





# Miata MISSION

## Testing Three Suspensions on One Miata

story by tom heath • photos as credited

It's one thing to have a fun car. It's another thing entirely to have a fast car. Our 1994 Miata was obviously quicker in a straight line thanks to the addition of a Flyin' Miata FMII Hydra turbocharger system, but around an autocross course the stock suspension components and street-duty tires were easily overwhelmed.

The result was only a slight increase in lap times. Yes, we could generate all of the tire smoke we wanted, but our actual forward thrust hadn't improved that much. Plus, our car needed to become easy to drive at 10/10ths if it was going to thrive in the world of autocross.

One of the greatest things about the Miata is the enormous volume of relevant knowledge and hardware out there. The list of high-quality component manufacturers for the ubiq-

uitous little roadster is remarkably long, and improvements are typically bolt-on affairs.

Because so many solid suspension choices exist, we sampled a few before making our final decision. First step: formulate a plan of attack.

### Fancy Footwork

Most seasoned veterans will tell you that the wheel-and-tire package is the most critical component of any autocross effort. For our testing, we went with Nitto's NT01 tires.

In our experience, the NT01s tend to be very durable and consistent, making them the perfect choice for autocross testing. Despite their high level of grip, these R-compound wonders also hold up well for street use on lightweight cars like our Miata. We went with the 225/45R15 size, as it's a good combination of width and overall diameter.

While the Nitto's make perfect sense for our testing and local autocross events, national-level Solo events have been home to giant-sized Hoosiers—at least in our Super Street Modified class. These tires provide the greatest amount of traction possible under a Miata. We couldn't resist ordering a competition-only set for our run at the trophies at the 2009 Tire Rack Solo National Championships. We got the massive 275/35R15 size.

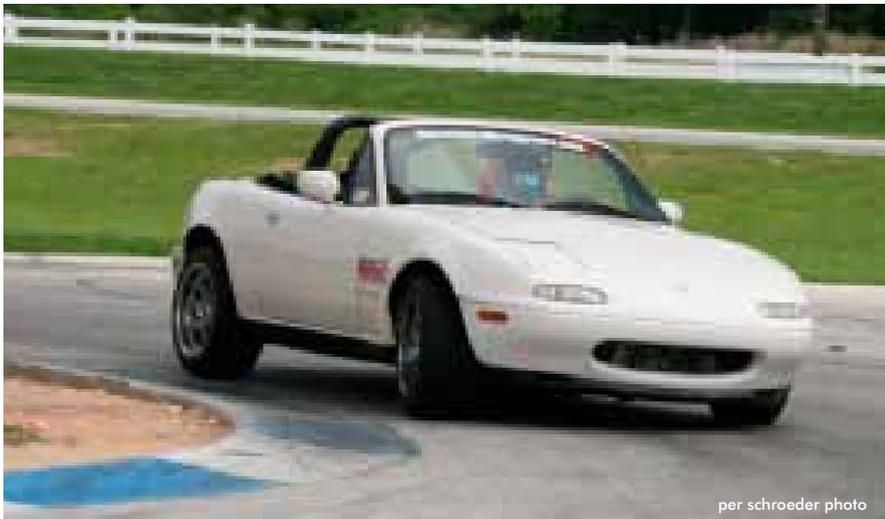
With two different sets of high-quality R-compound tires in our arsenal, we needed a wheel that would offer the proper support. Many of the 15-inch-wide wheels that can accept a 275-width tire

Our 1994 Miata R had served us well for more than 130,000 miles of street and autocross use, but it was long overdue for some fresh suspension components. Before we began testing, we upgraded from our street-oriented Fuzion ZRi tires to the stickier Nitto NT01s that we'd be using for autocross.



**RIGHT:** After traveling the equivalent of five times around the planet, our Miata R's stock Bilstein dampers were understandably beat.

