

## **TECHNICAL WHITEPAPER:**

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

#### *Bed-In FAQ's*

#### **FAQ #1: How can I tell if my brakes are bedded-in?**

This is a question without a single definitive answer; however, there are visual indicators on the rotor itself which can help determine the state of the bed-in.

1. Rotor discoloration. Typically, there will be a bluish tint to a used rotor which is from heat. A more important color is a grayish tint or film on the face of the rotor where the pads touch. This color is actually from the pad material building up and is the best indication of how much pad material is adhered to the rotor. In general, if the rotor face is still shiny there is not enough pad material built up. Note that different pads will generate different appearances, so take notice of how the rotor appears before starting the bed-in process so you can recognize any difference after.
2. Machining marks. On a new rotor, you can often use machining marks on the rotor face to assess the state of the bed-in. Typically, there will be either very slight grooves from turning the rotor (like a vinyl record – ask your parents) or more random marks from grinding the rotor surface during manufacturing. Prior to starting the bed-in process take a mental picture of the machining marks. If they are still very prominent following bed-in, you may not be bedding-in aggressively enough. In general it's alright if there are still slight traces of the machining marks after a few bed-in cycles, but you should definitely see them starting to go away.

#### **FAQ #2: What happens if I can't do the bed-in right away?**

Often times, weather or other conditions can prevent one from fully bedding-in the brakes before having to drive the car. Fortunately, this is not a dire situation. If you are running new street/performance pads and rotors, remember that they are designed for the street and will slowly bed-in by themselves over time. Typically just a few stops from moderate speeds will start the bed-in process for normal driving.

In general, as long as the brakes are not overheated, you can drive them at normal street limits indefinitely without worrying about a formal bed-in. It's only when you get them good and hot

that a fully bedded-in system becomes so important. This is why we recommend a slightly more aggressive bed-in procedure than most...we know performance brake customers are not “normal” and typically can't wait to try their new brakes at speed.

### **FAQ #3: What do you mean I “un-bedded” the brakes?**

If any brake pad is used below its adherent operating temperature, it will create friction through primarily abrasive mechanisms, slowly but surely removing the transfer layer on the rotor. For this reason, most street/performance pads like to be driven just a little bit aggressively every now and again to maintain a proper transfer layer of pad material on the rotor face.

If the brakes are used passively for an extended period of time, the transfer layer can be completely removed, effectively un-bedding the brakes. The brake system will still perform well under normal driving conditions, but before heading to the autocross or your favorite canyon back road you will want to perform a bed-in procedure. Failing to do so will only increase the risk of TV generation.

### **FAQ #4: What precautions must be taken when switching from street pads to track pads?**

If you are changing pad compounds, such switching from street pads to track pads, you need to remove all of the material on the rotor and replace it with a fresh transfer layer of material from the new pads. To be honest, rotors do not like to have different compounds used on them, and virtually all rotor and pad manufacturers recommend that you do not swap pad compounds on the same rotors. The reality is, however, that most customers don't have two complete sets of rotors, so here are our recommendation for managing compounds between track and street use. Note that diligent bedding-in is the key.

When switching from street pads to track pads, one needs to make sure that as much of the street compound is removed from the rotor as possible before aggressive track use. The risk here is that any street pad material remaining on the rotor will be subject to deterioration from overheating. This can ultimately cause severe vibrations due to uneven pad deposits (a smearing of the street pad material on the rotor face).

A common method for removing street pad material is to install the track pad prior to driving to the event. Because most track pads operate in an abrasive mode during regular street operation, driving them to the track will wear off any existing brake pad material en route. You

will know when the street pad material is gone by the squealing noises coming from your brakes after a short while...

## **FAQ #5: What precautions must be taken when switching from track pads to street pads?**

Many people make the mistake of thinking that because they have a used set of pads in the past that the system does not need re-bedding when they are re-installed. Remember, the same material must be adhered to the rotor as the pad running against it for effective braking. Race pad material must be removed prior to street use.

Since you're not as likely to overheat the rotors on the street after a track event, over time the street pads will remove and replace the track pad material on the rotors naturally. However, the best solution where street pads are being put back into service after a track day is to follow the original bed-in procedure for the street pads after the swap.

