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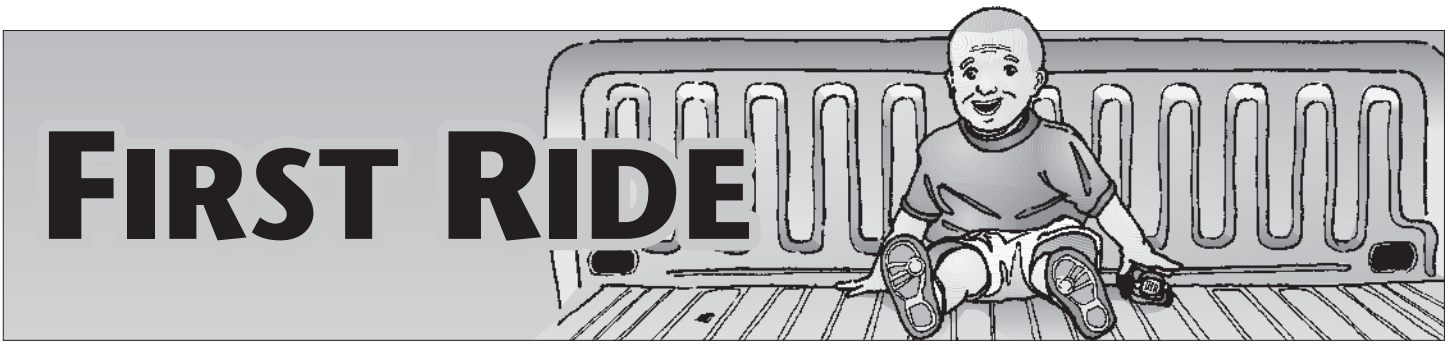


## WAITING FOR DIVINE INTERVENTION

So there I was, sitting in front of my PC struggling to come up with a juicy topic for Issue 51's First Ride. Being the TDR one-trick brake pony, I was trying to branch out into other areas but was coming up woefully short. I had exhausted creativity, decided against blatant plagiarism, and was basically waiting for divine intervention. It was just one of those moments we refer to as "writer's block."

Then the phone rang. On the other end was TDR Editor Robert Patton. Yes, it was a far cry from divine intervention, but I was desperate for material!

Robert had been perusing Issue's 41's Member2Member section and, more specifically, a piece I had prepared on brake pads. His bevy of questions quickly led us to the conclusion that a follow-up piece was most appropriate.

So without further ado, James, the TDR one-trick brake pony, will now fill in a few more gaps in our collective brake system knowledge. Maybe I'll get the chance to branch out in Issue 52.

## Brake Pad Spotter's Guide

As we learned back in Issue 41 (pages 10-12 to be exact), brake pad selection is a bit of a black art. Okay, so actually there's a lot of black art involved, but that should not dissuade you from trying to find the best pad for your truck.

In order to help you out in the hunt for the right brake pad, here is a brief brake pad "spotter's guide" which describes different brake pad types, their characteristics, and key features. Basically, it tells you what to look for when you open the box and peer inside.

However, one word of caution: because these terms are used with great liberty, please do not take any of these comments or observations as absolute truths. Unfortunately, there are no rules, regulations, or requirements for labeling brake pads here in the US, so there is a ton of variability in what may be in each box.

## It's All About Chemistry

First we'll try to separate some of the marketing hooey from the actual chemistry, or material composition, of the brake pads themselves. As we will learn, this is a bit harder than it sounds!

**Non-asbestos organic pads**

In the early days of the modern automobile, organic brake pads were all the rage. These materials had good wear, performance, and noise attributes even by today's standards. However, the key to their performance came from a material called asbestos, and as we now know, asbestos isn't the friendliest material out there.

While asbestos-based organic pads were largely replaced by semi-metallic pads in the 1970s and 1980s, there has been a relatively recent resurgence of organic pads. However, these new formulations are of the non-asbestos variety, hence the name non-asbestos organic, or NAO.

In general, NAO pads do not contain any ferrous materials in the friction material itself (although the backing plate is still made from steel in most applications). There may be non-ferrous particulates added for lubrication (copper is a common additive), but you won't be able to stick a magnet to a NAO pad.

Usually, because of their chemistry, NAO pads provide lower friction characteristics than semi-metallic pads. They are also more sensitive to heat than semi-metallic pads, as their base materials change more rapidly with extreme temperatures. So why then are NAO pads found on most new production cars today?

