

WORDS & PHOTOGRAPHY // **ANDY WIGAN**

# TAPERED THINKING

Could Teknik's tapered-wire springs deliver the predictable progression that's eluded WP's PDS for 10 years?

**W**P's PDS shock absorber first appeared on KTMs and Husabergs a decade ago. The no-linkage system is great for its simplicity, low maintenance and low weight, but not everyone likes the way it rides.

Each year, KTM has introduced significant changes to springs, valving and other internal components to improve the shock's performance. And in 2007, the Austrian factory made the biggest change when they laid the shock further down in the bike. But despite all this effort, there remains very little consensus about how to best set up a KTM's rear-end; or even whether a straight-rate (linear) or progressive-rate spring is preferable. And with all the spring options now available, the market seems genuinely confused.

A couple of years ago, Sydney-based suspension tuner Nick Dole, from Teknik Motorsport, added another option to the mix – a revolutionary new shock spring with progression created by the tapered wire in the spring itself, rather than by the way the coils are wound. Despite struggling to market the concept, Teknik has notched up some success with its tapered-wire springs, so we figured it was time to have a closer look at this Australian innovation.

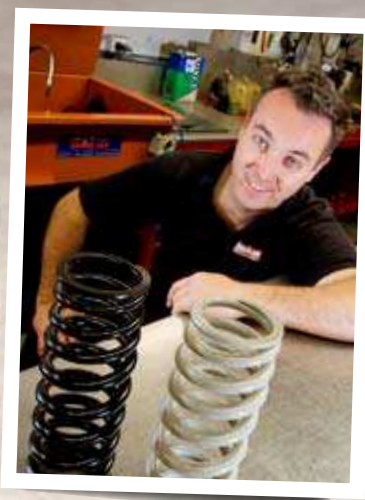
## SPRING PROGRESSION

Teknik offers two tapered-wire spring options. On both springs, the inside diameter of the coil remains the same, while the outside diameter tapers slightly due to the tapered wire. Unlike more conventional progressive-rate springs, the pitch remains the same for the entire spring (so the coils remain equal distance apart), and the taper of the wire itself – something Dole claims can be manufactured to very fine tolerances – delivers the progression. Interestingly, both spring options are priced below KTM's \$280-\$300 OEM WP progressive springs.

### The RACE spring:

- The initial portion of the coil is made from a constant-diameter wire (from 11 to 14mm, depending on rider weight). It then has a tapered mid-section, and reverts to a straight section (approx 8mm diameter) for the final few coils.
- Fitting this spring must be accompanied by a re-valve.
- It is available in nine rates (coded A through to I) to cover all riders from 45 to 110kg.
- Set up to run a conventional 38-42mm of static sag, and 113-118mm of race sag. The Race spring will require a lot more preload (8-10mm, compared with 6mm on the T-Series) to create these same sag settings.

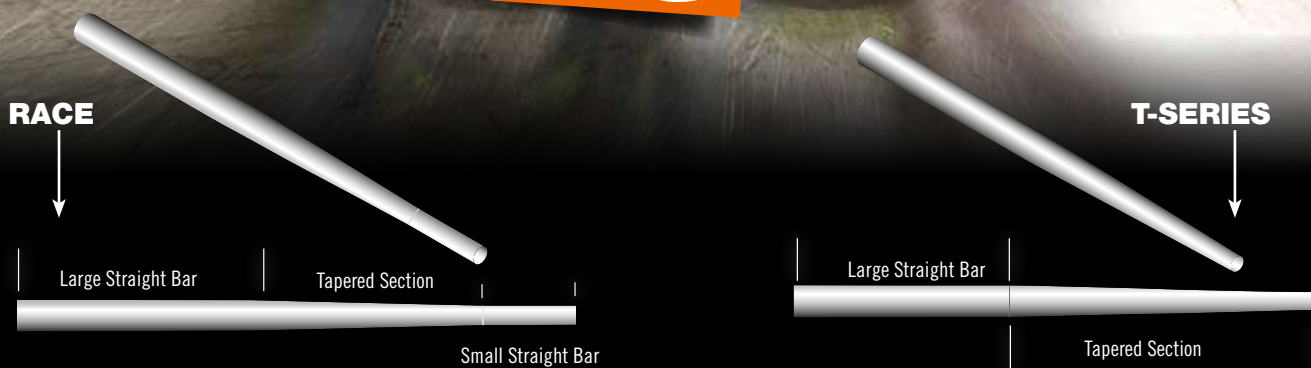
**COST:** \$240 (spring), plus \$219 (re-valved to suit), marketed primarily to racers.



