We’ve taken the leading brands of shock absorbers and put them through the biggest no-bull, real-world comparo yet!

WORDS BY PAUL ZIELINSKI, PHOTOGRAPHY BY ANTHONY WARRY
Undoubtedly, the humble shock absorber is one of the most underrated components in a 4WD’s suspension. Off-road your 4WD’s suspension, in particular the shock absorbers, is under enormous forces, rapidly moving up and down. Without a set of shocks fitted, you’d be lucky to drive little more than 50m before the vehicle was overcome by an uncontrollable bounce.

With this in mind, we’ve undertaken a comprehensive no-bull shock absorber comparo to help you get the most out of your 4WD set-up. This comparo focuses on real world and uncontrollable bounce. This comparo isn’t enough, we test vehicle, the shocks had nowhere to hide and were set to get put through their paces. To keep the testing completely objective, we had Bruce test each set of shocks without knowing what brand was fitted each time.

As if the driving leg of this comparo wasn’t enough, we punished each shock on the dyno. Utilising state of the art equipment, we were able to precisely rerun every bump each shock went through on our test track back on the shock dyno. Each shock was graphed for performance before and after the run to determine if shock fade was a factor. So sit back as we tackle the biggest shock comparison test we’ve ever done!

**INSTALLATION TIP**

By cycling the shock through its outer tube where it belongs. Bled out, keeping it in the top of the head of the piston in the shock. Valve and become trapped behind. There’s a chance gas may have made its way into the piston chamber through the foot period of time. Gas rises to the highest part of the shock after they have been lying down for a cycle. With Bruce on the strength and weaknesses of each shock along the way. As if the driving leg of this comparo wasn’t enough, we punished each shock on the dyno. Utilising state of the art equipment with a data replay facility, we were able to precisely rerun every bump the shock went through on our test track back on the shock dyno. Each shock was graphed for performance before and after the run to determine if shock fade was a factor. So sit back as we tackle the biggest shock comparison test we’ve ever done!

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**THE TEST MULE**

The ‘Cruiser was lowered onto a set of wireless scales to measure both individual corner weights and total vehicle weight.

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**THE SHOCKS WE TESTED**

<table>
<thead>
<tr>
<th>Brand</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Koni</td>
<td>RS9000 XL</td>
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<tr>
<td>Rancho</td>
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<tr>
<td>BilsTein</td>
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<td>Aussie Ryder</td>
<td>Heavy Track</td>
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**THE TEST MULE**

The Cruiser is a typical 4WD with a number of accessories to help it along in the bush. It’s fitted with steel front and rear bars, rear wheel carrier, long-range tank (180L aftermarket sub tank + 90L factory main tank). It’s also fitted with a roof cage, rear cargo drawers and 285/75 R16 Copper STT tyres wrapped around a set of steel wheels.

On the suspension side of things, we had a new set of heavy-duty 2in lift King Springs that were fitted by the guys at Wholesale Suspension in Penrith. The team also thoroughly shocked over the Cruiser to ensure everything was in top shape prior to the testing getting underway. This way we could compare the performance of each set of shocks closely, knowing the Cruiser’s suspension components remained consistent during the test and worn parts were not influencing the ride quality.
TWIN-TUBE SHOCKS

At touring speeds, controlling spring movement is no easy feat. Every bump that’s felt from inside the vehicle will be cushioned significantly by your springs and shocks. If the shocks aren’t up to the task, you’ll find most 4WDs will be dancing all over the track. Not only will worn shocks make for an uncomfortable experience for everyone on-board, but it makes travelling at any speed dangerous.

There’s a fine line that shock absorber engineers balance when designing a shock to get the maximum amount of control without jeopardising comfort. Countless hours of R&D are invested by shock manufacturers to refine the shock’s performance to suit each vehicle and application. It’s this balance of control and comfort that defines a good shock absorber.

