



WHAT GOES BUMPS

How to install: Light Racing JounceShocks

By *Ned Bacon*

When it comes to suspension design, proper spring rates and great damping are essential to maintaining control at faster speeds. Faster speed over rough terrain creates more suspension movement, and eventually you run out of it. It is just before this bottom-out point that a secondary suspension system is crucial to vehicle durability/survivability and a fluid ride that doesn't compress your spine into that of a midget.

A secondary suspension, usually a rubber

bumpstop, is utilized in almost all OE suspension systems. While OK for street use, when subjecting a vehicle to rough off-highway abuse, the limitations of a chunk of rubber become readily apparent. This is where Light Racing's new JounceShocks come into play.

The JounceShock is a nitrogen- and oil-charged cylinder and shaft that, when properly installed, only comes into play during the last one half to one third of your vehicle's suspension travel. The body of the JounceShock is attached to the vehicle's frame, while a "target" or contact pad is attached to the moving axlehousing (live axle application), or lower control arm (IFS or IRS application). When the suspension nears its maximum upward travel, the tar-

△ Jumps like this are not a problem for the old Bee these days. When the rig comes down and the coilovers compress 11 of their 14 inches of travel, the JounceShocks come into play, and the final 3 inches are soaked up in a steep, progressive curve of energy absorption that translates into a smooth landing with no jarring jolt.

▽ These are the components that make up a JounceShock. On the left is one of two styles of mounts available that attach, via a thread-on design, the JounceShock body to the vehicle's frame. This mount is welded to the frame. In the middle is the JounceShock itself. They are available in two sizes: 1½ inches and 3 inches of travel (shown



here). The 1½ is 6 inches long overall, while the 3-inch is 9 inches long overall. Both bodies are the same diameter and use the same frame mounts and feet. Below is the thread-on nylon "foot" that comes in contact with the weld-on "target" below it when the vehicle's suspension travels upwards. The feet and targets are available in corresponding convex and concave shapes to fit different applications.

get comes in contact with the moveable shaft of the JounceShock. The suspension's upward force pushes the shaft into the J'Shock body, which is filled with nitrogen

and a bit of oil. Via valving, the shaft compresses the nitrogen, causing its pressure to increase dramatically since the cylinder is small and the travel of the shaft is 1.5 or 3.0 inches, depending on application. The increased pressure absorbs the force of the upward traveling suspension as a smooth exponential increase in force instead of a force spike which would occur if the suspension went metal to metal. (Read: painful spine compression.)

Once the upward travel energy is absorbed by the valving in the JounceShock, the suspension will rebound in the opposite direction (the speed of which is controlled by the regular shock

1 I utilized the 15-degree upper Flex Mount to attach the JounceShocks to the Bee's frame. Light Racing offers a ridged fixed mount for this position as well. You can see how the J'Shock body threads onto this mount after it is welded into position on your frame.

2 Here, a Flex Mount is tacked to the bracket I fabricated off of my frame in the proper position for a 1:1 contact ratio with my front axle when the front suspension bottoms out. Besides the universal application used here, Light Racing has kits available for some specific trucks. These kits incorporate this upper mount into special, weld-on mounts designed to fit in the optimum frame locations for these given vehicles.

3 This is an exploded view of the Flex Mount. It incorporates a rubber O-ring that allows for flex, yet also keeps things centered. This mount's purpose is to provide up to 7.5 degrees of misalignment in any direction when the J'Shock's shaft contacts the target. This is useful in reducing side loads to the unit in IFS applications where the suspension travels in an arc. It is also beneficial on a rockbuggy that misaligns its axle to its frame during huge flex. When using the Flex Mount, a concave or cupped foot and convex, or domed, target are recommended. This is the setup I went with, and it seems to work well in deflecting the JounceShocks during big flex. A ridged upper mount and domed foot and flat target are also available; these might work better in some applications.

4 The bottom of the JounceShock, where the nylon cupped or domed foot threads onto the shaft. Note the yellow cap in the center. Under this cap is a Schrader valve for changing the nitrogen pressure or the oil. My J'Shocks came with 80 psi of nitro, which proved to be too stiff for the 3,500-pound Bee. Reducing the pressure to 40 psi made a huge difference. By the time you read this, Light Racing will have probably reduced the initial 80psi pressure to 40 in all its universal applications. Also note the small hole at about 4 o'clock on the shaft. This is one of two holes around the base of the shaft that contain adjustment screws for fine-tuning the compression and rebound valving.

