

Brakes

How can I put this delicately? A good many people, myself included, think the braking system on the 914 sucks. Step on the brake pedal and both your confidence level and your foot sink. The car seems to stop OK, but you're never comfortable with late braking maneuvers in traffic. The 914 brake system also has certain design oddities, most significantly the rear calipers, that add mechanical complexity to its questionable performance.

OK, let's pause a few seconds to give the hardcore 914 purists a chance to regroup from my initial attack. Defending the faith is the purist's prerogative. Just remember that very few of these purists drive around in 914s that maintain the stock brake system. Those who do keep their systems stock follow a meticulous maintenance schedule and, most importantly, use high quality brake pads.

I must admit that I am a bit prejudiced. We won't call it a brake bias, to avoid confusion with the role of another of the system's anomalies, the brake proportioning valve. My intolerance for the stock 914 brakes is rooted in the outstanding stopping qualities of the Porsche 911.

Chapter Seven

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Anyone who has driven a 911 and had to rely on the capabilities of what are lovingly referred to as "Porsche brakes" to get them out of some very close calls is prone to expect that philosophy and performance to have trickled down to the 914. The firm pedal feel and excellent stopping that are trademarks of the 911 were somehow lost in translation to the 914. The weak, spongy feel of the 914 pedal does little to inspire confidence. Overall stopping ability can at best be rated as adequate, especially for a car that can generate such outstanding speed through the corners.

The theory of a light car with four-wheel disc brakes is obviously a good one, and, as we have pointed out, the 914 was one of the first lower priced cars to offer this system. The good news is that over the years a number of techniques have been devised to improve the 914's braking prowess. Even better news is that some of them do work. The bad news is that some of the more popular tweaks, while certainly contributing to the overall quality of the system, have become the 914 counterparts to urban legends. It's a case of good intentions missing their specific targets but still providing value. We'll examine these improvements more closely a bit later. I'm specifically referring to the ideas that a larger master cylinder and stainless steel brake lines will cure the 914's spongy pedal feel. Before we go more in-depth on this and other performance changes, let's review the basics of the stock 914 brake system.

A Breakdown of the Basic 914 Brake System

The 914 brake system consists of disc brakes with fixed calipers at all four wheels. The brake pedal moves a push rod to actuate the dual-circuit master cylinder. The main system is hydraulic, while the emergency brake is mechanically operated by two cables that apply pressure to the inner brake pads on each rear caliper. A brake pressure regulator mounted in the engine compartment controls the pressure sent to the rear calipers to guard against the rear brakes locking up and causing the car to spin. The brake lights are activated by a mechanical switch mounted on the pedal assembly.

The 914/6 differs from the rest of the 914s by having ventilated front brake rotors, a 19-millimeter as opposed to a



View of front caliper, showing brake pad retaining pin (1); spreader spring (2); brake pad (3); piston retaining plate (4); clamp ring (5); seal (6); piston (7); bleeder valve (10); and brake disc (16). Porsche AG

17-millimeter master cylinder, and slightly larger rotors and calipers all around. It also stops better.

Brake Work

Before discussing how and why to modify the 914 brake system, let's cover some aspects of routine maintenance that aren't quite as routine when dealing with our little twin trunk vehicle. Because I think that even a person who just uses his 914 as a daily driver needs to upgrade the performance of the braking system, I am deviating from my plan to group all racing and track related improvements in the chapter on competition—chapter 12. I have decided to include all braking modifications in this chapter.

This is also a good time to issue a warning that safety should be a major concern whenever you are working on and around your car. This is especially critical when working on the brake system. Remember, if your brakes are not working properly you are not only putting your life at risk, you are endangering the lives of anyone who rides with you along with anyone else on the highway.

Installing New Brake Pads

Even if you think you can change brake pads in your sleep, the 914 has enough idiosyncrasies to keep you up nights trying to make sense of what Porsche was thinking when it designed the rear calipers. Before working our way back to introduce you to the weird science of the rear brakes, we'll start our installation procedure with the front pads.