**BELOW:** While the car was still fun to drive, it was sloppy around the corners and through the slalom. With the added grip of the sticky Nitto tires, body roll on the old stock springs was significant.



are custom made, but 949 Racing had just released a line of wheels aimed directly at Miata owners. Their 6UL wheels are available in a variety of widths to suit even giant tires like ours.

They're also extremely lightweight, with their 15x9-inch wheels tipping the scales at a scant 12.7 pounds. These 15x9s were the perfect solution for our effort: wide enough to accept the 275-width Hoosiers, but still narrow enough to accommodate the 225-width Nittos.

### Roll With It

Before we could start testing different suspensions, we needed to firm up our foundation. The stock anti-roll bars allowed a bit too much body roll, so we looked for alternatives.

When considering anti-roll bars, it's easy to fall into the "bigger is better" mentality and simply install the largest ones available at both ends of the car. After talking with some experts, we decided to take a more unconventional approach.

A few experienced Miata autocrossers have had success with a large front bar teamed with a bare rear. It's one less part to buy, install and test, and the move sheds weight from the overall package.

For the front, we installed a Racing Beat tubular anti-roll bar. With a diameter of 35mm, the Racing Beat tubular bar is one of the stiffest available for an early Miata. Its hollow construction also reduces weight.



Our first step was to replace the stock 20mm R-model anti-roll bar with a much beefier 35mm Racing Beat tubular bar. We included Racing Beat's Sway Bar Brace Kit to minimize the chances of the thick bar tearing out of the chassis under load.

Large anti-roll bars, big sticky tires, and a decade-old Miata chassis can be a dangerous mix, however. There have been numerous examples of failures from fatigued anti-roll bar mounts, so we went one step further and added Racing Beat's anti-roll bar brace kit. This device effectively increases the surface area of the mount, making it stronger and reducing the likelihood of failure.

### Spring in Our Step

We were fairly confident that the parts we had chosen so far would be effective when supported by a quality spring-and-shock package. Again, the market is littered with quality options. For our goal, however, we were looking for the best mix of overall grip, transitional response, and street-capable manners.

To determine which upgrade path would yield the best results, we planned our comparison around two aftermarket options, each with a budget cap of \$2000. A couple grand is hardly chump change, so we wanted to make sure that we were getting the most shock for our money. Plus, we could pass along good info to the rest of the world.

Our baseline setup would be the stock Bilstein shock absorbers fitted to our 1994 R-model Miata. The two upgraded packages also use Bilstein dampers: Bilstein HD shock absorbers that had been revalved for our car's specifications; adjustable spring sleeves; and a premium Bilstein PSS9 threaded-body coil-over system.

These three setups are only a sliver of what the aftermarket has to offer, but the results should be somewhat transferable to many other available setups. All three configurations feature a monotube shock absorber manufactured by Bilstein that's been tuned to work with a specific set of springs.

In the end, we were measuring two basic factors: the effect of different spring rates and how well the shock valving could control body motion. We grabbed our suspension parts and headed to Central Florida's Ocala Gran Prix kart track for some instrumented testing and timed laps.

## Stock and Soft

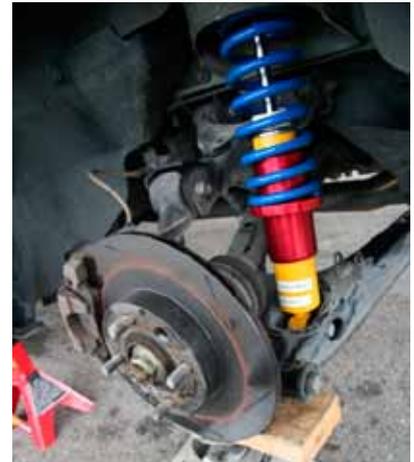
We started our day with the stock R-package suspension. Our Miata, like many others, came equipped from the factory with a set of quality Bilstein shock absorbers. Those are pretty choice units for a stock arrangement, and they have worked well with the stock springs.





tom heath photos

**LEFT:** Shaikh J. Ahmad of Fat Cat Motorsports was on hand to aid with the installation of his Variant 2 suspension setup. **BELOW LEFT AND CENTER:** The Bilstein PSS9 coil-overs are beautifully manufactured, feature a helper spring setup, and are easily adjusted with a precise clicking dial at the top of each damper. **BELOW RIGHT:** The Fat Cat Motorsports Variant 2 coil-overs on our application combine custom-valved Bilstein HD dampers with 425 lbs./in. front and 300 lbs./in. rear springs.



