

Project 911S

Part 16: Speed check—upgrading the braking system

By Mitchell Sam Rossi

PHOTOS BY THE AUTHOR

As an early 911, my project car's braking system did not include the modern wonders of ABS, drilled rotors or even power assistance. The stopping scheme was a straightforward affair combining mechanical, hydraulic and kinetic forces to reverse what the high revving engine struggled to achieve—catapulting the car from rest to speed.

Press the center pedal, initiate the master cylinder piston, increase the brake fluid pressure, engage the caliper pistons against the brake pads, squeeze pads against the spinning brake rotor. Mechanical energy transforms into heat via friction. Dissipate said heat and, voilà, the car comes to a stop.

This is, of course, an extremely simplified explanation of what it takes to slow a vehicle hurling down the road at, say, 220 ft/sec. or 150 mph. In reality, it is nothing short of rocket science. But then, rocket scientists are not so much concerned with slowing their vehicles, only launching them.

While simple, the S was fitted with one of the best braking systems of its time. At each corner, Porsche furnished the car with vented discs, with diameters of 282mm front and 290mm in the rear. Under the nose, the discs spun through lightweight one-piece aluminum S-type calipers from Ate. At the rear, M-type cast-iron calipers were employed. A firm sense of security was transmitted through the pedal by a dual-chambered 19mm master cylinder.

In the first phase of Project 911S, when the car was reconditioned from a deteriorating shell to a high-performance street car, restoring the original braking system was sufficient. As the S continued to evolve toward a dedicated racer, however, serious consideration was given to

how to best rein in the car's elevated potential.

The initial impulse was to bolt on the brawniest calipers and rotors that could be squeezed under the wheels, but employing huge brake components is not necessarily the right course. Other factors had to be considered, such as unsprung weight; that is, weight not supported by the suspension system.

As this weight cannot be adjusted for or balanced with the suspension, the less of it the bet-

Compared to the project car, the 2002 996 Turbo weighs in at 3,395 lb and packs 415 horses. Clearly, the lighter, less powerful S does not require the same advanced braking system as Porsche's current flagship. What is important, especially under road-racing conditions, is that the brake system can be relied upon time after time, corner after corner, without the pedal ever going soft or, worse, losing pressure completely.

The aluminum S-type calipers are prized by restoration perfectionists and still used by many club racers. But under extreme conditions, these calipers have a tendency to flex, resulting in uneven pad wear and scalloping of the rotors. Excessive scalloping can be felt as an oscillation in the brake pedal.

To enhance the project car's braking system, Brembo's four-piston, monoblock aluminum calipers were positioned on the front struts. Available from Performance Products, the bolt-on kit comes complete with calipers, cross-drilled, Carrera-sized vented rotors and the necessary mounting hardware, including braided stainless-steel brake lines.

While the swept area of the Brembo rotors is significantly

larger than the S-type calipers, the new components were not so large as to throw off the car's front-to-rear braking bias.

Admittedly, it was difficult to accept the idea that it was not necessary to increase the rear caliper size when increasing the front. However, Jaime Trimble of Race Technologies, a principal distributor for Brembo's high-performance brake systems in the U.S., said the system had enough latitude to use the Brembos and retain the rear M-type brakes. "On your car, the front probably does 75- to 80% of the work," Trimble stressed.



ter. And, as one might expect, the calipers and rotors make up the heaviest elements. Choosing components that offered optimum braking forces yet did not hinder the car's acceleration or handling was critical.

Another consideration was the car itself. In its original form, the 911S weighed only 2,247 lb, and mine had since undergone paring of its undercoating, sound-deadening materials, interior appointments and replacement of several sheetmetal pieces with fiberglass. The hope was these reductions would shave off about 250 lb.

