Project 911S

Part 18: The Ultimate Suspension

By Mitchell Sam Rossi
PHOTOS BY THE AUTHOR

My mother always told me in order to make a good impression at dinner parties, I must never discuss religion, politics or what was served for dessert. Somewhere along the line, she forgot to mention race car suspension. For the gatherings I normally attend, that piece of advice would have been far more useful. Suspension, I've discovered, is a delicate topic.

Theories on camber setting, torsion bar thickness and spring rates, especially among Porsche enthusiasts, are as varied as recipes for pumpkin pie. Everyone has their secret ingredients, their baking methods and their personal tastes.

From the first 356 prototypes until the introduction of the Carrera 4 in 1989, rear-engine Porsches successfully relied on a torsion bar suspension to stabilize their high-speed excursions. On the racetrack, however, it was a different story. Porsche began controlling the body roll and brake dive of their battle chariots with coilover springs on the 1973 911 RSR. Although other suspension components have changed drastically over the last 30 years, Weissach continues to use coiled springs to keep its racers in touch with Mother Earth.

This does not mean, however, that the engineering of the 911's torsion bar suspension was anything short of remarkable. The pros and cons between the two techniques of springing the car are only apparent when pushing the original equipment to extreme levels of performance.

Although both are designed to limit body roll, one advantage of helical coil springs is their compactness, an important factor for automotive designers of day-to-day people movers as well as competition vehicles. But the primary benefit is the ease with which springs can be made with very high spring rates. To achieve the same firmness in a torsion bar, the piece would have to be too large and too heavy for practical use. (Spring rates are calculated by the amount of force required to compress a coil spring a set distance. For American manufacturers it is usually designated in pounds per inch and for European makers in kilograms per centimeter.)

Converting the project car's rear suspension to coilover springs was a simple decision, considering that the 911s which dominate the upper classes of the Porsche Owners Club, a Southern California-based racing organization, have all received this upgrade. To run amidst these greyhounds, stabilizing the project car's rear end with a spring package was essential.

At the front, however, many racers, especially those whose cars are based on an early chassis, retain the original torsion bar arrangement. The early 911 is considerably lighter than its successors, and thus, if a driver continues to use the accepted parameters to tune the front of the car, there is a large selection of aftermarket torsion bars offering anything from slightly stiffer than original to teeth-chattering firmness.

At the outset of Phase Two of this project, the premise was to transform the S into a club Cup racer that, with the help of modern components, would handle as well as or better than the RS and RSR of 30 years ago. Given the race history of these renowned Porsches, the idea created a good challenge if not an absurd objective.

Unlike the Weissach engineers who simply fabricated the suspension pieces they needed, I was faced with the task of sifting through myriad aftermarket components from an endless number of companies, all of whom boasted the best possible racing equipment for the 911.

To determine the proper suspension components for the S, I did what I have done throughout the series. I turned to the experts. Urs Gretener of Gretener Carrosserie, an automotive fabrication shop in Los Alamitos, Calif., is better known for restoring historically significant Porsches than he is for suspension tuning. He recently finished a flawless 1960 RS 61 that required four years to complete and is valued in the high six-figure range.

What underscores his work with the 911 suspensions is Gretener's success campaigning a relatively underpowered 1983 930 RUF BTR Turbo in the top class of the P.O.C.

"It's all in the handling," the Swiss-born tinsmith said with his characteristic smile. "It has to be. I have no power." He ventured that his 930 was generating about half the horsepower of his nearest competitor, making his podium finishes all the more surprising and impressive.

Splitting his racing season between the States and Europe, Gretener has had the opportunity to scrutinize Porsche's professional racers on their home turf. "The cup cars in Europe use very heavy spring rates," Gretener said, noting

that although the 996s are much heavier than the project car, in theory high spring rates should work just as well.

When Gretener started tossing out numbers, they didn't sound so bad. Then I realized he was talking kilograms. I did rough conversions in my head and was immediately aware that Gretener likes big springs…really big springs.