5 This shot gives you an idea of the overall size of a 6-inch-travel JounceShock. The silver-domed target is welded to the axlehousing in the exact location where the mounted J'Shock shaft makes contact when the suspension is 3 inches from being fully compressed. You can also see the valving adjustment screw a little better here.

absorber). Meanwhile, the valving inside the JounceShock doesn't allow it to rebound as fast as the suspension, so it doesn't contribute to pushing the suspension back out (like a rubber bushing will). This energy dissipation is one of the key reasons JounceShocks are so effective in controlling a vehicle when it's driven at high speeds over rough terrain.

Since a JounceShock is not engaged until the end of a vehicle's suspension travel, on-

road ride quality and ride height are unaffected. However, handling with a heavy payload can be improved if the suspension squats enough to engage the JounceShocks during sharp cornering or big bumps. Once off-pavement and driven at speed, your rig will feel like it never bottoms out and it will bounce around less. Care must be taken, as this added suspension capacity can mislead one into thinking the overall vehicle is now stronger and can take blows like a Trophy



Truck. An example of this came when the military was testing otherwise-stock GM trucks equipped with J'Shocks for use as Border Patrol rigs. The ride was so good, they unknowingly beat the trucks so hard that their frames spread and the engines fell out of the bottom of them!

So all this is great for going fast, but why put them on a rockcrawler? Well, if crawling rocks is all you do with your rig then yeah, they would be unnecessary. However,



I like my rig multifunctional. It's more of a dual-sport rig these days that can go fast or slow. The beauty of JounceShocks is that, for slow rockcrawling, they don't have any negative effect. I haven't noticed any change or limitation in articulation during extreme flex, and in fact, it feels more stable when completely twisted up or when climbing walls where the weight transfer is heavily rearward.

JounceShocks are available in a universal application. Light Racing also has developed specific kits to attach them to Toyota Tacomas, 4Runners, and the new FJs, as well as late-model F-150s and GM pickups. More applications are under development, including TJs and the new JKs. Pictures better explain the several clever ways J'Shocks are mounted, so check out the photos. And if you're ready to go faster in your rig, don't forget that all-important secondary suspension that takes the shock out of your jounce.

6 The complete JounceShock assembly as mounted at the right rear of the Killer Bee. Note that the mount you fabricate must be strong enough to withstand the blows of a harsh bottoming-out. Gussets and triangulation help here.

7 For slow rockcrawling, the JounceShocks do not hamper articulation. They do, however, make the rig feel a little more stable when teetering on opposing axle ends.

8 When leaping off of whoops, its reassuring to know when you come crashing down you've got JounceShocks to cushion the blow. Just remember, even though your ride may feel more indestructible, it's only as strong as its weakest part. After about a dozen jumps to get shots for this article, a 10-year-old control arm broke and ended our photo session. Back to the drawing board ...FW



SOURCE

Light Racing
800/525-6505, www.lightracing.com



TO CRAWL OR HAUL? DO BOTH

Installing Rancho's RS 9000X Pro Series coilover shocks on the Killer Bee

By Ned Bacon Photography: Ned Bacon

"**W**ow, I should have installed these things years ago!" This was the first thought that went through my mind after hitting a familiar bump and feeling virtually nothing. This bump, if hit at half the speed I was now traveling, would have previously sent a compressing blow up my spine and a whiplash effect to my neck. My old Killer Bee rockcrawler has been transformed into a prerunner buggy. It's now capable of flying over rough terrain that previously meant slow going or suffering painful repercussions up one's backside, not to mention worrying about breaking or bending the thing.