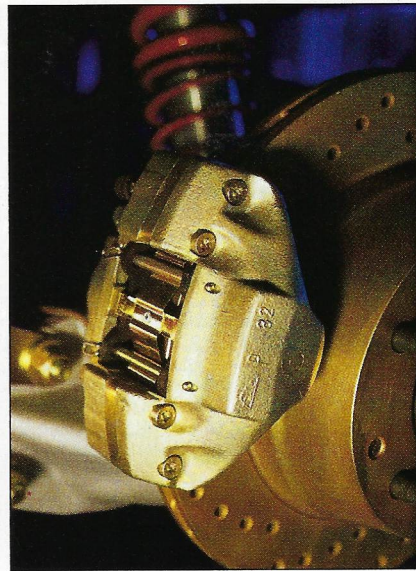
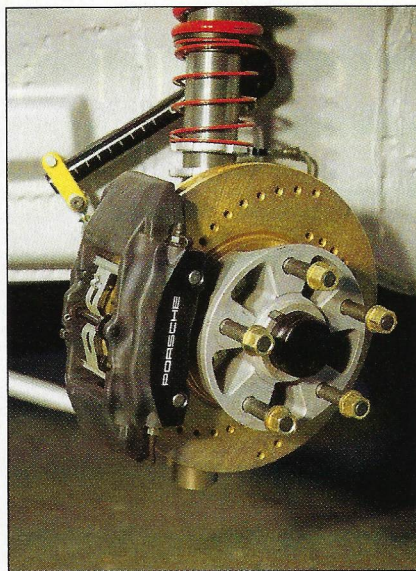
Project 911S

While the monoblock calipers greatly enhance the stopping power via their increased rigidity, the four-piston design adds the benefit of improved modulation. "The original calipers are either on or off," Trimble said. "But with these monoblock calipers, braking is so smooth you can actually feel it in the pedal."

At this stage, the factory 19mm master cylinder was deemed sufficient. An upgrade to a 21mm unit would have required very little modification, but Trimble pointed out the bigger master cylinder would only add brake pedal pressure and not change the brake bias.

"If you start running a high downforce rear wing or wider wheels with racing slicks, you might consider adding larger rear calipers to the car," Trimble said. "But we'd still develop the system step by step."

For brake rotors, cross-drilled discs were fastened to each corner. In the rear, the rotors were the same size as the original vented discs, but up front the Brembo kit used 24mm-thick rotors, a 4mm increase over the original non-drilled discs.



Left: Brembo monoblock, four-piston aluminum front caliper with cross-drilled rotors. Right: Original M-type cast-iron rear caliper with cross-drilled rotors.

Although these discs are slightly heavier, they are more efficient at dissipating heat and thus have less tendency to lose their trued surface. The diameter was kept to 282mm so that 15-in. Fuchs alloy wheels could still be used. This was required by a Southern California RS-spec racing series that calls for certain wheel sizes in order to compete.

There are pros and cons to cross-drilled rotors. Unless they are properly manufactured, they can be subject to cracking. Trimble was certain we would have little problem with the Brembos, but he did suggest the brake rotors, whether cross-drilled, slotted or solid, should be removed and inspected before the start of each race season.

NUMBER

INNOVATOR

100% Made in Germany

SPRINGS CUP KITS COIL OVERS TRAK+ WHEEL SPACERS

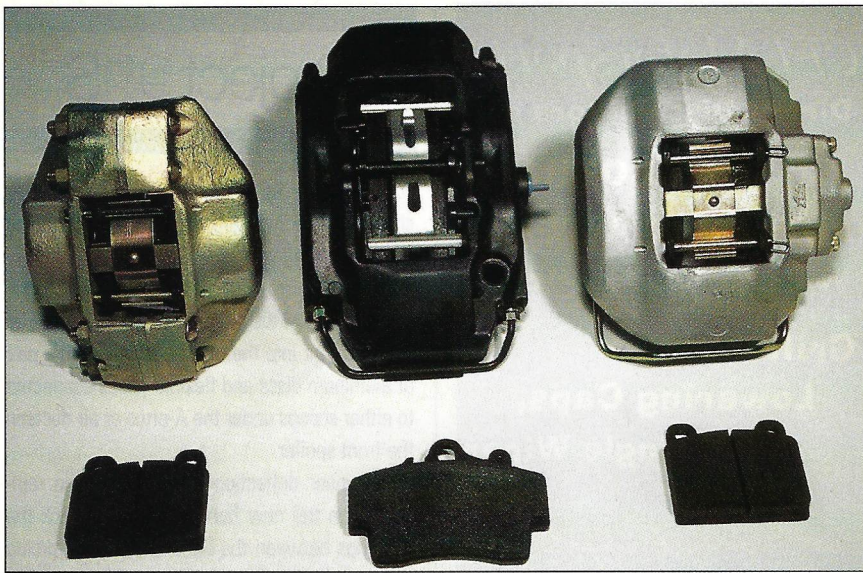
Why buy H&R? Granted, H&R makes the highest quality, best engineered suspensions available. There's a better reason though.