BEHIND THE COLOURFUL PAINT

As with many off-road products, there are various designs and features that set out to achieve a similar result – shocks are no exception. Within the range of shocks we had for this comparo we had a mix of mono-, twin- and triple-tube design shocks, shim, spring and needle valving, and both adjustable and fixed valving. It makes travelling at any speed dangerous.

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NOT ALL SHOCKS ARE CREATED EQUALLY

The majority of shock absorbers on the market are twin-tube design shocks. This style of shock has an outer oil chamber surrounding the main tube. The piston works similarly to a mono-tube shock with the addition of an extra valve in the base of the shock that allows fluid to pass into the outer oil tube.

The hydraulic oil and gas are together in the same outer chamber, which once the shock starts working hard can cause some aeration or foaming. To combat this foaming effect, some manufacturers install a material barrier to limit the oil and gas blending.

Foam is a material that is most commonly used in the top section of the outer tube cavity. The foam cell is designed to capture any gas bubbles and keep them from mixing with the oil. The Tough Dog shocks that we tested were foam cell designed twin-tube shocks. Small gas-absorbing bags, known as gas cells, are also used by some manufacturers and are designed to capture any rogue gas particles in the outer tube to keep them separate from the oil. The Raw Nilco Max shocks we tested utilise this gas cell design in its twin-tube shock.
This style of valving is made up of small disc-shaped shims that are fitted to the head of the piston. As the piston moves through its stroke, the oil is forced through small ports in the piston, which push against the shims. The oil then begins to flex, allowing the oil to pass through at a controlled speed. If you are looking for a 4WD well, there are a number of factors that are calculated into the R&D process before a shock becomes suitable for a specific vehicle and the intended application.

Shock absorbers need to be able to control suspension movement over a range of different speeds and terrains. They convert kinetic energy, or movement, from the vehicle's suspension as it reacts to bumps into thermal energy, or heat. The harder a shock works to control your 4WD's suspension, the more heat that it will generate. To be able to control your 4WD well, there are a number of factors that are calculated into the R&D process before a shock becomes suitable for a specific vehicle and the intended application.

Bump and rebound are two forms of movement that a shock absorber is subjected to. Bump (or compression) is any movement where the wheel is traveling up into the guard, closing the shock. Rebound is the term given to movement of the wheel away from the guard, opening up the shock. Bump and rebound also factors in energy from the spring as it tries to return to its normal ride height after a bump. There are also factors such as port (or orifice) sizing and the grade of hydraulic oil circulating around the shock.

There are several different types of shock valving on the market, each one designed for specific applications. The most common type of valving is the disc and needle valve. The disc valve is a small disc that is fitted to the head of the piston. As the piston moves through its stroke, the oil is forced through small ports in the piston, which push against the disc. The disc then begins to flex, allowing the oil to pass through at a controlled speed.

Some shocks use a different type of valving, such as the "shim stack" style. The shim stack style is made up of small disc-shaped shims that are fitted to the head of the piston. As the piston moves through its stroke, the shims begin to flex, allowing the oil to pass through at a controlled speed.

The manufacturer can vary the thickness and quantity of these shim stacks to give the desired release pressure as the piston travels through the oil. This is known as a "mono-tube" design, and is commonly used in twin-tube shocks. Old Man Emu, TJM, King, Ultimate Suspension, Bilstein and Terrain Tamer all utilise the shim stack style valving.
How We Tested Them

Real-World Testing

Many 4WDers will have an idea of what their preferred level of comfort is. What can’t be denied is the feedback from the driver’s seat from a shock that is able to give good control on and off the road. The key to a good shock is a balance of control and comfort that ultimately creates a safer 4WD.

With this in mind, we set out to push each shock through a series of driving tests that would most certainly expose both the strengths and weaknesses of each shock. Following the off-road test, we covered a 25km on-road section that had a mix of tight sweeping turns along with high-speed straights to gauge how the shocks impact on the on-road handling. After all, we spend a reasonable amount of time travelling on the blacktop between tracks.