They are still mass-market, over-the-shelf components, however, and the softest in this test by far. The spring rates only measure 154 lbs./in. for the fronts and 94 lbs./in. for the rears. The damping characteristics, especially at low piston speeds, are less than ideal for passenger comfort. Additionally, these units had seen more than 100,000 miles of daily use and occasional abuse.

Around the short Ocala Gran Prix course, we noticed the same tail-out antics that we'd experienced at local autocross events. This forced us to be patient through corners and before applying more throttle when accelerating from the sweepers. The front of the car felt solid, although we hoped some of the other units would quicken the car's steering response thanks to their higher spring rates.

lap times	
36.89 sec.	
36.07	
36.54	
36.23	
35.77	
35.86	
36.02	
<b>average:</b> 36.19	
<b>range:</b> 1.12	

*subjective street comfort:*



Choppy and abrupt over bumps and road joints. They were also squeaky thanks to covering more than 100,000 miles of abuse. Spring rates: 154 lbs./in. fronts, 94 lbs./in. rears.

came from a 1999 car. Thank you, Mazda, for keeping those model updates simple and easy.

Once installed, we checked our alignment settings and went back out on track. We could immediately feel the PSS9's increased spring rate, as the car felt tighter and more composed during cornering and transitional moves. Lap times decreased notably as we dialed in our valving before going out for our final set of timed runs. (For our timed runs, we set the shock absorbers five clicks from full firm up front, full soft in the rear.)

The PSS9 coil-overs unconventionally use the same spring rate at all four corners, and at first we were skeptical of this arrangement. On track, however, the car felt surprisingly good. The rear end was still harder to control than the front, but the car had more grip and offered far better feedback than the R-package configuration.

lap times	
35.20 sec.	
34.64	
34.64	
35.09	
35.18	
35.48	
<b>average:</b> 35.05	
<b>range:</b> 0.84	

*subjective street comfort:*



The PSS9 shocks use a tender/main spring arrangement that helped a lot with small road surface changes, but big bumps were still fairly harsh. Spring rates: 343 lbs./in. front and rear.

## Getting Stiffer and Faster

Our second configuration was the Bilstein PSS9 coil-over kit. This setup features more adjustable, aggressive damping and significantly stiffer springs: 343 lbs./in. at all four corners. These nickel-plated units are both gorgeous and durable, and the kit simply reeks of quality.

The PSS9 was created for the NB-chassis Miatas—the cars built from 1999 through 2005—but they can be installed on the earlier models simply by updating the upper shock absorber mounts. Ours

## Custom and Composed

Finding a whole second of improvement over the stock shocks was very encouraging, and we were impressed by the PSS9 coil-overs. Our times were also closer together, indicating that the car was easier to drive consistently.

Our third suspension configuration is a custom product from cottage manufacturer Fat Cat Motorsports. Factors such as vehicle weight, driver





**ABOVE:** We posted our quickest times of the day on the Fat Cat Variant 2 setup. There was a night-and-day difference between how the car handled with the new equipment versus the worn-out stock components. Instead of sloppy roll through the slalom, our Miata was more nimble and kartlike than ever before.