"Four hundred and 600 lb used to be the magical numbers for the cars," he said of the front and rear spring combination used on the RSRs of the past. "But they didn't work for us. So we began bumping them up; 800 in the rear, then 1,000, then 1,200. We just kept going up until we found what worked. It has a lot to do with testing. Just going out to the track and trying something different."

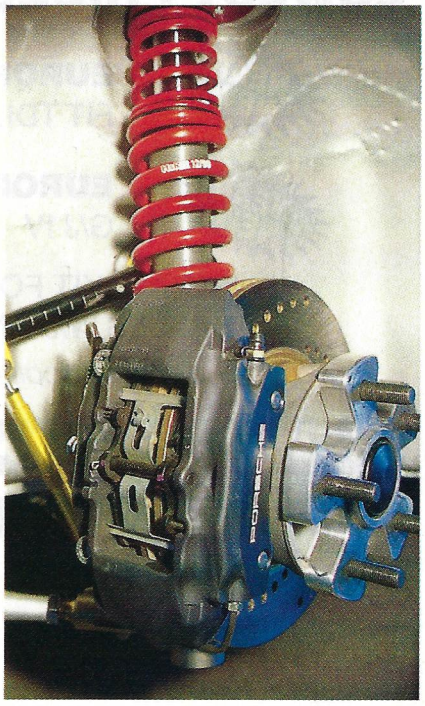
Before the flatbed tow-truck driver finishes unhooking the S in front of Gretener's shop, the fabricator is scrutinizing the chassis' previous modifications. Luckily, his concerns about strengthening the rear crossmember and front towers were already addressed. (See Project 911S, Part 13, Oct. 2001). Unlike the original torsion bar suspension, coilovers force the shock towers to endure not only the car's entire weight but also the aerodynamic downforces and body roll experienced at speed. Without the reinforcements, there is the possibility of ripping the towers right out of the car.

For the proper coilovers, I contacted H&R Springs. Having a long association with Porsche racing, and with a full line of product, no one else seemed better able to offer the combinations Gretener was looking for. Beyond the main springs, tender and helper springs were needed for the system.

The helper spring is a light coil responsible for keeping the components in place when under a full droop—e.g., when the car is on the hoist or under extreme racing conditions, i.e., airborne. The tender, spring, on the other hand, is an actual working part of the suspension. Together with the main spring, it provides a dual spring rate with a rapid transition between the rates. The tender spring is collapsed when the car is at rest. Compression beyond this point works at the rate of the main spring. When the suspension droops, as the inside suspension does during hard cornering, the spring rate is reduced by the action of the springs working in series.

Another plus using the German company was that the springs were manufactured with an inside diameter of 60mm. "The 2 1/4-in. I.D. of other springs run very close to the shock bodies," Gretener noted. "They always scuff the threads, and then it is hard to get a smooth adjustment." H&R also offers inner sleeves on which to stack the different springs. With the space restriction between the tire and chassis, these were a necessity.

For the front strut assemblies and rear shocks and threaded bodies, Bilstein was the first choice to damp Gretener's spring selection. Bilstein's RSR struts use a high-pressure gas monotube design. This configuration has a large piston area, so there is a lot of oil movement, making it easier to control high-rate springs. The deflective disc valving is well understood in the racing suspension community. The gas pressurization helps prevent cavitation of the oil when the dampers get hot during heavy use.



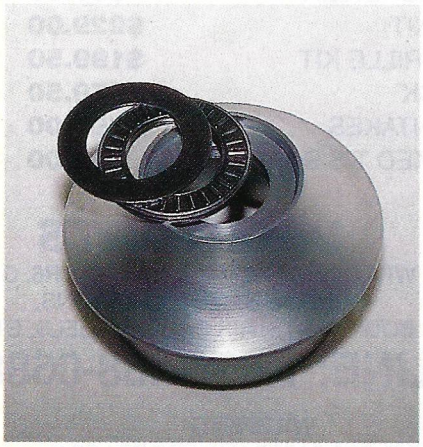
Bilstein RSR front strut with H&R springs rest atop E.R.P A-arms.