Almost without exception, these pads are used because of their immunity to noise and vibration. They are typically rotor-friendly and will go a long way toward preventing rotor thickness variation, which as we learned in Issue 50, is the precursor to brake vibration.

So in summary, NAO pads are great if you want quiet, smooth operation. If you are a demanding user, though, they might not be the hot ticket for your ride. Literally.

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**Ceramic pads**

Here's a tough one to nail down. Ceramic pads are really just the next evolution in the NAO pad family tree. The differentiating factor is that there is some magic ceramic dust thrown in the compound. The amount varies by manufacturer and is not regulated, so it's tough to say what a ceramic pad really is. Some manufacturers claim 1% to 5% ceramic content by volume, but every pad is different.

That said, ceramic pads may also, sometimes, contain ferrous elements. Yikes! Does this now make it a semi-metallic pad too? Good question…and one without an answer. In the OEM world we might refer to these pads as low-metallic materials, but it's just another confusing marketing term.

Ceramic pads' claim to fame is less dust, longer life, and increased temperature performance. These pads are essentially trying to bridge the gap between the NAO pads and the semi-metallic pads. The end result, though, is that you end up with the brake pad equivalent of the all-season tire: middle of the road performance without being particularly good at anything.

Is this bad? Maybe not, but for whatever reason ceramic pads have really caught on in the aftermarket arena, although at the OEM level they have not gained widespread acceptance. It must be that the phrase *ceramic pad* sounds high-tech to consumers or something…

**Semi-metallic pads**

In general, semi-metallic friction materials are made with significant amounts of iron (ferrous) ingredients. In plain English, there is a bunch of steel wool in the mixer. This is done primarily to increase the operating temperature range of the friction material as steel has relatively stable output characteristics at elevated temperatures.

A side benefit of adding iron to the compound is that the effective coefficient of friction will usually increase. Not always, but usually. This means that for a given amount of push on the brake pedal the truck will stop a little more aggressively. In effect, semi-metallic pads can raise the overall brake system mechanical advantage.

Because of their desirable temperature and friction capabilities, semi-metallic pads are typically specified for high-performance and/or severe-duty applications. The big downside, however, is that the ferrous materials are generally less friendly to the rotor surface (they are typically quite abrasive) and as a result these pads may wear the rotors and/or squeal during use more so than the other pads listed.

So how much ferrous content is required for the pad to be called semi-metallic pad? Well, some companies proclaim that their semi-metallic pads are 50% ferrous materials by weight, but this is not an industry standard by any means. It is up to the manufacturer (and usually the marketing department) to decide what constitutes a semi-metallic pad.

## Okay, There's More To It Than Just Chemistry

In addition to the formulation of the brake pad friction material itself, there are other features or design elements which may be added to a brake pad to enhance its performance. Your pads may contain all of these, none of these, or any given combination; but in any case what works on truck A may not work on truck B…

**Shims**

Shims are typically thin stainless steel plates attached to the back side of the brake pad backing plate. They may also contain a thin layer of damping material (rubber in some cases) sandwiched between multiple stainless steel plates, but in any case these devices are used to damp out noises which may be generated by the brake pad during use.

Note that the presence of shims does not guarantee noise-free performance, but in many applications they certainly help a great deal. A bonus side effect is that the stainless steel material can serve as a good thermal barrier (insulator) for the brake fluid in the caliper body.

**Lubricants**

Lubricants can serve two purposes. The first is to allow free motion between the brake pad and its mounts to prevent binding or drag during use. This is generally a good thing.

In other applications, though, lubricant is applied to the backing plate in an attempt to provide some measure of noise suppression. Frankly speaking, if this technique worked you would find it in widespread use among the vehicle manufacturers, but it probably doesn't hurt.

**Chamfers**

Chamfers are sometimes found cut into the leading and trailing edges of the brake pad friction material itself. By angling the edge of the pad, there is belief that the pad and rotor are less susceptible to certain noise frequencies. This is black magic at best, but many, many OEM applications have chamfers cut into their pads from the factory.

The downside is that the chamfers wear down with use and may lose their effectiveness as a result. In the end, every application is once again different and simply having the chamfer does not guarantee noise-free operation.

**Slots**

Slots, or vertical grooves cut into the face of the friction material, serve a variety of purposes. First and foremost, they allow an escape route for the worn brake pad material, preventing it from building up between the pad and rotor face. Second, they allow for thermal expansion of the brake pad at elevated temperatures which prevents stress cracks in the pad. And finally, slots can act as redundant leading edges for the friction material which can, in some cases, increase the effective coefficient of friction of the pad.