## prices

<b>Racing Beat anti-roll bar brace kit:</b>	\$81.00
<b>Racing Beat tubular anti-roll bar:</b>	\$144.00
<b>Bilstein PSS9 coil-over kit:</b>	\$1499.00
<b>1999 Miata shock mounts:</b>	\$16.70 each (requires two)
<b>Fat Cat Motorsports Variant 2 coil-over set:</b>	\$1698.00
<b>Fat Cat Motorsports bumpstop kit:</b>	\$64.00
<b>949 Racing 6UL wheels:</b>	\$189.00 each
<b>Nitto NT01 225/45R15 tires:</b>	\$157.00 each
<b>Hoosier A6 275/35R15 tires:</b>	\$253.00 each

## sources

**949 Racing:** 6UL wheels, 949racing.com, (949) 716-3111

**Bargain Signs, Inc.:** vinyl wrap, bargainsignsinc.com, (727) 573-1526

**Bilstein:** PSS9 coil-overs, bilsteinus.com, (704) 663-7563

**Fat Cat Motorsports:** Variant Coilovers and Bump Stop kit, fatcatmotorsports.com, (408) 221-8247

**Flyin' Miata:** turbo kit, flyinmiata.com, (800) 359-6957

**Good-Win:** anti-roll bar and brace kit, good-win-racing.com, (858) 775-2810

**Hoosier:** A6 tires, hoosiertire.com, (574) 784-3152

**Nitto:** NT01 tires, nittotire.com

**Ocala Gran Prix:** ocalagranprix.com, (352) 291-0600

weight, wheel-and-tire package, anti-roll bar configuration and the end user's intended application are considered when Shaikh Ahmad designs each set, allowing a level of precision that simply can't be duplicated by a mass-produced coil-over. For our needs, Shaikh had prepared the coil-overs with 425 lbs./in. springs in front and 300 lbs./in. springs for the rear.

We used the Fat Cat Motorsports Variant 2 package, which consists of Bilstein HD dampers, adjustable spring perches, and specially selected springs. The Bilstein HD shocks are converted to adjustable specs thanks to Fat Cat Motorsports's gun-drilled shafts fitted with needle valves. We also used special foam bumpstops manufactured by Fat Cat to provide a more controlled transition as the spring runs out of travel.

Some initial laps helped dial in the shock valving: two turns from full stiff up front and 2.5 turns from full stiff in the rear. At the firmest shock settings, there was a bit of tramp over bumps. Softening the shock absorbers made our Miata feel downright smooth over pavement irregularities and surface changes.

The performance? Wow. Faster laps, more control. What really impressed us was the car's absolutely planted feel when receiving more throttle. We were able to get on the gas sooner and harder at nearly every corner exit, and we really had to provoke the car to induce oversteer. Combined with the comfort of this setup on the street, we were hugely impressed.

lap times	
	34.99 sec.
	34.65
	34.87
	34.65
	34.43
	34.79
<b>average:</b>	34.73
<b>range:</b>	0.56

*subjective street comfort:*



Against common logic, we found the stiff springs on the Fat Cat Motorsports package to be extremely comfortable. It was the fastest setup, too. Spring rates: 425 lbs./in. front, 300 lbs./in. rear.

### Lessons Learned

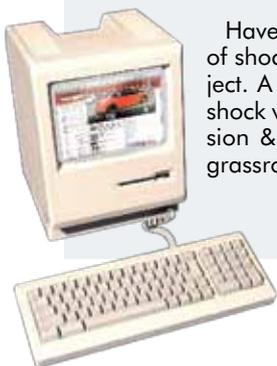
Looking back at the data, it's easy to see that a generally stiffer spring rate helps the chassis make use of the additional grip that an R-compound tire generates. Both the PSS9 and the Variant 2 showed a huge improvement in grip and drivability. For that last little bit of performance, however, it's hard to beat custom shock valving.

It's worth noting that each of the shocks we tested (even the R-package Bilsteins) can be rebuilt and revalved to suit your performance goals and car setup. Companies like Bilstein, Fat Cat Motorsports and others offer shock revalving to both extend the life of the units and yield more performance.

While this can be a path down a slippery slope, it can also result in some major benefits: faster laps and a more controllable chassis.



### More Online



Have questions about the inner workings of shock absorbers? Read up on the subject. A few tech articles specifically about shock valving can be found in the Suspension & Handling section of our website, [grassrootsmotorsports.com](http://grassrootsmotorsports.com).