

BY DOUG NEILSON

# BRAKING SYSTEM UPGRADES



In Part 1, we examine improvements for brake fluid and pads.

**PORSCHE FACTORY BRAKES** are better quality than those from most other manufacturers, but this doesn't mean they are perfect. While it is extremely important to keep your braking system in top order, one can also find ways to make your Porsche's braking even better. Whether your Porsche is an "oldie" or the latest model, your braking quality always can be improved by upgrading the brake fluid and/or the brake pads.

The main limitation of your braking system is the ability to keep within operating temperature range when the going gets demanding, such as the conditions experienced on a canyon/mountain run, auto-cross, or the racetrack. Manufacturers want to ensure that factory braking systems work well in very low

to medium temperatures because that's where these systems tend to work for more than 95% of their life on a regular car. This means that you will have no issues at the end of your driveway or down your street on a very cold morning, and braking efficiency will be consistent from such low temperatures into the medium temperature ranges. However, in heavy-use conditions, you will push your braking system from medium temperatures up into much higher temperatures, and obviously this is when issues can begin.

## BRAKE FADE

Assuming that one has a perfectly operating braking system to begin with, braking issues caused by high temperatures are usually

classified as "brake fade." There are two types of brake fade: 1) brake fluid boiling, and 2) brake pad degassing. Either of these conditions will cause a great deal of anxiety at the track; you may need a "pit stop" the first time you experience one of these "fading" occurrences. If you have driven your car for a period of time and extended your brake temperatures above where they are designed to operate, and you find that your brake pedal pushes easily to the floor with no effective braking, then you have just boiled your brake fluid. I'll get into the properties and nuances of brake fluid in greater detail later, but what has happened is that the high temperature from the mechanical parts of your brake system—namely the calipers, pads,

and rotors—has transferred a great deal of heat into the brake fluid and caused it to partially change from the liquid state to the gaseous state. Any time a gas is introduced or created in your brake hydraulic system, one loses the effectiveness of creating mechanical force through the use of hydraulic principles. Gas, of course, is much more compressible than a liquid. From a driver's perspective, this causes your brake pedal to feel spongy, or in the worst-case condition, it will allow the brake pedal to push easily to the floor without building any pressure, which means no brakes. All you can do is pump the pedal and pray.

The other type of brake fade is "pad degassing," which can be equally surprising and dangerous. Overheating of the actual brake pads causes the brake pad material to degas, which in turn, in effect, lubricates the surface of the pads and the rotor, greatly reducing the friction coefficient. When the friction coefficient is reduced in this way, one will experience what has been coined as "wooden pedal," which refers to a brake pedal that has good pressure, but no matter how hard it is pushed, the effective braking is not increased, and not anywhere close to what it was originally. A similar effect happens on a bicycle with handbrakes when they become wet—no matter how hard you squeeze, braking does not progress in a linear fashion as usual. Brake-pad fade is just as scary, and perhaps more than boiling your brake fluid, because you will not be able to regain any braking efficiency until everything cools off (and it is not happening in the next 5 to 30 seconds).

#### INDICATORS OF IMPENDING BRAKE FADE:

- Softening of the pedal or longer pedal travel—even by the slightest amount—could mean that your brake fluid is about to boil
- A small decrease in effective braking force could mean that your brakes are near the useful end of their life, or that

**your brake pads are on the verge of degassing**

#### ■ Any type of brake warning light

If you notice any of these symptoms or warnings, it is time to back off and get off the road or track to allow the brakes to cool and investigate the problem. Do not ignore any of these red flags.

## BRAKE PADS

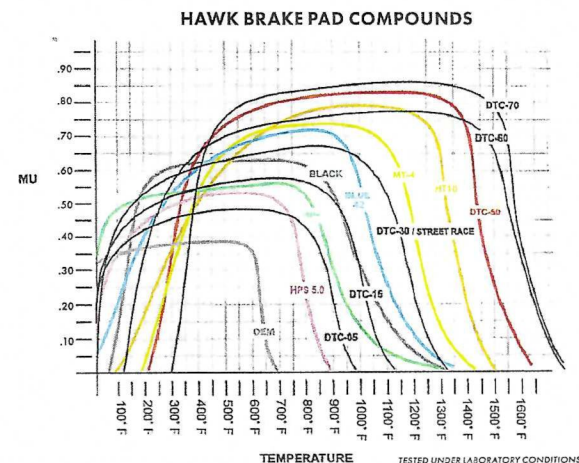
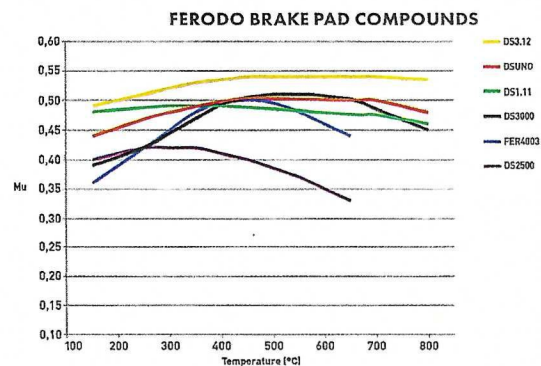
Manufacturers usually supply stock brake pads designed primarily for low noise and low dust, and not for high-heat situations, unless of course, the car is of a more sporting nature. Standard stock pads fall into the nonasbestos organic (or organic) category, and these organic materials simply can't deal with high levels of heat. The more sporting brake pad material is referred to as semimetallic, a category generally defined as composed of 10-25% metal fibers. The metal content helps the pads remain effective at higher temperatures and provides higher friction coefficients (bite); this, however, is at the expense of greater noise and larger amounts of dust and increased wear on the rotors.