For more than 20 years H&R has pushed the suspension industry forward. H&R was the first suspension company to introduce ABE certified springs, the first to create TÜV approved springs, the first to be ISO 9001 certified—worldwide, the first to create threaded-body coil over suspensions for the street, and the first to engineer a specifically matched shock / spring suspension kit for street use.

H&R is a true innovator.

It takes years for other suspension manufacturers to engineer products that strive to compete with those that H&R produces. The difference between those products and the ones created by H&R is the knowledge behind the product. H&R engineered the original designs, the concepts, and all the variations on them. Other suspension manufacturers mimic H&R's products and alter the basic ideas without spending nearly the amount of time on design and production. The inferior designs, materials and production processes used by the competition results in a product that is nothing more than a poor copy of the original.

Nothing can compare. **H&R.**



Size comparison (left to right): M-type rear caliper, Brembo monoblock, four-piston aluminum front caliper, S-type aluminum caliper.

High-performance organic brake pads come with the Brembo kit. They carry a slightly higher coefficient of friction and operating temperature than the car's original pads. These new pads were also used in the rear calipers.

For the track, Pagid Orange pads will be used all around. "I would keep away from the Orange pads for the street," Trimble warned, noting that

they can damage the rotor if not run at their optimal temperature range, which is much higher than normal street driving can generate.

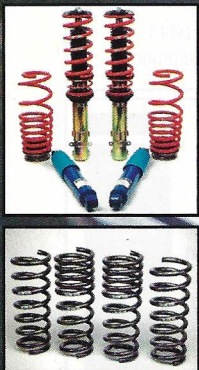
For brake fluid, Trimble suggested Motul Racing Brake Fluid 600. Rated to a boiling point of 585°F, I have used Motul extensively at both short and long racing circuits. Short tracks are inherently cruel to a car's braking system, not

only for the innumerable times a driver must stand on the pedal but also because of the limited time the brakes are allowed to cool. In contrast, the challenge of a long track is the excessive speed from which the brakes must repeatedly slow the car.

Arguably, the brakes are the most critical system on any race car, and adhering to a strict regimen when it comes to preparing and maintaining the S's stoppers is imperative. The system should be flushed at least twice a year, whether the car is used occasionally or constantly. Personally, I bleed the brakes before every track event; if the conditions are particularly harsh or it is a tightly laid-out course, I go through the procedure during the lunch hour as well.

Although not specifically a brake system component, one part of the front end upgraded on the S was the wheel hubs. In 1974, a centering ring was cast into the aluminum hubs and machined true, helping center and stabilize the wheel before the lugs are tightened down. To accept a variety of offset wheels and spacers, the original front and rear wheel studs were replaced with units measuring 72mm in length. Steel lug nuts were used as opposed to the capped, black anodized aluminum lugs that came standard with Fuchs wheels. As it is diffi-

QUALITY. PERFORMANCE.



find an H&R dealer near you
phone 888 827.8881

find an application for your car
://www.hrsprings.com

CUSTOM VEHICLE COVERS MANUFACTURER DIRECT



AVAILABLE IN FOUR FABRICS
MADE IN THE U.S.A.

ALL-WEATHER: Three-layer lightweight protection for severe weather conditions. Polyester construction with UV protected outer shell, and smooth inner shell that is easy on paintwork – **\$105 to \$130.**

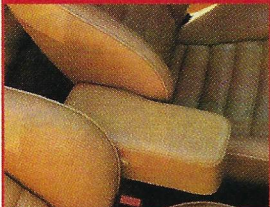
ALL-WEATHER SUPREME: Durable UV protected fabric with flannel cotton inner shell that is super soft on paintwork – **\$210 to \$260.**

COTTON/POLY: A soft cotton base fabric with polyester added for durability. This fabric is both soft and strong. It is water resistant, and a heavier weight than the competition – **\$105 to \$130.**

100% COTTON FLANNEL: Super soft to preserve collector cars and delicate paint finishes – **\$115 to \$140.**

Custom sizes available for most cars & lightweight trucks. Please call for motorcycles & other applications.