The object of the dedicated off-road test track was to replicate the same conditions for every shock. This way we could directly compare how each set of shocks handled specific sections and obstacles on the track. Being the only vehicle on the track, we were able to follow the same wheel tracks for each test without being interrupted by any other vehicles.

Two loops of the dedicated off-road test track were covered for each set of shocks, with the top four performers refitted for a shootout. The first loop of the track was taken at a general touring pace. We set a target time of 10 minutes to keep the speed of each run consistent. The aim was to travel at the pace an owner would drive after just purchasing their new 4WD.

On the second loop, we asked Bruce to step it up a notch, taking a slightly quicker pace. This second run was asked to push the shocks to their limits and replicated a slightly more demanding driving style. This run had a target time of eight minutes.

Both loops were driven back to back with individual shock temperatures noted after each run. From these on- and off-road tests, we were able to establish the different characteristics each shock had and the overall influence on the body language of the truck, which we’ll outline in the rundown of each brand.

Wayne made short work of swapping in each set of shocks for the real-world testing.
The real-world testing brought out significant differences in each shock’s performance that were noticeable from inside the vehicle. To top off this comparo, we wanted to see how each shock was really affected by the heat generated during the off-road leg of our test.

To do this, we tracked down a state-of-the-art shock dyno that was able to capture and replay the exact terrain we used for our off-road test track. By hooking up a displacement sensor to one of the shocks during the real-world testing, we were able to record the two off-road loops. The data we collected was then able to be replayed on the dyno once we were back in the workshop.

A rear shock from each brand was loaded on the dyno one after the other and run through a standard cold performance test to gauge the base values for the shock. The dyno then replayed the first off-road loop, followed by the quicker second off-road loop back to back. Once the punishment from the two off-road loops had finished, we re-ran the standard performance test to establish if the shock had degraded once it was hot. It’s one thing being inside a vehicle in harsh off-road conditions, but seeing what the shocks are subjected to back on the dyno is enough to give any self-respecting 4WDer cold shivers.

WHAT TO LOOK FOR

When you’re looking over the performance graphs, there are a few things to look out for. During the performance test, the dyno cycles the shock over a set stroke at nine different speeds – from 0.05m/s (meters per second) to 1m/s. The columns along the bottom of each graph represent each of the nine test speeds, 0.05m/s, 0.1m/s, 0.2m/s and so on. Their measured forces are displayed as a dot on the graph above each column. The top half of the graph shows the rebound forces and the lower half shows the compression forces. Blue correspond to the cold performance test and red is for its hot test.

As a general rule, you will see low forces in the 0.05m/s to 0.2m/s range so the shock remains compliant during low-speed rock crawling situations. From 0.25m/s onwards, the forces will progressively ramp up to control the vehicle at touring speeds. The compression forces are always lower than the rebound, as rebound has to control the spring’s urge to return back to its original height after a bump in the road.

We’ve also measured shock temperatures at the completion of the cold and hot performance test. While the difference is displayed as a percentage of change from start to finish, things such as oil volume, twin or mono-tube design and how firm the valving is tuned all influence how heat will affect the shock.

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SHOCK FADE

Shock fade is a term given to the soft feeling a shock can develop after being punished over long stretches of harsh terrain. Not all shocks are created equally, and some will be affected by fade more than others.

Shock fade begins to occur as the gas starts to overheat and tiny bubbles become mixed in with the hydraulic oil inside the shock. Once these tiny bubbles make their way to the piston chamber, they start to pass through the valving much more easily compared to the hydraulic oil. This reduces the shock’s ability to control rapid suspension movement. Generally giving a soft, uncontrolled feeling back to the driver that’s often noticed as excessive bounce over bumps.

If you notice this happening to your vehicle, it’s best to stop for a break to give the shocks some time to cool down. Once you get back home, get them checked, as it might be time to upgrade.