As it turned out, the RSR valving corresponded with our initial spring rates. Had Gretener decided on even bigger springs, the shocks would have needed re-valving. When the coilover spring and shock absorber are not matched, the car has a tendency to hop. This is caused by the shock not reacting fast enough to dampen the spring.

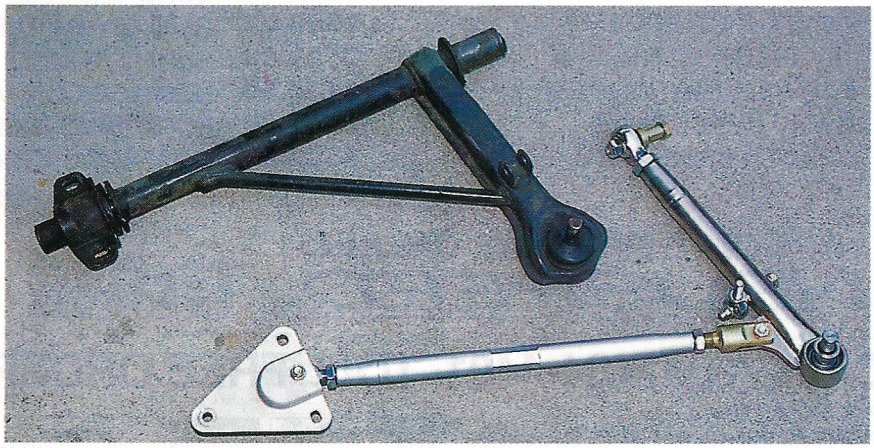
I have to admit, although the S's suspension had been upgraded with poly-graphite bushings during the initial phase of the project, installing the Bilstein shocks and H&R springs with the car's original A-arms in place seemed self-defeating. The only thing to do was to take the car to the next level and replace the entire suspension with a completely adjustable mono-ball system.

For the 911, there is only one system that fits this criteria—the ultra-precise 935-type suspension components from Eisenlohr Racing Products. While there are several suppliers for the E.R.P. system, Smart Racing Products of Campbell, Calif., offered both technical support and a large inventory.

Inspired by Porsche's famed 935 race cars, the E.R.P. components were originally developed out of necessity. A lot of this came about while I was co-driving the IMSA Porsche of Gary Auberlen during the mid-1980s," said Cary Eisenlohr, designer of these remarkable suspension pieces. The Auberlen



E.R.P. front spring hat with roller bearings.



Original 911 A-arms (above) vs. E.R.P. mono-ball A-arms (below).

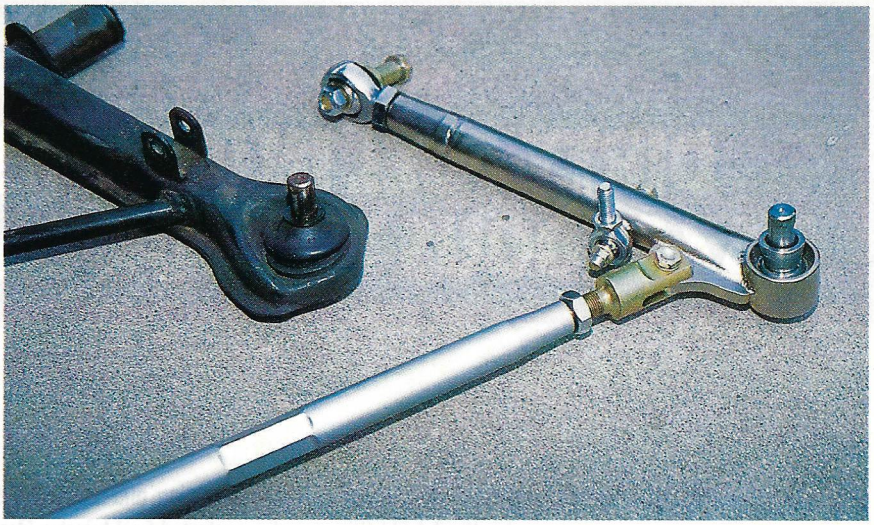
name might sound familiar. Gary's son, Bill, is currently one of the top drivers in ALMS and GrandAm.