Indications of worn or abused brake pads include squealing or grinding noises when the brakes are applied, veering to one side or another under braking, a spongy or soft brake pedal (a bit tricky to diagnose since stock 914 brake pedals



Front caliper piston retaining clip. www.pelicanparts.com



914 rear caliper. www.pelicanparts.com

always feel spongy), and longer stopping distances than normal. Any of these symptoms should prompt you to remove the wheels and visually inspect the brakes, specifically the pads. Check for unusual or uneven wear. Porsche says pads should be replaced when they are worn down to 2 millimeters, about .08 of an inch. Many pads have indicator grooves cut into them that make it easier to determine when it's time for replacement. As this groove begins to disappear it's time to start shopping for new pads.

Always purchase and install new pads as a complete set for each axle. In other words, you may not have to do both the fronts and the rears at the same time, but you should do all the fronts, or all the rears, at the same time. The front and rear pads are not interchangeable. Remember that if you do plan to reinstall used pads, make sure you mark them as to where they originally were located so that you can put them back exactly the same way. Pads develop wear patterns over use and switching their location can cause uneven braking applications that lead to vibration and pulling to one side or the other.

There are a number of options available when choosing a brake pad. If you will be doing most of your driving on the street with an occasional autocross or time trial, don't go overboard and get a set of pads that are designed for heavy racing use. The problem with many pads developed for the track is that they need to heat up thoroughly before they work well. Normal street driving may not heat them up enough to be effective. Driving for miles on the freeway without having to apply the brakes and then suddenly having to



Note ends of brake pad retaining pins on right edge of caliper. www.pelicanparts.com

make a panic stop from 70 miles an hour is not the kind of application racing brakes were designed to handle.

Another disadvantage of the pads directed more for track use than the street is that they tend to squeal. Some more so than others. The carbon compound pads also throw off a good bit of black dust. This can discolor your wheels if you neglect to clean them on a regular basis. The black powder will bake itself to the wheel surface, making removal very difficult. There are a number of sprays, lubricants, and rubberized pad liners that are sold to reduce or stop squealing pads. Most work to some degree, and you will have to experiment to determine which solution works best for the pads in your car.

Pagid and Porterfield have earned the respect of many 914 owners who participate in some form of competition. They offer a range of pads that should meet your needs for track or street use. There are a number of other suppliers that provide reliable and high quality products. The best way to find the pads that fit your needs and price range is by talking to other 914 owners about how they use their cars and their experience with various pads. A parts supplier who offers more than one brand will also be able to help you choose which is best for your use. You will be surprised how much difference a capable set of brake pads can make to the stopping prowess of an otherwise stock 914 brake system. If you only had to make one improvement to your 914's brakes, a quality set of new pads would be your best choice. Also keep in mind that since the front brakes do most of the stopping, if you need to watch your pennies, you can still increase a car's braking effectiveness by installing the high performance pads up front while sticking to a cheaper but still high quality set in the rear.

Once you have settled on a new set of front pads, it's time to remove the old ones before you can install the new ones. After securely setting your car up on jack stands and removing the front wheels, direct your attention to the calipers and drive out the brake pad retaining pins, using a punch or small screwdriver. The spreader spring that keeps the pads apart can now be removed. Pull out the pads. You

Arrow shows cover over adjusting screw that retracts pistons. www.pelican-parts.com





Loosening the outer retaining screw to retract piston on rear brakes. www.pelicanparts.com

may have to wiggle them a bit to free them up. A wire hook, made from a coat hanger, may be inserted in one of the holes in the back of the pad to pull it free.

Take a flat block of wood or plastic and use it to press the front pistons back into their housings. Make sure the wood rests flat against the entire surface of the piston before you begin pushing. If your brake reservoir is pretty full, you may want to siphon off a bit of brake fluid before pushing on the pistons to compensate for the fluid that will be forced back through the system into the reservoir.

Now pry out the piston retaining plate. Use compressed air to blow out any dirt on the inside of the caliper. Be careful, since many brake pads contain asbestos you don't want to touch or inhale any brake dust. Check for any signs of leakage around the rubber seal of the piston. If everything looks good, rub down the surface with isopropyl alcohol to clean it up. Using anything other than the isopropyl alcohol might harm the rubber seals around the piston. Replace the piston retaining plate by firmly pressing it down onto the head of the piston.