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Just before we get stuck into the individual rundown from inside the vehicle. The firm tested, but it was still acceptable of the firmest out of all the shocks that we did find the ride to be one trade-off for that precise control is control for the driver. The slight adjustments can still be made to it’s set on the lowest setting, from soft, as per Koni’s recommendation. It was matched well to the ‘Cruiser with its extra gear and firmer ride. As a trade-off to the slightly firmer ride, you develop some firmer steering inputs were very direct and allowed for good feedback to the driver. They proved to give a very predictable ride both on and off-road.

KONI – HEAVY TRACK

The Koni Heavy Track shocks have the benefit of being adjustable. The main purpose of the adjustability is to compensate for wear as the shock, along with the rest of the suspension, gets a few years under its belt. The shock must be removed and compressed to carry out the adjustment.

While Koni originally tune the shocks to match the vehicle when it’s set on the lowest setting, adjustments can still be made to suit personal applications. A cam engages with the foot valve in the base of the shock when it’s fully compressed. By turning the body and shaft clockwise, it adjusts the valve and stiffens the rebound force of the shock. It can change the feel of the shock up to a maximum of 100% stiffer than its softest setting.

We tested the Koni Heavy Tracks on a setting of one and a half turns from soft, as per Koni’s recommendation. It was matched well to the ‘Cruiser with its extra gear and heavier springs. They showed terrific on-road characteristics were also improved, giving a great deal of confidence back to the driver at touring speeds. Overall, this shock is a great driver’s shock if you can deal with a slightly firmer ride.

BRUCE’S OPINION

Bilstein is no stranger in the world of high-performance shocks, and while you might find yourself paying a little more initially for each corner, the rewards are clearly evident. A strong performing mono-tube shock that is fully rebuildable. The Bilstein 86 Off-Roads hold their own over practically every terrain we could throw at them. They provided great feedback and control for the driver. The slight trade-off for that precise control is that we did find the ride to be one of the firmest out of all the shocks tested, but it was still acceptable from inside the vehicle. The firm ride is only a small price to pay for the direct control for the driver.

BILSTEIN – B6 OFF-ROAD

Bilstein is an off-road shock professional, and their Heavy Track Shock is a true testament to that. Bilstein Heavy Track shocks are made of lightweight plastic and would help to deaden the sound of stone grinding through the painted surface. It’s set on the lowest setting, from soft, as per Koni’s recommendation. It was matched well to the ‘Cruiser with its extra gear and firmer ride. As a trade-off to the slightly firmer ride, you develop some very favourable handling characteristics from behind the wheel.

The ‘Cruiser hard on the second loop. Both off-road and particularly on-road characteristics were also improved, giving a great deal of confidence back to the driver at touring speeds. Overall, this shock is a great driver’s shock if you can deal with a slightly firmer ride.

BRUCE’S OPINION

The Old Man Emu Nitrocharger Sport shock was a strong performer in both the real-world testing and on the dyno. It’s great to see products that have been 100% designed and manufactured in Australia giving the offshore market a run for its money. The stone guard on the QME shocks is made of lightweight plastic and would help to deaden the sound of stone impacts from under the vehicle. We did notice by the end of unit testing that the stone guards had begun to slightly rub on the sides of the shock body. Although supertufi, over time this may lead to a small amount of rubbing through the painted surface.

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BRUCE’S OPINION

These shocks held up superbly over the first and second-off-road test, maintaining a consistent feel from inside the vehicle over every terrain. The ride was noticeably stiffer than most other shocks, but this is always going to be a trade-off for a high level of control on the track. On-road, they were one of the most direct and responsive sets of shocks in the test. They showed terrific on-road manners, especially at weight shift in the transition between left and right bends at speed.

OLD MAN EMU – NITROCHARGER SPORT

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While the Terrain Tamer shocks were a little on the softer side of the shocks we tested, it did leave you with a comfortable ride from inside the vehicle. All in all, they’re a great budget shock that is up to the task. Coming up as the most affordable shock in the test, they definitely proved their worth amongst the some of the dearer shocks in both the real world and controlled environment testing.