"At the time, we were running the 911 in GTU," Eisenlohr explained. "There wasn't much in the way of pure racing components, and the factory 935 parts were not only expensive but you essentially needed a full fabrication facility with a frame jig to install them. So I designed parts that offered benefits similar to the 935 geometry yet could be installed directly to a stock street car's attachment points."

In 1985, the senior Auberlen, along with Eisenlohr and his teammates, took their modified 911 to a GTU class win at the 12 Hours of Sebring.

In Porsche club racing today, the E.R.P. 935-type system is one of the most desired upgrades a racer can bolt to the underbelly of his or her 911. The components are computer designed with the aid of CAD (computer-aided design) and FEA (finite element analysis) and manufactured on CNC machinery from lightweight, high-grade aluminum and alloy steels. Every pivot point uses precision spherical bearings for smooth, dependable action. Camber, caster and track width are all fully adjustable beyond stock settings. Aesthetically, fit and finish of the pieces exceed anything that has ever come out of Weissach for the 911.

"The whole idea behind it was to make a true bolt-on racing suspension that can win races," Eisenlohr said. "It's about getting the average guy to go as fast as possible, as easily as he can and give his car adjustments he can do himself."



Original 911 A-arms (above) vs. E.R.P. mono-ball A-arms (below).

Gretener agreed. "The adjustability is key. It is easier to set up the car, especially with the spring plates." Weight is another benefit of the E.R.P suspension. Depending on the torsion bars being replaced, the new system can save about 13 lb at the nose.

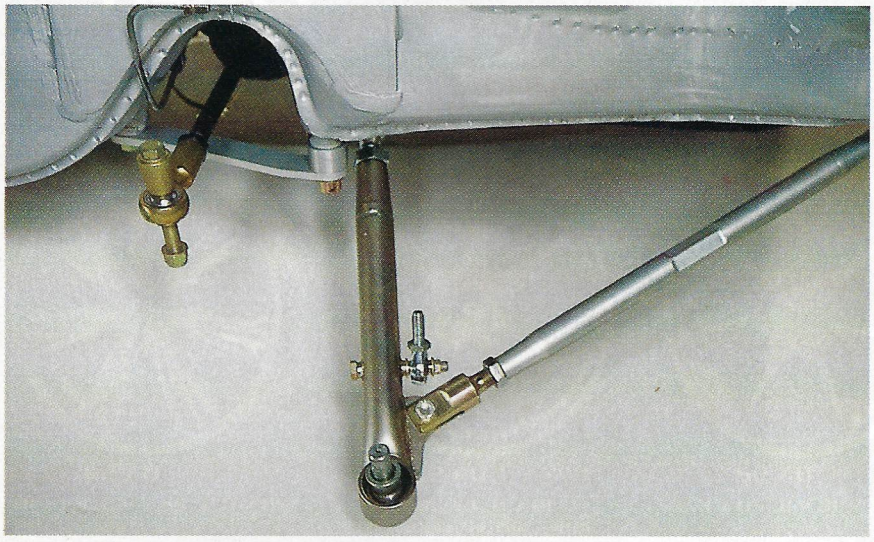
When it was finally time for installation, Gretener topped the front spring package with E.R.P's upper hats, which use roller bearings to keep the spring seats from binding. For camber plates, I used the billet aluminum pieces with Teflon®-lined spherical bearing from Tarett Engineering. These aided Gretener in putting nearly 3 1/2 degrees of camber into the front wheels. At the rear, the E.R.P spring plates allowed us to reach 3.0 degrees. These are extremes and will be reevaluated when the car is tested on race rubber.