RETRACTABLE ARMRESTS



- Audi
- BMW
- Mercedes
- Porsche
- Saab
- Volkswagen

AVAILABLE IN FACTORY COLORS

For most vehicles *not* equipped with factory armrests. *Leather*-\$149; *Vinyl*-\$99

RED LINE OIL PRODUCTS



NOW AVAILABLE - PURCHASE
RED LINE OIL PRODUCTS ONLINE!

\$6.00 shipping/handling on any Red Line order anywhere in the Continental U.S.

Auto Chic®

6-B Hamilton Business Park
85 Franklin Road • Dover, NJ 07801
Call Toll Free: 866-654-7843

Phone: 973-989-9220 • Fax: 973-989-9234
Hours: Mon.-Fri., 8 am-5 pm Eastern Time

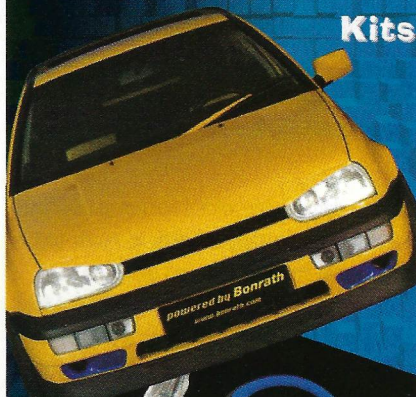
Visit us online at www.AutoChic.com

CFI Motorsports

Direct Distributors of:

**BONRATH
AUTOSPEZIALTEILE-**
(North American Applications!)

**Grilles,
Lowering Caps,
180° Single Wiper
Kits**



**CONRERO,
THE NEW EURO-
STYLE ACCESSORIES**

**Boots, Pedal Sets,
Gear Frames,
Shift Knobs**

(Now in Titanium Anodize)

**CFI Motorsports,
www.cfimotorsports.com**

Phone: 800-989-9260/

fax: 800-989-9258

Project 911S

cult to torque the aluminum lugs properly, they should be the first items replaced before racing or autocrossing your Porsche.

The Cooler Brake kit that had been used in the earlier phase of the project was carried over. The kit directs air into the front rotors through a pair of aluminum discs and flexible hoses connected to either scoops under the A-arms or air ducts in the front spoiler.

The inner deflection plates were also reinstalled on the new hubs. The plates block the openings between the hubs and rotors, forcing the incoming air through the discs' inner vanes and greatly increasing the cooling effect. Both the Cooler Brake kit and the deflection plates were obtained from Performance Products.

An honest evaluation of whether the larger front Brembo calipers are an indispensable upgrade will have to wait until the S has completed several days of testing on both short and long circuits. As the car is finally taking shape, results of this and other improvements should not be too far down the winding road. ☒

Project 911S

Sept. 2000	Part 1: The first steps
Oct. 2000	Part 2: A green 1970 911S
Nov. 2000	Part 3: Front suspension
Dec. 2000	Part 4: Rear suspension
Jan. 2001	Part 5: Bigger brakes
Feb. 2001	Part 6: Paint and interior
Mar. 2001	Part 7: Balancing the chassis
Apr. 2001	Part 8: Going racing
May 2001	Part 9: Phase II, the engine
Jun. 2001	Part 10: Induction & exhaust systems
Jul. 2001	Part 11: The transmission
Aug. 2001	Part 12: Removing the undercoating
Oct. 2001	Part 13: Strengthening the chassis
Feb. 2002	Part 14: Body and paint
Mar. 2002	Part 15: Safety equipment

Performance Products

8000 Haskell Ave.
Van Nuys, CA 91406
800-423-3173
www.performanceproducts.com

Race Technologies

13360 Beach Ave.
Marina Del Rey, CA 90292
310-306-3158
www.racetechnologies.com