Before inserting the new pads, check the rotor for signs of wear. Take a micrometer and measure the thickness of the rotor. Its minimum thickness per the Porsche factory is 10 millimeters. Any thinner than that, it should be replaced. Also check to see if it is warped or shows signs of abnormal wear. If you're not sure, get a second opinion. Replacing the rotors is pretty straightforward, but it does require the removal of the calipers. The brake hose to the front caliper must be disconnected and plugged up. Then you can unbolt the caliper. Before you can detach the front rotors, you must also remove the clamp that holds on the outer wheel bearing. This is a good time to inspect and repack the front wheel bearings.



Venting rear rotors by adjusting clearance between pads and piston. www.pelicanparts.com

After installing the new front rotors and wheel bearing assembly, it is necessary to adjust the endplay of the wheel bearings. You must also bleed the brakes after this job. At the rear, there is no need to disconnect the brake lines before unbolting the calipers as long as you support the calipers and keep it from hanging by the brake line. Remember to unhook the emergency brake cables prior to removing the rear calipers. Removal of the rear disc simply requires unscrewing two bolts and pulling off the disc. Replacement is the reverse procedure of removal.

If everything checks out with the rotor, it's time to install the new pads. Slide them in place, then reinsert the retaining pins and the spreading spring that keeps the pads separated from each other. Use a hammer to gently tap the retaining



Removing the rear cover of inner adjusting screw is accomplished by reaching through hole in trailing arm. www.pelicanparts.com

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Brake fluid reservoir should be watched during brake bleeding process so that it doesn't run dry. www.pelicanparts.com



Close-up of brake bleeder on caliper. www.pelican-parts.com

pins in place. Install the retaining clips for the pins. Depress the brake pedal a few times to seat the pads.

You should have some space between the pads and the rotors. This distance is called the venting clearance. This should measure about .05–.20 millimeter (.002–.008 inch) for proper clearance. If the distance is larger than the acceptable limits, this could be an indication that the rubber O-ring inside the piston has become stuck. To remedy this, replace the brake pad with a wooden block at least 0.2 inches thick. Step on the brake pedal as hard as you can several times to free up the stuck piston. If you are successful, reinstall the brake pads and check the clearance. If you still can't come within the tolerance limits, it may be time to remove and rebuild the caliper.

Before you resort to this, it's a prudent idea to bleed the brake system and recheck the venting distance.

Now you're ready for new adventures with the 914 rear brakes. The parking brake system that works off the rear brake pads necessitates manually setting the venting distance when replacing pads. You should get better wear out of the rear pads than the front ones unless you are the absent-minded sort who drives off with the handbrake partially engaged. Removing the pads and inspecting and cleaning the rear calipers is pretty much the same drill as for the front brakes. Now things get ugly. Maybe that's being a bit too harsh for the 914 purists, so let's say "quirky."

Before installing the new pads, you must move the pistons back inside the calipers. This is done by adjusting screws on either side of the rear caliper. Usually, there are protective caps that must be removed to reach these adjusting screws. A black plastic cap is used for the outer adjusting screw. It should easily twist off with a gentle application of a wrench. Once the cover is removed, take a 13-millimeter wrench and loosen up the retaining nut for the adjusting screw. Now push on the piston with a flat object, while turning the adjusting screw clockwise with a 4-millimeter Allen wrench. This should get the piston to move back into position. For the inside adjusting screw, you will need an extension to reach through the access hole in the rear trailing arm to enable the 4-millimeter Allen wrench or hex key to remove the aluminum cover over the adjusting screw. Turn counterclockwise to remove this cover. Be careful. If the cap is stripped, it may be necessary to dismount the caliper to remove the cap. If this happens, take out the two bolts that hold the caliper in place. This should give you the room necessary to use needle-nose pliers to remove



The source of all your spongy pedal problems, the 914 proportioning valve. www.pelicanparts.com

the cap. Once you have access to the adjusting screw, use a 4-millimeter Allen wrench, turning in a counterclockwise direction to cause the piston to retract.