One of the most common questions I am asked by Porsche enthusiasts is, "What brake pads are best for my Porsche?" The answer is, "It's not the same for everyone," so let me list the variables that will help you decide for yourself. I will limit this discussion to iron brakes only.

- What Porsche model do you drive?
- What brake setup are you running: OEM or aftermarket?
- What do you use the car for?
- Do you want OEM replacements?
- Do you want aftermarket replacements?
- Do you mind brake dust?
- Do you mind a little extra noise?
- Do you want more initial bite?
- Do you like a relatively smooth or slightly harsher feel?
- Are you driving at the racetrack?
- What level of track driving are you at (beginner, intermediate, advanced, racer)?

Indeed, there are a lot of questions, but each one needs to be answered to make a precise decision. Semimetallics are the most common type of performance brake pad on the market today, and there is a very wide selection to choose from. Within this category I suggest you target brake pad manufacturers who provide detailed information regarding these lines of brake pads, namely, friction coefficients ( $\mu$ ), and temperature ranges. This information is easily found online at manufacturer websites. (See examples from Ferodo and Hawk Performance, below.)

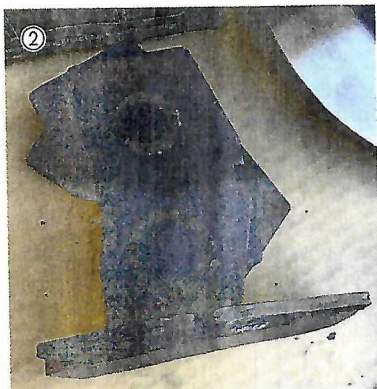
Looking at data is very helpful, but only if you know what you are looking for, so you will need to gain your own experience to decide what you like and dislike to take advantage of the available information. To do this, you are going to have to test various types of brake pads. Even if your budget is limited, try one set of pads one season, and another brand or model the next—this will give you at least some sort of com-





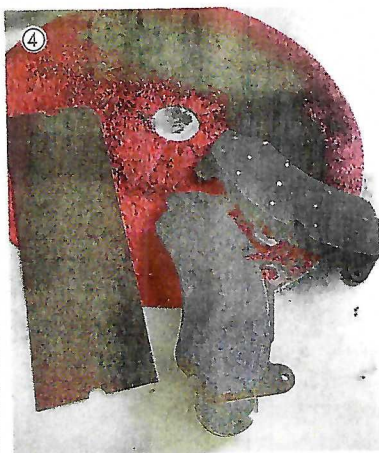
(1) Some well-used brake pads; time for new.

(2) Check for abnormal wear (pad rotation may be necessary to extend life); these show material "wedging."

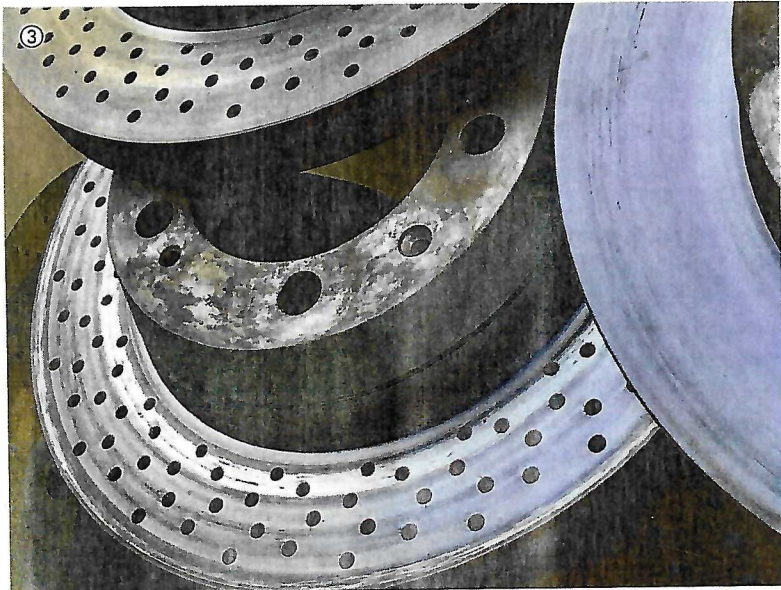


(3) We will discuss rotors in Part 2.