Once everything was in place, Gretener lowered the S 2.0 in. below the stock ride height, thus dropping the car's center of gravity. With the E.R.P. suspension, there was room to go lower, but as I was planning to drive the car on the street, we decided this was good enough for now. With the car nearer the pavement, E.R.P.'s new bump steer kit from Performance Products was used to correct the steering geometry.

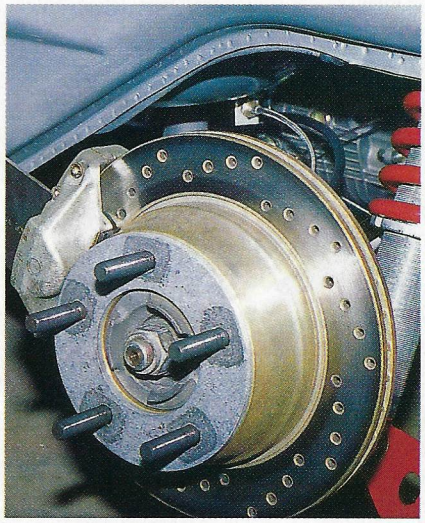
The last detail for the suspension was finding the right anti-roll bars to augment the entire package. Gretener equipped the S with relatively light bars from Smart Racing Products instead of going with the normal philosophy and bolting on the massive anti-roll bars found on every other 911 in the club paddock.

"You have to remember the roll bar is basically a horseshoe. Lift one side and the other has to go up," he said. "The roll bar is for smoothing things out; that's all it's used for."

As for the anti-roll bars, Smart Racing's engineers may not have reinvented the 911 bar, but they have surely taken their product to the next level. Instead of simply slipping their lever arm over the



E.R.P. mono-ball A-arm in place on 911S chassis.

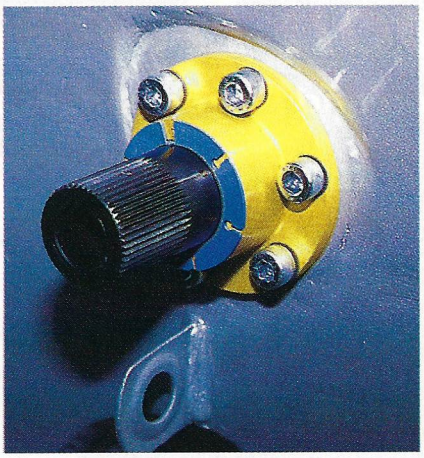


E.R.P. rear spring plate utilizing the original torsion tube for its attachment point.

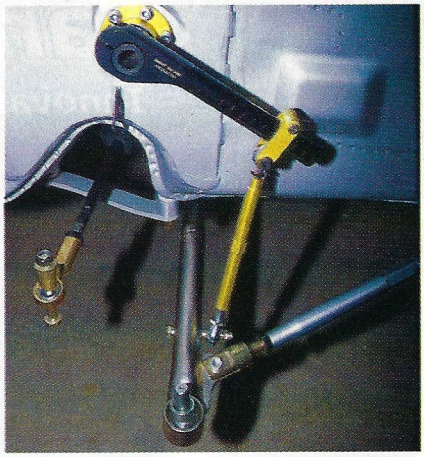
squared-off end and clamping it down, Smart Racing uses splines to ensure a secure and precise fit.

At the front, special mounting plates are used to strengthen the car's original attachment points. The front anti-roll-bar lever arms are longer than most aftermarket units, allowing adjustments from very light to extremely firm. The rear lever arm is uniquely designed with a slight curve, allowing the bar to move smoothly with the trailing arm, which keeps the drop links from binding regardless of the adjustment setting.