The Rancho RS9000XL shock is one of the best-performing shocks on the market. With a high level of control and comfort, it’s suited to a wide range of driving conditions. Being an externally adjustable shock, it comes with the benefit of tuning the shock’s performance to suit a wide range of driving conditions. For our off-road test, we started Brucie off with the lowest setting of nine, but soon found it to be way too soft to control the big ‘Cruiser’. After a quick adjustment, Wayne adjusted them to their maximum stiffness setting of nine so we could continue with the test.

The Rancho uses a unique valving setup, which incorporates a tri-tube design body. The valving is controlled by a spring-loaded needle in the foot of the shock. This needle valve is directly behind the adjuster knob and controls the flow rate of oil transferred around the shock.

Being on the soft side, it did take away some driver confidence at touring speeds, on and off-road. This shock would be best suited to low-speed off-road work and may well be more at home on a lighter vehicle.

The Raw 4x4 Nitro Max is one of the best-performing shocks on the market. With a high level of control and comfort, it’s suited to a wide range of driving conditions. Being an externally adjustable shock, it comes with the benefit of tuning the shock’s performance to suit a wide range of driving conditions. For our off-road test, we started Brucie off with the lowest setting of nine, but soon found it to be way too soft to control the big ‘Cruiser’. After a quick adjustment, Wayne adjusted them to their maximum stiffness setting of nine so we could continue with the test.

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The Tough Dog Foam Cell came in section of the rear shocks. Skin on the vulnerable lower have a secondary stone guard were one of the only shocks to utilise the foam cell design. They at 41mm, and the only shock to utilise the foam cell design. They

A combination of great value handling and steering response (pitch and roll)

Performance helped the Tough Dog Foam Cell take the crown of some serious competition. –

The Ultimate Suspension shocks did really well over the slow-speed bumps. They gave a comfortable ride from inside the vehicle while still giving confidence to the driver as they reacted to the terrain. They also have the benefit of being rebuildable for great long-term value.

In fact, in most cases the shock can be rebuilt for as little as $60. The warranty period of two years or 50,000km has a slightly different twist – it’s whatever comes last! So for example, if you find you’re only covering 20,000km per year, then the warranty will cover you for four years.

The Ultimate Suspension – Aussie Ryder

BRUCE’S OPINION
These shocks worked well with the vehicle, giving a nice controlled balance without being too firm. At slow speeds off-road, these shocks really worked a treat soaking up the terrain slightly more than others. On some of the quicker sections of the track, a small trade-off to the softer ride was as the shocks began to move faster through their stroke, they did allow the ‘Cruiser to pitch and roll a little more than the others when they faced off-camber crests.

If you don’t mind a softer feel from inside the vehicle, then these shocks would serve you well.

TJM - XGS Gold Limited Edition

BRUCE’S OPINION
This set of shocks is by far one of the softest-feeling shocks over the bumps. In the driver’s seat, the shocks didn’t inspire confidence when you asked them to control the weight of the ‘Cruiser along the track. If you’re looking for a particularly softer ride, these shocks would suit your style. Out of the variety of terrains we pushed them through, they were most at home over the low speed off-road tracks.

BRUCE’S OPINION
On the outside, the TJM XGS shocks have all the right ingredients for a tough, bush-ready shock. Steel slung guards, compliant rubber bushes and a generously sized outer body. They also have a built-in hydraulic bumpstop that assists with preventing shock damage on full compression. Needless to say, your vehicle should always make contact with independent bump stops before relying on the shock alone to limit up-travel.

SHOCK NAME: THE ULTIMATE SUSPENSION

Performance helped the Tough Dog Foam Cell take the crown of some serious competition.

SHOCK NAME: TJM – XGS GOLD

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SHOCK NAME: TOUGH DOG – FOAM CELL

The Tough Dog Foam Cell came in with the longest stroke out of the rear shocks we tested. It was also the equal-first largest bore size at 41mm, and the only shock to utilise the foam cell design. They were one of the only shocks to have a secondary stone guard skin on the vulnerable lower section of the rear shocks. A combination of great value for money and outstanding performance helped the Tough Dog Foam Cell take the crown of Best Shock Overall amongst some serious competition.