Insert the brake pads and replace the retaining pins without installing the spreading spring between them. Now you must set the venting distance. Insert a feeler gauge between the pad and the disc and tighten the adjusting screws until the clearance is .20 millimeter (.008 inch) on either side. Remember to turn the adjusting screws in the proper direction. Outside goes counterclockwise to tighten, inside is clockwise.

Once you have the proper clearances, remove the retaining pins, and install the spreading springs. Replace the retaining pins and secure them with the appropriate spring clips. Recheck the venting distance and make sure that you tighten down the retaining nut on the outside screw. Replace the inner and outer covers and you're done.

Bleeding the Brakes

Removing any air that has worked its way into the brake system is the first step toward eliminating the spongy brake pedal in a 914. There are brake bleeding tools on the market that make bleeding the brakes a one-person job. These tools either work as vacuums to suck the air out of the system or by pressurizing the system and forcing the air out. The standard brake bleeding procedure requires two people to carry it out properly. One person pushes on the brake pedal while the other opens and closes the bleeder valves on each of the brake calipers. No matter what method you use, there is a certain sequence as to which brake gets bled before another. The rule of thumb is to start with the brake farthest from the master cylinder and do each brake in turn until you finish with the brake that is closest to the master cylinder. Simply stated, start at the right rear, then left rear, right front, and finally, the left front.

Starting with the right rear caliper, have your assistant step on the brake pedal several times and then hold it down. While they hold the pedal down, open the bleeder valve, allowing any air and the old brake fluid to come out. You should have a large container for the fluid to drip into. (Remember brake fluid is highly corrosive. Protect yourself and your car's paint from the fluid. Use plenty of water to wash off any fluid that may come in contact with the paint. Do not rub it with a rag.) Close the valve. Have your helper pump the pedal several more times and then hold the pedal down while you again open the bleeder valve. After more air and old fluid come out, tighten the valve. Keep repeating the process until the fluid coming out is clear. Pedal feel should also be improving each time more air is purged from the system. Keep your eye on the brake reservoir and make sure you add new fluid as needed. If your 914 has two bleeder valves per caliper, bleed the bottom one first before doing the upper one.

Always use fresh brake fluid whenever you are working on your brakes. Brake fluid is adversely affected by moisture. It absorbs water from the air, so any containers that you have had sitting around, even if you tightly recapped them after opening, will have a very short shelf life. The fluid in your system can also draw water from the air, which is why Porsche recommends flushing the system every two years. Your 914 should use either DOT 3 or DOT 4 brake fluid. These will sufficiently meet the needs of daily drivers and the street/track



Master cylinder from 911 will cause a slight increase in braking performance but won't cure spongy pedal. www.pelicanparts.com



All that's left of the 17-millimeter unit is a hole and the disconnected lines. www.pelicanparts.com

cars. Silicone brake fluid has both its proponents and detractors. Porsche does not recommend silicone brake fluid. The safe call is to avoid it for any car driven on the street.

Installing a 19-Millimeter Master Cylinder

Over the years, one of the "urban legends" surrounding the 914 has been that the spongy pedal feel could be eliminated by switching to the 19-millimeter master cylinder that came on 911s and the 914/6. While the larger unit will give you a slightly firmer pedal, its main advantage is to increase the brake pressure of the system. If your 17-millimeter cylinder is leaking, the 19-millimeter unit costs about the same as rebuilding the smaller one, bolts right in, and does provide a slight performance improvement. The first step in replacing the master cylinder is to bleed the brake system dry of fluid. Use a suction pump to remove fluid from the reservoir. Make sure the brake reservoir is completely empty.

Once this is accomplished, head under the car to remove the panel that protects the steering rack, fuel lines, and brake cylinder. Once you get this cover off, disconnect the wires for the brake pressure warning switch where they attach to the master cylinder.

Now remove the brake lines from the master cylinder. Be careful when loosening the nuts surrounding these lines. A crows foot wrench is recommended. After the brake lines are off, pull out the reservoir lines from the top of the master cylinder. The only thing left is to remove the two nuts that



Illustration of rear brake and trailing arm. Caliper is No. 3 and brake disc is No. 5. Porsche AG

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hold the master cylinder to the mounting studs from the pedal assembly. Remove the old master cylinder.