### The T-SERIES spring:

- The lower portion of the coil is made from a constant-diameter wire (from 11 to 14mm, depending on rider weight). It then tapers gradually all the way to the spring tail at the top.
- It is not as progressive as a Race spring, as the wire's taper is not as pronounced and its initial rate is firmer than a Race spring's.
- It is available in five rates (T-3 to T-7), covering riders from 65 to 120kg.
- It's set up to run a conventional 38-42mm of static sag, and 113-118mm of race sag.

**COST:** \$240 (spring), and marketed to trail and enduro riders.



## BIRTH OF THE TAPERED SPRING

"Ken Wheeler from Team Motorex KTM had been grinding a few mils of end condition into the shock springs he was using on Tye Simmonds' bikes and getting some good results," says Teknik's Nick Dole. "It was creating a more compliant ride in the first part of the stroke without compromising bottoming resistance as you moved further into the stroke. So Ken then asked me for springs with softer starting rates.

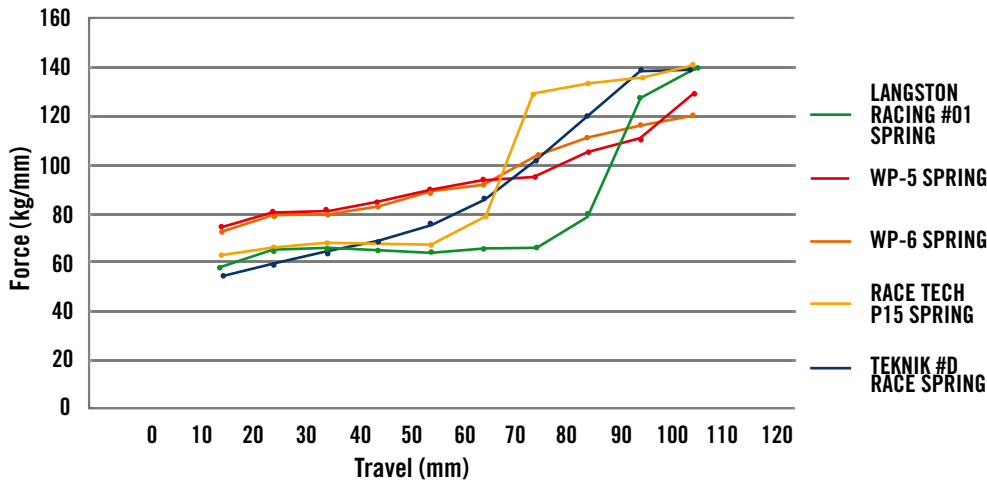
"At the same time, I'd started working with an Australian spring manufacturer, after a rally car suspension guy called Jamie Drummond told me they had the capability of manufacturing tapered-wire springs.

"I sent the manufacturer some shock springs from Factory Connection, Eibach, Race Tech and Langston Racing, who all make progressive-rate springs using a constant-diameter bar. In other words, all those springs were creating rate-progression conventionally – by

altering the pitch of the coil, or the coil spacing. And, as Ken and I found, manufacturing tolerance issues were restricting the performance of those springs.

"Springs that were supposed to be the same rate, clearly weren't. It turned out that pitches on pretty much all the major brands' springs weren't very consistent. Making a progressive spring by altering pitch opens up a can of worms in the quality control department.

"It dawned on me that these tapered-wire springs could help overcome the long-standing problems with the PDS shock; that they could more consistently and reliably produce exactly the spring rate ranges required because it's easier to control the wire diameter than it is the coil's pitch. This is exactly what our manufacturer had already discovered with car springs, and why they'd invested millions in equipment that could machine a taper into the wire.



The graph compares the resistance offered by a number of progressive-rate shock springs (WPs plus aftermarket options), all of which are marketed to suit a 70-75kg rider. The tester measures spring force only (does not take valving into account) over the 110mm of travel in each of these springs, which translates into more than 300mm of rear-wheel travel.

