cooling exercise. In some situations, a third set is beneficial, but two are normally sufficient.

## Bedding-in Club Race or Full Race Pads

For a typical performance brake system using race pads, the bed-in procedure must be somewhat more aggressive, as higher temperatures need to be reached, in order to bring certain brands of pad material up to their full race potential.

We typically recommend a set of ten partial braking events, from 60mph down to 10mph, followed immediately by three or four partial braking events, from 80mph down to 10mph. Alternately, a set of eleven stops, from 80mph to 40mph, or a set of seven stops, from 100mph to 50mph, would be approximately the same. As with street pads, each of the partial braking events should achieve moderate-to-high deceleration (about 80% of the deceleration required to lock up the brakes and/or to engage the ABS), and they should be made one after the other, without allowing the brakes to cool in between.

Again, depending on the make-up of the pad material, the brake friction will seem to gain slightly in performance, and will then lose or fade somewhat about halfway through the first set of stops. This does not indicate that the brakes are bedded-in, except where race-ready pads are being used. This phenomenon is the same as that which occurs with high-performance or street pads (except that, when race-ready pads are used, they do not exhibit green fade, and they will be bedded-in after just one complete set of stops).

As when bedding-in any set of brakes, care should be taken regarding the longer stopping distance necessary with incompletely bedded pads. This first set of stops in the bed-in process is only complete when the recommended number of stops has been performed - not before. As a general rule, it would be better to perform additional stops, than not enough. The system should then be allowed to cool, by driving the vehicle at the highest safe speed for the circumstances, without bringing it to a complete stop with the brakes still applied.

After cooling the vehicle, a second set of the recommended number of stops should be performed, followed by another cooling exercise. In some situations, a third set is beneficial, but two are normally sufficient.

Racers will note that, when a pad is bedded-in properly, there will be approximately 2mm (0.1 inch) of the pad edge near the rotor, on which the paint will have turned to ash, or the color of the pad will have changed to look as though it has been overheated.

In summary, the key to successfully bedding-in performance brakes is to bring the pads up to their operating temperature range, in a controlled manner, and to keep them there long enough to start the pad material transfer process. Different brake system designs, pad types, and driving conditions require different procedures to achieve a successful bed-in. The

procedures recommended above should provide a useful starting point for developing bed-in procedures appropriate to individual applications.

**by Matt Weiss and James Walker, Jr. of scR motorsports, exclusively for StopTech**

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Stoptech is the performance engineering and manufacturing division of Centric Parts. It is the leader in Balanced Brake Upgrades for production cars and has three patents in basic brake technology and one other pending. With a worldwide network of resellers, StopTech's product line includes Balanced Brake Upgrades for approximately 450 applications featuring StopTech's own six-, four- and two-piston calipers, two-piece AeroRotor Direct Replacement Kits, braided stainless steel brake lines and slotted and drilled original-dimension rotors. StopTech also stocks a wide range of performance brake pads. The company's website, [www.stoptech.com](http://www.stoptech.com), is a clearinghouse of performance brake information, and provides details on StopTech products.

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