## **FAQ #6: Do I need to bed-in new pads if I do not change pad compounds?**

Although you do not typically need to establish a fresh transfer layer for a new set of pads if they are of the same compound as the previous set of pads, there is still a need to mechanically seat the pad face to the rotor face. Because the pad and rotor wear together as a matched set, by the end of a pad's useful life the rotor face is usually not completely flat. Consequently, when installing new pads on a used rotor, there is a small window of time in which the new pads will rapidly wear down against the peaks and valleys of the existing rotor face. This process of re-establishing the wear interface is often referred to as burnishing.

At the same time, new pads may need to be heated and cooled a few times before hard use in order to burn off all of the residual manufacturing resins and excess binding agents present in the pad compound. This process ensures that the exaggerated fade present in new pads (the "green" fade) is not experienced at speed when they are needed most. Unfortunately, this process of heating and cooling the pads is commonly referred to as bedding-in even though it has nothing to do with establishing a transfer layer. Gassing-out is a more appropriate term for this process.

So, while establishing a transfer layer is not necessary with new pads of the same compound, performing a bed-in procedure will serve to establish the wear interface as well as to expose the pads to their green fade in a controlled environment. For this reason,

we recommend performing a formal bed-in any time rotors, pads, or both are changed, regardless of pad compound or rotor manufacturer.

## **FAQ #7: Is bedding-in on track different than bedding-in on the street?**

When bedding-in a system on the track, it is usually neither safe nor much appreciated if you start braking to a near stop multiple times per lap, so a different approach is necessary. A good rule of thumb is to start with 2 or 3 warm-up laps, slowly and evenly bringing the system up to temperature. Follow immediately with 2 or 3 laps at speed. Note that more laps may be appropriate for a light braking track, and fewer for a heavy braking track. Ambient temperature should also be a consideration, as a cooler day requires a few more stops at speed.

After several laps at race pace using normal braking sequences, back off and let the system cool for 2 or 3 laps while staying off the brakes. Out of courtesy, maintain a reasonable speed and signal other drivers you are not running at full song.

Following the cool down laps it is usually best to come into the pits and let the system fully cool. However, track time is typically limited so staying on course is compelling. If the brakes are firm and vibration-free, take it back to speed and you'll likely be OK.

## FAQ #8: What brake pads are in what categories?

StopTech offers a variety of pads not only for our ST-40 calipers, but for many other applications (OEM and otherwise) as well. The following compounds are currently available through StopTech and have been sorted into Street Performance, Club Race, and Full Race type pad categories:

### **Street Performance**

AXXIS Ultimate  
AXXIS Deluxe Plus  
AXXIS Metal Master  
Cobalt GT-Sport  
Hawk HPS  
Hawk HP+  
Pagid Sport Pad (Blue)  
Pagid RS 4-2-1 (Blue)  
StopTech Street  
Performance

### **Club Race**

Ferodo DS-2500  
Hawk Blue 9012  
Mintex M1144  
Pagid RS 4-4 (Orange)  
StopTech Club Race

### **Full Race**

Cobalt Spec-VR  
Ferodo DS-3000  
Hawk HT-10  
Hawk HT-14  
Pagid RS-14  
Pagid RS-15  
Performance Friction 97  
Performance Friction 01

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

James Walker, Jr. is currently the supervisor of vehicle performance development for brake control systems at Delphi Energy & Chassis. His prior professional experience includes brake control system development, design, release, and application engineering at Kelsey-Hayes, Saturn Corporation, General Motors, Bosch, and the Ford Motor Company. Mr. Walker created scR motorsports consulting in 1997, and subsequently competed in seven years of SCCA Club Racing in the Showroom Stock and Improved Touring categories.

Through scR motorsports, he has been actively serving as an industry advisor to Kettering University in the fields of brake system design and brake control systems. He also serves as a brake control system consultant for StopTech, a manufacturer of high-performance racing brake systems. In addition, Mr. Walker contributes regularly to several automotive publications focusing on brake system analysis, design, and modification for racing and other high-performance applications. He is a recipient of the SAE Forest R. McFarland Award for distinction in professional development/education. Mr. Walker has a B.S. in mechanical engineering from GMI Engineering & Management Institute.

To find out more about Mr. Walker and scR Motorsports, visit their website at [www.teamscR.com](http://www.teamscR.com)



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.

####