What's interesting is how initially both WP-5 and WP-6 options are relatively

firm and how they don't offer much progression as the shock moves into its stroke. Each of the aftermarket shock springs have a softer initial rate and all end up firmer than the WP shock springs late in the stroke, but their progression ramps up very quickly in the mid-stroke. They are therefore likely to rely more heavily on valving to create a predictable rate of progression.

Teknik's Race spring has the softest rate initially and matches the firmest

springs' resistance at full travel, but it makes the transition over a much smoother arc. The idea is to therefore create a compliant ride in the first part of the stroke and still offer plenty of bottoming resistance. In principle, the Race spring's smoother progression should be a whole lot easier for suspension tuners to match with the valving set-up. Teknik offers dealers two setting cards to make valving easy and/or an optional shim kit.

### SPRING FACTS...

- All motorcycle shock springs have, until now, used a straight bar. That is, the wire remains at a constant diameter for the length of the spring.
- With all other things being equal, the closer the coils are on a shock spring, the softer the spring rate. The further apart the coils, the firmer the spring.
- Progressive-rate springs incorporate both tight-wound and spaced-out coils to deliver a progressive rate of resistance to compression. To achieve this, the pitch of the coils must change (that is, the angle from horizontal becomes more or less steep).
- Virtually all late-model Japanese bikes with linkages use straight-rate springs, whereas KTM has used both progressive and linear.
- One of the hallmarks of a well-made spring is that its tail will touch the first coil as soon as it has any pre-load on it. When the tail doesn't touch the coil (whether by design or a gap being created with a grinder), this is called "end condition". It creates a softer initial spring rate until the tail comes into contact with the coil, from which point it becomes progressively firmer.
- A spring's resistance is position-sensitive. Valving is velocity-sensitive.
- KTM's WP springs are Dutch-made. Europe winds its springs to the left, while springs made in America and Australia generally wind to the right.

“Manufacturing tolerance issues were restricting the performance of the conventional progressive-rate springs.” Nick Dole

### THE PDS HISTORY...

Over the past decade, WP's PDS shock absorbers have retained their original 18mm shock shaft, 50mm-bore reservoir and twin-piston set-up. But they have also seen lots of changes – both from the factory and aftermarket suspension tuners – to help get them working better. Straight-rate (linear) aftermarket springs were available in the early days

(2000-2001) before the factory embraced them in 2004.

There have been significantly revised valving specs, new pistons, new needles, telescopic needles, different progressive spring designs and bladder kits. Some tuners have even removed the secondary piston completely!

In broad terms, all these measures have been aimed at making the KTM's

rear-end plusher and more compliant on small bumps – without compromising bottoming resistance – and more stable through braking bumps. It'd be fair to say the mods have produced pretty mixed results on the whole. And certainly, no one has got it good enough for a top AMA rider to want to race a full season on it.

The most significant change to the

PDS system came in 2007, when the shock was laid further down in KTM's SX models, with the EXCs getting the upgrade the following year. This allowed the use of lighter springs and made the progressive-rate springs easier to get working more effectively. It also prompted Teknik to invest in the development of the all new tapered-wire shock springs.

“That was at the beginning of '08, and after a lot of trial-and-error we got to the point where we offered eight different spring rates, and valving specs to match. They're available for the '07 SXs and '08 EXCs onwards – that is, the models with the shock laid down further in the bike. It physically wouldn't have been possible to do what we have with the tapered springs on the earlier KTMs with a more upright shock, as their springs were just too stiff and not conducive to the progressive effect the tapered-wire springs can deliver.

“I only wish we'd started developing this in 2002 as it appears that KTM may be returning to a rising-rate linkage set-up for the SX models in 2011 onwards.”

### THE THEORY

The basic idea behind the tapered-wire progressive spring is not new. It

aims to create a more compliant ride in the initial part of the stroke, and a more linear progression in spring rate as the shock travels into its stroke. The Teknik guys claim the tapered-wire progressive springs can more accurately and predictably recreate the sort of mechanical progression offered by a rising-rate linkage. This means better traction out of corners and more stability through braking bumps.

### IN PRACTICE

So has the tapered idea met with success? “The reality is, despite the results we've had with the likes of Tye Simmonds and Ben Grabham, it's been a very hard sell to dealers,” concedes Dole, “mainly because you must re-valve the shock when you fit our tapered-wire Race spring.