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<tr>
<td>Ability to limit harshness inside the vehicle handling and steering response (pitch and roll)</td>
<td>0</td>
<td>0</td>
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</table>
WE WOULD ALSO LIKE TO THANK:
Wayne ‘Wayno’ Murphy from Mad Fab for his handiwork on the spanners throwing in each set of shocks for this comparo. You can contact Wayno on 0404 586 139 if you’re looking for any custom 4WD fabrication.

The team out at Wholesale Suspension in Penrith for their help fitting the springs and giving the ‘Cruiser a complete check over prior to our testing. Check them out at www.wholesalesuspension.com.au or on (02) 4721 2112.

King Springs for supplying a set of 2in lift springs that perfectly suit the ‘Cruiser with all its extra gear. For your nearest King Springs dealer call (07) 5539 6700 or head to their website at www.kingsprings.com.

And last but not least, a special thanks to Bruce Garland for taking some time out of his busy schedule to come away for this comparo. You can follow Garland Motorsport as the team prepare their race-bred D-Max at www.isuzumotorsports.com.

THE VERDICT

Whether it’s driving to the limits on tough off-road tracks or long-distance touring that gets you going, your shocks will need to be up to the task. Without a good set of shocks under vehicle, you could be risking your tyres leaving the ground unnecessarily. Not only will this result in a loss of traction, but it can be downright dangerous when you’re travelling at speed. A lot of factors that we all regard as good suspension characteristics rest on the shoulders of our shock absorbers. So, it pays to give them some attention before we come undone on the track.

The back to back, real world and controlled environment testing in this comparo brought out some interesting differences between the shocks. The shocks had nowhere to hide with Bruce Garland behind the wheel. The variation in characteristics we picked up between the shocks are things the average 4WDer would feel from inside the vehicle, either as a driver or passenger.

Given that every 4WDer has a preference to the way a vehicle feels behind the wheel, it was one of our most difficult comparos to rate. With price, on- and off-road performance and long-term durability in mind, we were able to crown the Tough Dog 41mm Bore Foam Cell as the Best Overall Shock, but it did have some pretty serious competition along the way.

Koni, Old Man Emu, Bilstein and Raw 4X4 were all wrestling with Tough Dog for the top spot. The superb handling characteristics of the Bilstein helped it come away as the Best Handling Shock, while the Terrain Tamer Premium Heavy Duty shock took out the Most Affordable Shock.

Ultimately, we’ve aimed to highlight each shock’s strengths and weaknesses to help you decide what best suits your driving style.

AFTER-SALES SUPPORT

When choosing your shock absorbers, always consider the after-sales service that’s on offer by the company. If a shock fails, chances are it’s likely to happen out in the bush where you’re a long way from home. Having the support of a manufacturer that can offer an Australia-wide network of distributors is a definite bonus to keep in mind.

FOR MORE INFO

BILSTEIN
SYDNEY SHOCK ABSORBERS
W: www.bilstein.com.au
PH: (02) 9557 5930

KONI
TOPERFORMANCE
W: www.toperformance.com.au
PH: (03) 9873 1722

OLD MAN EMU
ARB 4X4 ACCESSORIES
W: www.arb.com.au
PH: (03) 9761 6622

RANCHO
4WD 1
W: www.4wd1.com
PH: (02) 9634 2238

THE ULTIMATE SUSPENSION
W: www.ultimatesuspension.com.au
PH: (02) 9618 7674

TJM
W: www.tjm.com.au
PH: (07) 3865 9999

TOUGH DOG
4 WAY SUSPENSION
W: www.4waysuspension.com.au
PH: (02) 9672 8899

RAW 4X4
W: www.raw4x4.com.au
PH: (02) 4949 0000

TERRAIN TAMER
TERRAIN TAMER 4WD PARTS
W: www.terraintamer.com
PH: 1300 888 444