(4) Not discussed in the text: Used brake pads with life left and glazed/overheated surfaces can be easily refreshed/resurfaced using 20- or 40-grit sandpaper face up on the floor. This will greatly aid the bed-in procedure.



parison. If you are really into it, you may find that subjective testing isn't enough; therefore, you will have to move into quantitative testing where you need to collect your own data. This can be done very easily with various tools and methods. These can be as simple or as sophisticated



as you like, and can include:

- Heat-sensitive paint for approximate caliper temperatures
- Pyrometer measurements for more precise caliper and rotor temperatures
- Stopping distance measurements from a set speed
- GPS data measurements (i.e., lap times, braking g-force)

Also, be sure to chat with others at the track or online to see what they are running to gather more information.

## BED-IN PROCEDURE

All new brake pads must be bedded-in properly with the rotors they will be used with. If you also are replacing your rotors at the same time, be sure that they have been cleaned with soap and water (to remove machine oils and rust inhibitors applied by the manufacturer), and then again with a brake cleaner spray available from any local auto parts shop.

Alternatively, if you are reusing your existing rotors, be sure to check them for stress cracks, excessive wear, or runout. It can help to lightly rough up the friction surfaces of each rotor with sandpaper to remove the sheen on the surfaces. You should then clean the rotors with brake cleaner spray.

The bedding-in process involves a gradual buildup of heat in the

brake pad material and rotors.

This is achieved by performing a series of braking events with your car. In a safe area, use your brakes to slow your car from 60 mph to 5 mph for performance street pads using about 70-80% of maximum brake force, normally accelerate back up to speed, and repeat, 10 times total (use 80 mph to 5 mph for track pads, or 100 mph to 5 mph for full-on race pads). Be sure **not** to come to a complete stop directly afterward; rather, it is best to drive the vehicle without any brake application for several minutes to allow for cooling of your brakes. This temperature-building procedure will lay down a thin layer of brake pad compound transfer film on the rotor surfaces. Next, you need to repeat the entire set of 10 decelerations in order to mature, or season, the brake pads, ensuring that the resins used to bind and form the pad material are burned off.

A powdery grey rim of about 1/8-inch in thickness will become visible on the edge of the pad adjacent to the rotor when the bedding is properly completed, and your rotor surfaces should have a shiny grey sheen. If this is not the case, you should repeat one additional set of 10 decelerations.

Note that if you have cooling ducts on your car, you may consider blocking them off to help facilitate the bed-in process.

## ROTOR JUDDER

Failure to follow the bed-in procedures above may result in brake judder, which is a vibration felt through the brake pedal caused by uneven brake compound deposits on your rotors.

This is typically caused by the uneven transfer of brake pad film on the rotor surface, and is often misdiagnosed as a warped rotor. If you come to a complete stop before the break-in process is completed (cooled), there is a very good chance for nonuniform pad material transfer. Judder also can be caused by residue from the previous pad compound on the surface, or from rotor material damage caused by uneven heating.

If judder occurs soon after the installation of new brake pads and bed-in procedure, it is best to restart the bed-in procedure. Note that it is highly unlikely that you have warped your rotors.

## BRAKE FLUID

Standard DOT 4 brake fluid is a mixture of the following components: polyglycol ethers, glycol ether borate esters, polyglycols, corrosion and oxidation inhibitors, and special scavengers to suppress boiling at higher moisture levels. This is the brake fluid for cars produced after 2006. It has high wet and dry boiling points, which means it can still provide safe braking even after absorbing some moisture over time. Note that all glycol-based brake fluids can damage a vehicle's paint, so they should be handled with care.

When choosing a DOT 4 brake fluid, note that they are not all created equal. If you are changing/flushing brake fluid on your street Porsche with no autocross, canyon carving, or track days in mind, I recommend Porsche OEM or ATE brand (note some models require the special low-viscosity fluid to prevent a



squeaky brake pedal). For (extra) high-performance brake fluid, there are many quality brands, including Brembo, Motul, AP Racing, and StopTech. It is best to look for DOT 4 fluids with high wet and dry boiling points; my favorite is Endless RF-650. I have never had an issue with it, never boiled it or lost pedal pressure, and I buy this with my own money.

## COMING UP NEXT

Next time, I will take you into the world of aftermarket brake rotors, and also full caliper and rotor upgrade kits. If you are serious about upgrading your Porsche's brakes, this is what you have been waiting for. ☺

High-performance DOT 4 brake fluid comes in 500-ml and/or 1000-ml (one-liter) sizes. Do your own research or ask a knowledgeable friend which brand might be best for you.

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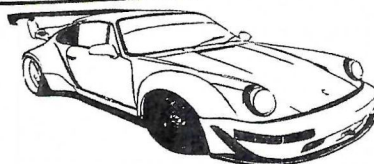


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