“Since the Race spring has a lot more spring-force in the bottom part of the stroke, the rebound damping in particular will try to catapult you

## ACCORDING TO THE PROS

While Teknik has struggled to market the idea to the KTM dealer network, the tapered-wire springs have kicked a few goals. We spoke to Motorex KTM MX/SX young gun Tye Simmonds, his mechanic Ken Wheeler and Motorex KTM Off-Road's Ben Grabham about their experience with the product.

“It makes the bike a lot easier to ride with confidence Tye Simmonds”

### KEN WHEELER:

“I found that when I was trying different spring rates, it was more than likely it was a different brand spring. And because everyone seems to wind their springs a different way, it was like putting a different linkage on the bike every time I was changing the spring.”

“The good thing about the Teknik springs is that there's a range, and the rate gets progressively firmer as you move from the start to the end of the travel – much like a linkage ratio curve.”

“This helps make it a lot easier to tune the bike. We found the spring offered improved bottoming resistance when we first started using it on Tye's bike at last year's Super X, but the biggest gains we found were on motocross tracks.”

“A KTM is quite a good thing under acceleration, but in off-throttle situations, where the front of the bike is loaded and the weight comes off the rear-end, KTMs with standard suspension tend to kick around a lot. The Teknik tapered-wire springs made the bike much more stable and predictable in these situations.”

### TYE SIMMONDS:

“Ken is always bringing me new things to try, and as

soon as I tried the tapered-wire progressive spring, I thought the thing was awesome and I've used it ever since – in the Super X, the MX Nats and the World Junior MX Championships over in New Zealand.

“I've found it tracks a lot better under acceleration, but the biggest difference is how stable it makes the bike through braking bumps. On small, chattery braking bumps and big ones – like the sand over at WA's Wanneroo track – the back-end behaves much better. It gave me some small improvements with lap times, but it makes the bike a lot

easier to ride with confidence. Now that I've stepped up the 450SX-F, I'm noticing the difference even more.”

### BEN GRABHAM:

“I first tested the Teknik tapered-wire spring back-to-back with some conventional progressive springs before this year's Finke Desert Race. Obviously, the shock needs to be re-valved when you fit the Race spring – it's a death-trap if you don't – but the tapered spring was noticeably softer in that initial part of the stroke and felt really good over the high-speed chop.”

“What surprised me was that it still worked well on the big bumps. So it was great to have a shock that was softer initially and still resisted bottoming better than other shocks. It was better on acceleration and under brakes, and that's why I decided to run it in the race. I plan to run it in the Baja 1000 later this year, too.”

“I can understand why the motocross guys have also found benefits with the thing. But, to be honest, I've struggled to find a setting that gives me the same improvements on the slower speed tracks at most AORC rounds. I think it has a lot of potential and I'd like to do some more testing. I know Teknik's got a less progressive tapered spring now available.”

over the bars if you run the standard valving. This is why we were sort of forced to introduce the T-Series tapered spring. In some respects, the T-Series is a compromise, but it means you can still achieve performance gains over the conventional progressive-rate springs, simply by replacing the spring. It's as progressive and predictable as we could get it, without causing havoc with standard valving.”

Accordingly, Teknik has ended up marketing the Race springs to serious racers, and the more cost-effective T-Series springs to the trail and enduro guys. Dole believes the choice is largely application dependant.

“Trailriders and enduro guys tend to prefer a spring that is less progressive – one that will absorb big hits with a lot of shock movement, while keeping the heavier motorcycle tall, with a higher starting rate than if a progressive was used,” he explains.

“Motocross riders, on the other hand, like a more progressive spring as the rear-end will ‘stand up’ under high-load situations with increasing force and give them more



Tye Simmonds ran second in Super X '08 and MX Nats '09 with a Teknik tapered-wire Race spring



Ben Grabham ran a tapered-wire Race spring en route to a third Finke Desert Race win in '09



Race springs have proven a hard sell. But trail and enduro riders are showing plenty of interest for the cheaper T-Series

bottoming resistance off big jumps.”

Teknik is now working on developing springs for other no-linkage bikes, such as Husabergs and BMWs, as well as ATV applications. And, given the recent interest from race teams in Europe and America, they're exploring export options, too. **ADB**