


● SPECIAL FEATURE

● Powerdown Suspension



Countless hours of real-world testing ensure optimum suspension kit performance





THE RIGHT TRACK >

Developing a 4X4 suspension system is not a simple process, as **ALLAN WHITING** discovers when he goes behind the doors of Powerdown's research facility

▶ PICS BY ALLAN WHITING

Suspension is a fine science that takes years of experimentation to improve and refine.

Powerdown, a Newcastle-based suspension specialist company, has been solving truck and 4X4 operators' suspension problems for more than 20 years. The company is one of the largest 4X4, truck and light commercial shock absorber suppliers in the Australian aftermarket.

4X4 Australia was invited to inspect Powerdown's latest research and development (R&D) investment and to experience the company's powerful new analytical technology.

One of the greatest difficulties facing original equipment makers (OEMs) and aftermarket suspension suppliers is the difference between Australian road and track conditions and those overseas, where most suspensions are designed and manufactured. The most successful suspensions have the maximum amount of local input, in terms of strength, spring rates and damper specifications.

The accepted practice for after-

market shock absorber design has been to take the OEM part and measure its valving and then experiment with varied valving to achieve better or vehicle-specific results. This trial-and-error method works most of the time, but is labour-intensive and time-consuming.

Powerdown's R&D solution is simple, if expensive: duplicate the equipment that OEMs rely on for suspension analysis. Millions of dollars later, Powerdown has installed what it claims is the most sophisticated shock absorber design equipment in Australia.

Professional suspension designers use a shock absorber dynamometer for analysing performance and durability. However, most local aftermarket dynos are designed to measure car- and wagon-sized components. Truck, trailer and large 4X4 suspensions endure much greater loads than smaller vehicles and analysing the behaviour of their larger springs and shock absorbers requires a large dyno.

The Powerdown truck-size shocker dyno is impressive – as



High-tech R&D means a fast reaction to market demands



Clockwise from left: In-cabin laptop collects suspension performance data for analysis; shocker at extension; production 35mm Nitro; RAW front strut monotube

is the huge electro-hydraulic powerplant in an adjacent room. This provides the urge to cycle shock absorbers through a virtual life-time of 'ins' and 'outs'.

This dyno is only part of the R&D story: using it effectively is just as important. The dyno is programmed with real-road suspension inputs, putting test shockers through the same cycle as real-world shock absorbers.

The Powerdown engineering team first fit suspension-measuring sensors to a 4X4 test 'mule'. The sensors are calibrated rods and cylinders that mimic the shock absorber acceleration and travel. Suspension movements are transmitted from the sensors to a laptop computer inside the vehicle, in a form that can be displayed on the screen as a 'sawtooth' graph.

The display allows Powerdown's engineers to confirm visually that the system is working correctly and that the recorded road surface has the required bump characteristics.

With the vehicle's suspension movements saved in the laptop the team returns to the lab, where the recorded inputs are fed into the computer that runs the dyno program.

A test shock absorber is then set up on the dyno and subjected to the same inputs as the on-road unit. The cycle can be made as long or as short as the designers want and can be repeated as often as needed, while the shocker behaviour parameters are recorded.

Matthew Gatgens, Powerdown's marketing manager, reckons that the investment in state-of-the-art R&D technology allows the company to react quickly to market demands:

"We already supply a wide range of shock absorbers to suit large and small volume products and this new R&D tool means we can develop new dampers within a very short time frame."

Two months after our initial visit we were back at Powerdown to check out the first 4X4 suspension package to be designed using the new R&D hardware and software tools.

We tested Powerdown's solution to the new HiLux's ride and ground-clearance issues.

The Raw Nitro shock absorber and spring package for the HiLux is a much more complicated kit than the one for its torsion-bar front suspension predecessors.

Like Prado, the current HiLux has a semi-

strut front end, in which the front coil springs fit over the shock absorber body and 'seat' on a collar mounted on the shock absorber tube. The front shock absorbers consequently bear the weight of the vehicle's front end and cop more road input forces than separately mounted shock absorbers do. Unlike separately mounted shockers the semi-strut type's tube and lower bush are under constant load and must be designed accordingly.

A semi-strut design has one advantage over a torsion bar and separately-mounted shock absorber suspension: when you increase the semi-strut's ground clearance you lengthen the shock absorber and potentially increase its oil capacity.

When Powerdown engineers set about designing a HiLux front suspension that would offer improved ground clearance they knew that the replacement shock absorber needed to have heavier wall thickness than normal, with a strong bottom bush assembly.

Their solution is a robust 46mm-diameter, thick-wall, monotube shock absorber, with a precision-made, long-life bonded metal-urethane lower bush that in Matthew Gatgens'

words "costs us a fair slice of the price of the shocker!"

The decision to go monotube was dictated by the need for maximum oil capacity within the 46mm envelope allowed by the coil spring's internal diameter.

Monotubes are more vulnerable to stone damage than twin-tubes, but that's not the same issue with front ends that it is with the rear, where flying stones are a hazard on gravel roads.

The Raw Nitro HiLux coil-over-shock suspension provides a 45mm ground clearance boost.

"We could have gone for more," Matthew says. "But we felt that was enough to overcome the HiLux's ground clearance issues, without risking premature wear in the CV joints."

"We've been running prototype front struts for the past two years at this suspension setting without any CV dramas."

There's also an optional heavy-duty coil

spring front end for the expedition market, for owners who fit heavier accessories.

The matching rear end lift on crew-cab HiLuxes is 50mm, giving the unladen vehicle a slight nose-down attitude that soon levels off with some freight in the back.

Aftermarket leaves with more camber than standard replicate the original seven-leaf pack, damped by 35mm Raw Nitro twin-tube shockers. The latest 41mm Raw NitroMax shockers are an option for those who want the biggest tubes in the range.

We tested the Raw kit in a dual-cab. We ran it three-up, with no load in the back – a worst-case situation for ride and handling.

The height increase meant the vehicle's side-steps made for easy entry and exit. The test machine's snug aluminium 'roo bar didn't decrease the approach angle.

We set the ute's 265/70R17 tyre pressures at 34psi up front and 28psi at the rear.

This is only the second current-model HiLux we've driven without flinching as it

traversed rocky ground. The Powerdown kit made the HiLux feel like the 'unbreakables' of yesteryear. Increased ground clearance meant the Raw HiLux could go pretty much anywhere it could find traction.

Ride quality was firm, as you'd expect from an unladen, leaf-sprung ute, but without the rear-end 'bounce' of the stock vehicle. The front end felt very controlled, with no steering 'kick' and very little cornering sway.

Back seat comfort wasn't in the 4X4 wagon class, but was quite acceptable.

We'd like to fiddle with rear damper valving a little; the compression valving at the front end felt stronger than at the rear.

Powerdown seems to have come up with a well-developed and well-researched suspension kit to improve the current HiLux's ride, handling and ground clearance.

At a kit price of only \$1400, including greasable rear shackles as well, we reckon Powerdown will do plenty of business. **4x4**

Ride quality was firm with 'bounce' very well controlled



Clockwise from left: Powerdown has grown into one of the largest aftermarket suspension manufacturers, hence the huge premises; Raw shockers are subject to extensive in-house testing; metal-urethane lower bush is built to last; the HiLux's ground clearance is significantly improved