How did this phenomenon come about? Three items: Coilover shocks, proper spring rates, and nitrogen bumpstops. First, a little history: I set up my Willys-based Jeep with a homebuilt and home-designed coil-spring suspension back in 1996. At the time, I stretched the wheelbase from 81 to 98 inches and utilized 3% x 14-inch free-standing stock car coils from Afco. Not knowing any better, I assumed the front was heavier than the rear and I needed a stiffer-rate spring up front. I started with 300 lb/in in front and 250 lb/in in the rear. Over the last 10 years, the control-arm geometry has been improved, various shocks have been tried, and all the springs wound up being 300-pounders. For slow-speed, high-articulation rockcrawling, the Jeep worked great, pulling off some amazing feats over the years. But when asked to go fast over washboard roads or rough two-tracks, the ride was akin to a bout in the ring with a prizefighter. It just flat beat you up.

I put up with this ride for so long



because (a) it rode so much better than leaf springs and an 81-inch wheelbase, (b) it worked so well in the rocks, I was afraid to mess with it, and (c) I was worried about the expense of coilovers and the seemingly trial-and-error approach to getting them set up properly. It seemed that everyone I talked to had a different answer, and nobody was quite sure about anything. However, they were doing something right because trying to hang with friends in newer, coilover-sprung machines was impossible. So I went coilover shopping.

There are many quality coilover shocks on the market, and all of them are fully rebuildable so you can fine-tune them to the ride you want. Choosing the correct coil springs to slide over the shocks requires knowing the ideal spring rates for your rig. Finding this is a process that involves math and formulas, subjects I'm terrible at. I could see why I'd put this modification off, and was contemplating continuing to do so. Then Rancho came out with its RS 9000X Pro Series fully adjustable coilover shocks. At less than \$400 apiece with the coils included, they are a bargain, and Rancho's Web site (www.gorancho.com) has a section devoted to choosing spring rates that even my math-impaired brain could figure out. The shocks are offered in 32-inch and 36.29-inch extended lengths.

The RS 9000X features an adjustment



1 This is one complete 36-inch extended-length RS 9000X as shipped. The two Eibach springs are included in the price, and you can pick your rates anywhere in a range between 80 and 350 lb/in. The shorter 12-incher goes on the top and is a lighter rate than the longer 14-inch unit which is installed on the bottom. The formulas to figure out the proper spring rates for your rig can be found on Rancho's Web site. Be prepared to know the weights of various components of your rig in order to dial in the proper suspension tuning for it.

2 Assembling the shocks is easy and doesn't require any special tools. First, slide this aluminum adjuster sleeve and threaded collar onto the shock body.

3 The adjuster sleeve is installed from the bottom of the shock (as are all the spring components). It bottoms out against this lip formed in the shock body.

knob, just like the company's other 9000-series shocks. This knob allows you to adjust the shock's damping characteristics without taking them apart to change shims and/or oil volume. You can even set them up with an in-cab remote for on-the-fly adjustments of compression and rebound damping. While they may not be as tunable as higher-dollar, take-apart shocks, that little knob still makes a huge difference in ride quality from 1 to 9, and the range is more than adequate for a rock buggy. Hell, we're not running the Baja 1000, and our rigs are far from Trophy Trucks! Although we'll probably never run 1,000 miles flat-out, the RS 9000Xs still feature remote nitrogen-charged reservoirs for extra fluid capacity, which keeps the shock from aerating (and then fading) during long high-speed runs.

An area of concern is the weld on the mounting eyes which replace the cool looking, and much stronger, CNC-machined units on higher-dollar shocks. When utilizing a coilover as your spring medium, all the weight of your rig is supported through the shock's eyelets, and in the case of the Ranchos, by these welds. Break one, and your suspension collapses. The question is,

just how strong is strong enough? So far I've had no problems. Further convincing that they are strong enough came after watching Rancho's own Bob Willis beat the stuffing out of the company's rock-buggy racer at a rock race in Moab. Bob, and the car's builder, Rob Bonning, have both told me they have only broken one shock in two years of competitive racing. While they don't look as nice, the Rancho welds do feature Heim-jointed eyelets that, after months of my pounding them, have yet to become loose or start squeaking.

