

Racers' FAQ

This month's topic: racing brakes

In each installment of Racers' FAQ, we go to industry professionals to get answers to common tech questions they receive from Saturday night racers. This month, we went to Outlaw Disc Brakes. We spoke with the new owner and long-time technical representative of Outlaw Disc Brakes, Todd Howerton.

By Sleepy Gomez, Technical Editor

Q: What makes my brakes drag?

Howerton: The most common cause for this is having residual pressure in the brake lines when pedal pressure is removed. This pressure causes the brake pads to stay in contact with the rotors. Even slight pressure can be a problem. You should not use more than a 2-pound residual valve in the system when using disc brakes. Some master cylinders have an internal residual valve. If so, it should be removed unless you know it is only a 2-pound valve.

Other things, such as a sticking master cylinder or caliper brackets not mounted square to the axle, can also cause this problem.

Q: Why is the car hard to stop? The pedal effort seems high and the car still won't stop well.

Howerton: Several things are at work here. Part of the problem can be in construction, such as pedal ratio being too short. The pedal needs to have a 7 to 1 ratio of movement of the pedal pad to the movement of the master cylinder piston. Also, a master cylinder that is too large will not allow you to build enough line pressure.

If the brake pads have been heated by dragging or overuse they can become glazed, offering little friction against the

rotors. Rotors can become glazed as well. You can grind the surface of the rotor to remove this glaze and then replace the pads.

Q: The pedal is soft, spongy, and sometimes bottoms out. I bled the brakes; what else can I do?

Howerton: Bleeding brakes can be difficult. Be very careful that the master cylinder reservoir does not run dry during the bleeding process. If the lines are run so there is a high spot, enough flow must occur during bleeding to force air from this high spot.

A master cylinder that is too small will not have enough volume to fill the calipers on one stroke. Pumping the brakes to get pedal feel, when the system is properly bled, is an indication of this problem.

Also, if the caliper brackets are not mounted square to the axle, too much caliper piston movement is required, thus wasting master cylinder stroke.

This is the place for a 2-pound in-line residual valve if the calipers are higher than the master cylinder (floor mount). This will prevent fluid in the calipers from draining back to the master cylinder.

Q: Why does the pedal get a pulse-like feeling when I'm on the brakes?

Howerton: The first thing to look for is a warped rotor. This wobble in the rotor will convey the feel you are referring to. A warped rotor should be replaced. If this happens with any frequency, the rotor may not be the correct one for your application or the brakes may need more cooling air directed to them. A warped rotor usually indicates an over-heat condition.

Something to check if the rotor seems to be true is the mounting flange for the rotor. Due to its small diameter it must be dead true, because only a few thousandths out of round will be magnified at the outer diameter of the rotor.

One last thing to look for is excessive bearing clearance on the spindle.

Q: Why does the pedal "go away" during a race?

Howerton: There are many causes for this. Boiling the brake fluid is a prominent cause for this problem. Now we come to why

the fluid boils. If a driver drags the brakes by keeping his foot touching the pedal during a race, this slight pressure keeps the pads in contact with the rotors and builds heat. If this is the case, you should flush the system with new, high-temperature brake fluid. An excellent reminder to the driver would be the addition of a brake-pressure light mounted on the dashboard.

An undersized brake system on the car can also be the culprit. Reassess the caliper/rotor/master cylinder selection. Your race requirements may dictate more properly sized components.

A residual valve of the wrong size can certainly cause this problem. Use one that does not allow more than 2 pounds of residual pressure. Remember, some master cylinders have one internally installed. Never stack two valves together by using an external with an internal one.

On a high-speed track where you are really using the brakes, check your brake

cooling. Each caliper should receive its portion of fresh air ducted in from outside. Ducting must be arranged to feed sufficient air to the caliper. Make sure the ducts are arranged to pick up air at high pressure points on the car's body.

Spindle or caliper bracket deflection during cornering can affect the release of the brake pad and cause excessive heat.

Q: Why does a caliper start leaking?

Howerton: Caliper seals, such as O-rings or square-faced O-rings, do get old and dry out. Disassemble the caliper and replace these items. At the same time, look for nicks or gouges in the bore or on the piston. If these cannot be smoothed out, the caliper should be replaced. Any wear on these parts can affect not just their ability to seal, but also to move freely. One point I should add is that the components of a brake system should be selected as a system. It is imperative to have all the parts match the need. 🏁

BASIC BRAKE FORMULAS

Calculating the Square Inches of Caliper Piston Area

$Pi \times (\text{radius of the piston squared}) \times (\text{half the number of pistons})$.

Example:

Calculate the square inches of piston area of a caliper with four pistons of 1.75-inch diameter each.

$Pi = 3.1417$

Radius of a 1.75-inch piston = 0.875 inch

So: $3.1417 \times (0.875 \times 0.875) \times 2 = 4.81 \text{ sq./in. of piston area}$

Calculating the Ratio of a Brake Pedal

Divide the length from the pivot point to the pushrod into the length from the pivot point to the center of the foot pad.

Example:

Length from pivot point to pushrod = 2 inches

Length from pivot point to center of foot pad = 14 inches

14 divided by 2 = 7

So: Pedal ratio = 7:1

Calculating Master Cylinder Line Pressure

$\text{Pressure} = (\text{Leg force on the pedal}) \times (\text{Pedal Ratio}) \text{ divided by } (\text{Master Cylinder Piston Area})$.

Example:

Calculate the line pressure of a 1-inch bore master cylinder using a 7:1 pedal ratio.

Leg Force (Effort) = 150 pounds

Pedal Ratio = 7:1

Square Inches of Area (1-inch bore master cylinder) = 0.785 sq. in.

So: $150 \times 7 / 0.785 = 1,337 \text{ psi}$