Installing the new master cylinder requires that you first attach the lines from the brake reservoir. Make sure these lines are properly attached before moving on. The next step is to mount the master cylinder on the two studs from the pedal assembly. Finally, reattach all the brake lines, followed by reconnecting the brake pressure warning switch lines.

Add brake fluid and bleed the brakes. Make sure everything is working satisfactorily before replacing the bottom protective panel.

If after bleeding the brakes, the brake pressure warning light on the dash remains lit and you know that everything is working properly, you may have to manually reset the switch. As stated above, the switch is connected to the master cylinder. If you remove the protective rubber boot where the connection is made to the master cylinder, you should see a reset button. Push it and the light should go out. It's the same principle as the little button on the kitchen garbage disposal that needs to be pressed after your unsuccessful attempts to grind up items like corn cobs or errant beer bottle caps. You may also want to check that the brake lights are working. It's possible that the brake light switch may have been knocked awry while you were working around the pedal cluster.

The Racer's Edge—New Brake Lines and Proportioning Valve Modifications

The 914 has more urban legends, especially when it comes to braking improvements, surrounding it than the Candy Man. One is the replacement of the OEM rubber flexible brake lines with stainless steel units. This is said to improve pedal feel. Again, this is one of a set of modifications (bigger master cylinder, high quality brake fluid, high quality brake pads, caliper rebuilding) that work together to improve the quality of the system. Just replacing the OEM brake hoses every couple of years will do as good a job. Brake hoses wear from the outside (abrasion, environmental erosion) and the inside. The insides suffer a form of mechanical arteriosclerosis where dirt and debris build up and shrink down the passage for flow of brake fluid. In short, they get clogged up with crud. Replacing them solves this problem.

If you do use the stainless steel lines, actually a Teflon/nylon tube with stainless steel braiding on the exterior, insist on the DOT-approved type. Make sure that they are long enough so they don't get stretched to the limit when you turn the wheels. Be wary of contact with any suspension parts or the wheels. Carefully check all clearances. Rubbing brake lines quickly become cut brake lines. That's not something you want to happen on the road or the track.

Now we get to the prime suspect in the case of the missing pedal pressure—the brake proportioning valve in the lower part of the engine compartment. A malfunctioning valve or one that has had air enter it is the biggest source of the 914's "soft" pedal. Some 914 drivers and racers simply remove it and replace it with a T-fitting from the hardware store. They consider it to be a quick and cheap solution to the spongy pedal problem. Before doing this on a street car, remember that the purpose of the stock unit was to prevent premature lock-up of the rear brakes under various road and weather conditions. Removing this valve could have an adverse effect on the car's ability to handle a variety of conditions.

There are also adjustable proportioning valves available to allow you to adjust the brake bias from front to rear. Many experienced 914 racers use these devices. The problem is, of course, being able to fine-tune the system to brake evenly under all situations. What works on the track may not be the best solution for the street.

Another alternative is to bleed the proportioning valve as you would the brakes. Do the inlet line first, having an assistant pump the brakes then hold the pedal down while you loosen the line. Once the flow of fluid stops, reconnect the line and repeat the procedure for the outlet side. This should remove any air that was trapped in the valve.

Installing Bigger Brakes

Another alternative to improving the 914 brake system is to install larger brakes up front. There are two common methods for doing this. The first goes hand in hand with improving the front suspension by installing the entire suspension/brake assembly from a 911. This is essentially a bolt-on replacement that also has the advantage of adding the five-bolt wheels from the 911. Obviously, you would have to convert the rear wheels to the five-bolt pattern as well.

Another alternative that is gaining in popularity since an aftermarket kit from GPR has been made available to take all the guess work out of the process is switching to the front brakes used on the BMW 320i. The advantages of the kit are that it includes new, as opposed to the used, parts you would acquire from a wrecking yard and that the minor clearance adjustments that are necessary have been engineered into the kit.

Of course, anyone building the ultimate track car or a "money isn't everything" street car can choose high tech racing brakes that cost more than a decent 914 daily driver. You just need to know when to call it quits as far as how well you want to stop your 914.