So the shock bodies seem strong enough, and the damping they provide is awesome, so the next issue that needs to be addressed is choosing the springs. Rancho sells the RS 9000X complete with two Eibach springs per shock, plus the necessary adjuster ring and slider. Rancho offers spring rates ranging from 80 to 350 lb/in, in both 12- and 14-inch heights. The rates you want can be calculated with the info on Rancho's Web site. I went one step further and consulted with someone who really understands chassis dynamics. In my case, that is Jim Frens from Nth Degree Mobility. The numbers needed are axle

weights front and rear, the total vehicle weight, the front-half weight and the rear-half weight of the whole rig, and the weight of a tire and wheel. From these numbers, Jim calculated my static spring load and determined the best spring rates for the front and rear. These numbers are then plugged into another formula to determine the best individual rate for each of the two springs that are stacked together over each shock body, providing a progressive rate and allowing a proper frequency split, front to rear. The frequency split is important so the rig won't "hobbyhorse" over washboards or consecutive bumps.

Then there is more math to fine-tune the rates after taking into account the angles the coilovers are mounted in relation to the axle/frame centerlines. As you can see, it's a complicated process that involves a more in-depth explanation than we have room for here.

Suffice to say, he got it right, or at least far better than it's ever been. The Jeep is an entirely different vehicle when driven fast on rough roads. No longer do I cringe at an upcoming bump or dip that there is no time to slow down for. In the Oregon sand dunes recently, the rig was incredible, soaking up witch's holes and jumps like a proper sand buggy. But the best part is I have not found any of the Bee's rockcrawling ability to have been compromised. None of its control-arm geometry has changed, so it 'wheels like it always has and actually has more travel and more ground clearance than before. An added bonus of coilovers is that they are adjustable for height, so I've been able to add a little. The 36-inch-long shocks with 14 inches of travel also allow the axles to articulate further than before.

There was still one more component that needed to be addressed. Physics is physics, and what goes up must come down. Having the proper spring rate and great damping to control it adds up to faster speed. Faster speed creates more suspension movement, and eventually you're gonna run out of it. This is when things can get ugly as metal collides with metal. This is the zone where good bumpstops come into play. For the answer to this problem, see "What Goes Bump" on page 80.

In retrospect, after experiencing the huge improvement in ride and the dual sportability the old Bee can now achieve, I wish I'd installed coilovers a long time ago. However, there weren't Rancho RS 9000Xs around until recently, and between their friendly price, helpful Web site, and built-in adjustability, I think they were worth the wait.

SOURCE

Rancho Suspension
www.gorancho.com



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4 Next, slide the 12-inch, lighter-rate spring into place. Then slide the nylon slider onto the shock body. I originally installed it (as this photo shows) with the long side of the sleeve up. After a few test runs, I noticed that the slider was bottoming against the adjuster sleeve before the upper spring was reaching total bind. This was limiting the total travel of the softer end of the progressive rate the dual-spring setup provides. A flip of this slider, so that the short side was up, solved the problem.



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5 The 14-inch, higher-rate bottom spring is then installed against the short side of the slider. Finally, the aluminum spring retainer slides on, and the whole package is ready to install on your rig.



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6 This is my area of concern. The shock's spherical rod-end mounts are welded on instead of being CNC-machined pieces like those found on higher-priced coilovers. Time will tell how they hold up, but so far, after eight months of abuse, all is well. Note the red adjuster knob, which has nine positions of adjustment for compression and rebound. The difference between 1 and 9 is huge and very noticeable from the seat of the pants.



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7 The RS 9000X is equipped with remote nitrogen-charged reservoirs for extra fluid capacity. This aids in keeping the shock from fading during prolonged use at high speeds. It's doubtful a rock buggy will ever generate enough prolonged speed to overwork these shocks—think prunning a 250-mile desert race course flat-out. (Note: I just had to change those Rancho Red coils to Killer Bee Yellow.)

8 Before: This was the right-front suspension setup on the Bee before changing to coilovers. The coils were 300 lb/in, 3/8 x 14-inch Afco stock-car units and were captured at both ends. Shocks were Bilstein 6000s. Note the tennis balls inside the springs that provided a bit of bumpstop action.



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9 After: Changing over to the Rancho coilovers was pretty easy. They fit in the same place as the old shocks. I had to reinforce the mounts to handle the weight of the entire vehicle being passed through them. The brackets that held the old springs are now utilized for the Light Racing JounceShocks featured on page 80. FW



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