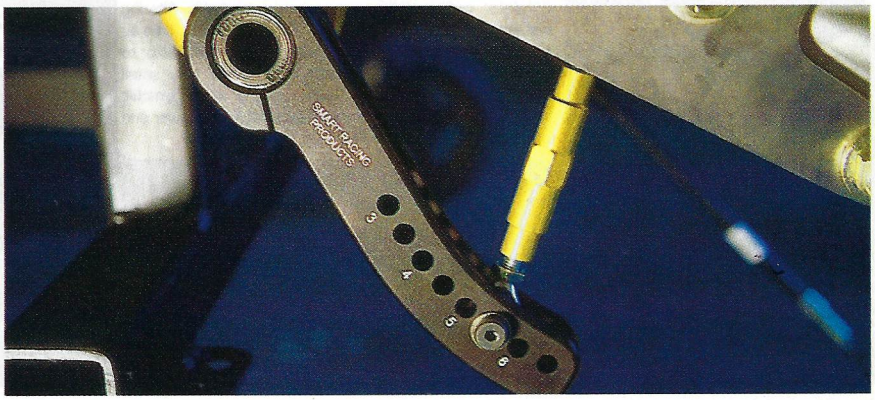
One of the advantages of the Smart Racing design is that the company offers a selection of replacement bars, from light 0.90-in. bars, the one used on the S, to a hefty shaft with 1.25 in. of diameter. When combined with the adjustable lever arms, the bars have working rates that overlap by 20%. This removes the frustration of discovering one bar is too soft while the next one is too stiff.



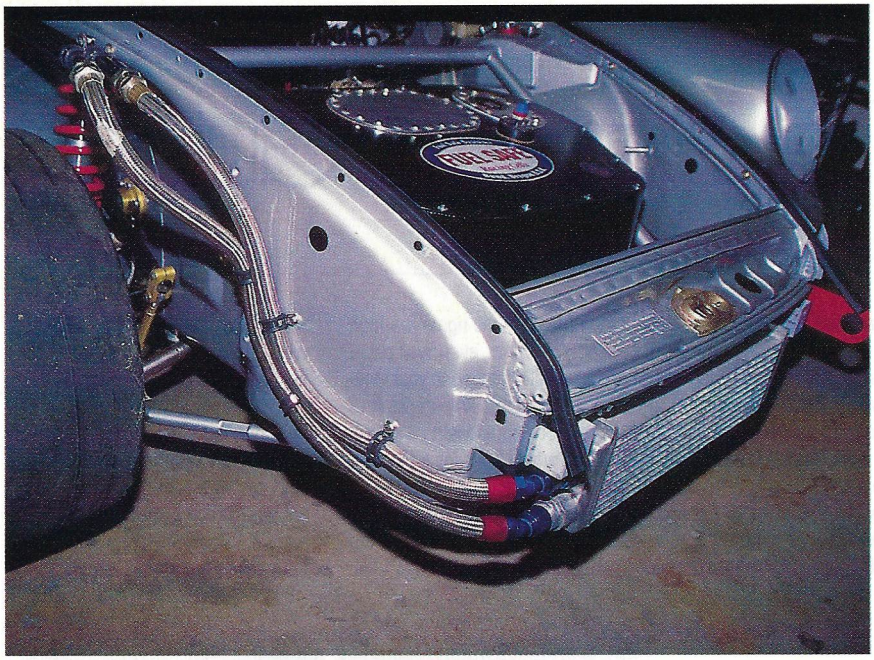
Smart Racing Products' reinforced front anti-roll bar bushing.



Smart Racing Products' front anti-roll bar affixed to E.R.P. A-arm.



The uniquely curved lever arm of Smart Racing Products rear anti-roll bar.



The complete package under the fender.

After nearly two years, Project 911 S was finally off the restoration dolly and crouching on its own four wheels. A few odds and ends still need sorting out, but it seems as though the time is rapidly approaching when I'll be sliding behind the wheel to see if the time and effort has created a racer deserving of the Weissach lineage.

If you are wondering exactly what springs we finally slipped beneath the S, let's just say that when it comes to spring rates, Gretener has his own advice. "Bigger is always better."

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