### How To Pick The Right Pad

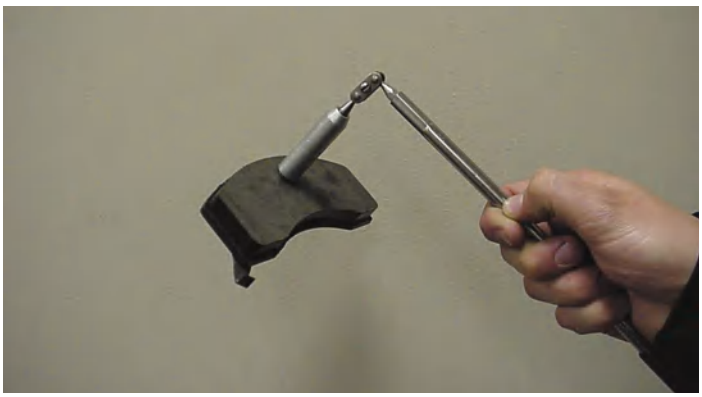
So here we are again, basically the same place we left off at the end of Issue 41. How does one use this information to choose the right brake pad? Well our story hasn't changed from last time—the conclusions bear repeating:

1. Stick with a name-brand brake pad. While this may sound obvious, there are countless no-name products on the market that could compromise your brake system performance. Nobody can tell how well a brake pad will perform by looking at the box, so rely on the company whose name is printed on the side. In a pinch anything that fits may be able to get you through, but sticking with a Performance Friction or Hawk brand pad (and there are many more—these are just examples) will most likely give you a more consistent product than a set of $9.99 Super Stoppers from the local discount auto parts counter.

2. In brake pad land, you still get what you pay for. Brake pad design, formulation, and manufacturing are not rocket science, but there is only so much quality that can be baked into a $9.99 set of linings, lifetime warranty or not. There is a very good reason that most racing brake pads cost hundreds of dollars—the materials that provide consistent friction at high temperatures cost more than those that fall apart on lap three. These same materials are required in severe use towing and hauling applications, so don't expect to pay any less!

3. Listen to recommendations from people using their trucks like you do. Word-of-mouth advertising is still one of the best ways to get a product known, and those brake pads with extreme performance, either good or bad, are certainly going to get noticed. Just because everyone is using a particular set of pads doesn't mean it's the best choice for you, but it sure can be a great place to start.

4. Don't be afraid to call the brake pad manufacturer, dealer, or distributor directly to get a pad recommendation. Typically a manufacturer will have several pad compounds to choose from, and the best fit to your application may not be obvious. Share all of your expectations and requirements and see what they have to offer. Naturally you will have to temper this recommendation with the knowledge that they are also trying to sell you their product, but it never hurts to ask.



Shown are Hawk-brand semi-metallic brake pads.
They passed the magnet test.

### Well, That Didn't Help Very Much

Okay, then try this on for size:

1. If you are using your truck as it was intended and working it hard, chances are that a semi-metallic lining will work well for you. It can take the abuse and has good wear characteristics at elevated temperatures. At the same time, you are probably more tolerant of brake noise and a little bit more brake dust.

2. If you spend most of your time commuting in your truck, chances are that a NAO lining or a ceramic pad might better suit your needs. The dusting might be lower than with a semi-metallic pad and the rotor life will be extended somewhat. Just don't rely on them too heavily when you are descending Pike's Peak with 1500 pounds of gravel in the bed.

Note that in any case there most certainly are some crappy semi-metallic pads which will be out-performed by some NAO pads, and vice versa. Remember, it's not the marketing category that's important—it's the demonstrated performance of the pad to live up to your particular needs.

In closing, there are no hard and fast rules, no absolutes, and no guarantees. To wit:

- Do ceramic pads *always* dust less than semi-metallic pads? Not necessarily.

- Do semi-metallic pads *always* display better friction consistency than NAO pads? Not always.

- Are NAO pads *the* quietest pads on the market? Sometimes.

- Will *any* of these pads decrease my stopping distance? No—the tire still ultimately stops the truck. (I just had to throw that in at the end.)

It all boils down to having a little bit of faith, a good measure of trust, a heap of education, and a whole bunch of luck. Hopefully, armed with this new knowledge, you now have more than enough education to ask the right questions.

**James Walker, Jr.**
**TDR Writer**