



RAGE AGAINST THE MACHINES

Meet the bike that is single-handedly
battling against the domination of
conventionally suspended racebikes

Words: Matt Wildee Photography: Paul Bryant



Everything on the bike was designed using Autodesk CAD



The top red rod is the brake torque arm. Black rod is for steering



Prototype clay and wood model of the tank took a month to perfect

ENGINEER BEN SHAUGHNESSY and his brother Aaron don't like doing things the easy way – and the stunningly-wrought two-wheeled thesis you see on these pages is testament to this. Meet the Alto Performance Rage superbike, a hub-centre-steered, British-built bike designed to race and win at the highest level.

Except for its Ducati 1098 engine, everything you see on this bike has been designed, specified or built by Ben and Aaron. Most of it has been machined, welded, filed and programmed by their own, calloused hands. This bike is a labour of love, pain, torment and countless sleepless, grafting nights. The process has been so involved and intense that this machine has lived up to its name, many times.

We've seen hub-steered bikes before, such as the Vyrus and the Bimota Tesi 2D, which I tested a couple of years ago. While they may look similar to the Rage, this isn't an adaptation – this is a brand new racer with none of the compromises of a road machine.

'The Rage has been three years in the making. And it really was blood, sweat and tears. Building bikes is tough, but it's also fun. However, there were times when this really wasn't fun,' says Ben, his haunted look a testament to the radical bike's difficult birth.

'It all started five years ago when we ran a modified Vyrus in Thunderbikes with Phil Read Jnr on board. I'd been studying hub-centre steering for 20 years and Ascanio Rodorigo at Vyrus helped with a chassis at a good price. Vyrus bikes are designed as road bikes and he wanted to see how they would go in a race environment.'

'It was a great learning experience. We changed so much – running the bike with a Ducati ST2, then ST3 engine, which had never been done before, we ended up re-engineering the swingarms, frames and everything else. By the end of the project it was mostly British built using F1 suppliers in the UK. It was more our bike than Vyrus.'

The team, led by Ben and Aaron, got the bike running well. Phil finished third in the championship in 2008, then second in 2009. 'It was tough. We developed and designed everything ourselves, there was no easy path. Remember the SV650s and CBR600s we were racing against had massive budgets behind their original development concepts. We didn't have that. But we were competitive. Forks have been developed over 80 years and we started from almost zero, but doing as well as we did proved that the concept works.'

'We learned so much. Thunderbikes was very competitive – many of the lap records set then are still standing today, but that was only the first stage of a three-part plan. We wanted more. We spent a lot of that time gathering data for what would come next – this bike.'

The regulations for Thunderbikes limit power-to-weight ratios, which restricted the development potential, so it was time to move up. It was time to build a proper, superbike-spec machine. To begin with, this bike will debut in the MRO Powerbike series, going up against high-spec ZX-10Rs and S1000RRs.

It sounds like a big job, but the Rage will be up to the task. 'To begin with the bike will be running a more-or-less standard Ducati 1098S motor, which kicks out 160bhp, but at 160kg we're already 20kg lighter than the likes of a race S1000RR. After we have the bike working properly, there is a 200bhp 1098RS motor to slot in. Eventually we want to race the bike at Daytona.'

'It's not going to be easy, but we know the package works. We've proven it before. We know the front suspension works. We know the rear suspension does, and now the bike has improved aerodynamics.'

'This is a serious effort. It isn't just another bike with a funny front end. This a bike built and designed around a total concept. There is potential for it to be a much better system than forks. We are only at the start. The key to hub-centre steering is the way it separates the braking and steering forces. One of the main problems with forks is the confusion between these forces.'

'It's impossible to control weight transfer with forks and, contrary to what you may have read elsewhere, uncontrolled weight transfer

isn't a good thing. Having a bike pitch forward on the brakes isn't desirable – you can only use one tyre to brake because the other one is up in the air, stability is affected and even aerodynamics is too, thanks to the change in the relationship between the bike and the ground. None of this is a problem with our system.

'There are other theoretical advantages too – you can run a rising-rate linkage for the front suspension and tune the set-up in a much easier way than forks. Altering the rake and trail is a mere tweak of a rose-joint away. The stability means you can run more aggressive geometry too – the bike runs 17 degrees of rake (an 1198 runs 24.5).

'And, because there isn't a direct connection between the front wheel and bars, you could run a rising-rate steering linkage to speed up turn-in (we don't at the moment because riders aren't familiar with this system). The lack of weight transfer also means that you can use softer, gripper qualifying front tyres. When we raced before, we'd use four rears and just two fronts over a race weekend.'

This bike is so different from any other racebike from a distance, but up-close it stands the deepest of scrutiny. I could spend hours working out the way the steering works, marvelling at the minimalism of the design from the tiny top 'yoke' to the highly evolved spider's web of the Omega frame.

Removing the seat unit and tank is four bolts away and whipping them off reveals a bike pared to the absolute minimum. Nothing is there that doesn't do a job and many things do two jobs at once. Everything is centralised, moved to the middle of the bike and mounted as low as possible. Ben is coy about the bike's weight distribution, but admits that the lack of dive means you can position the weight differently than normal. Everything looks lower to me.



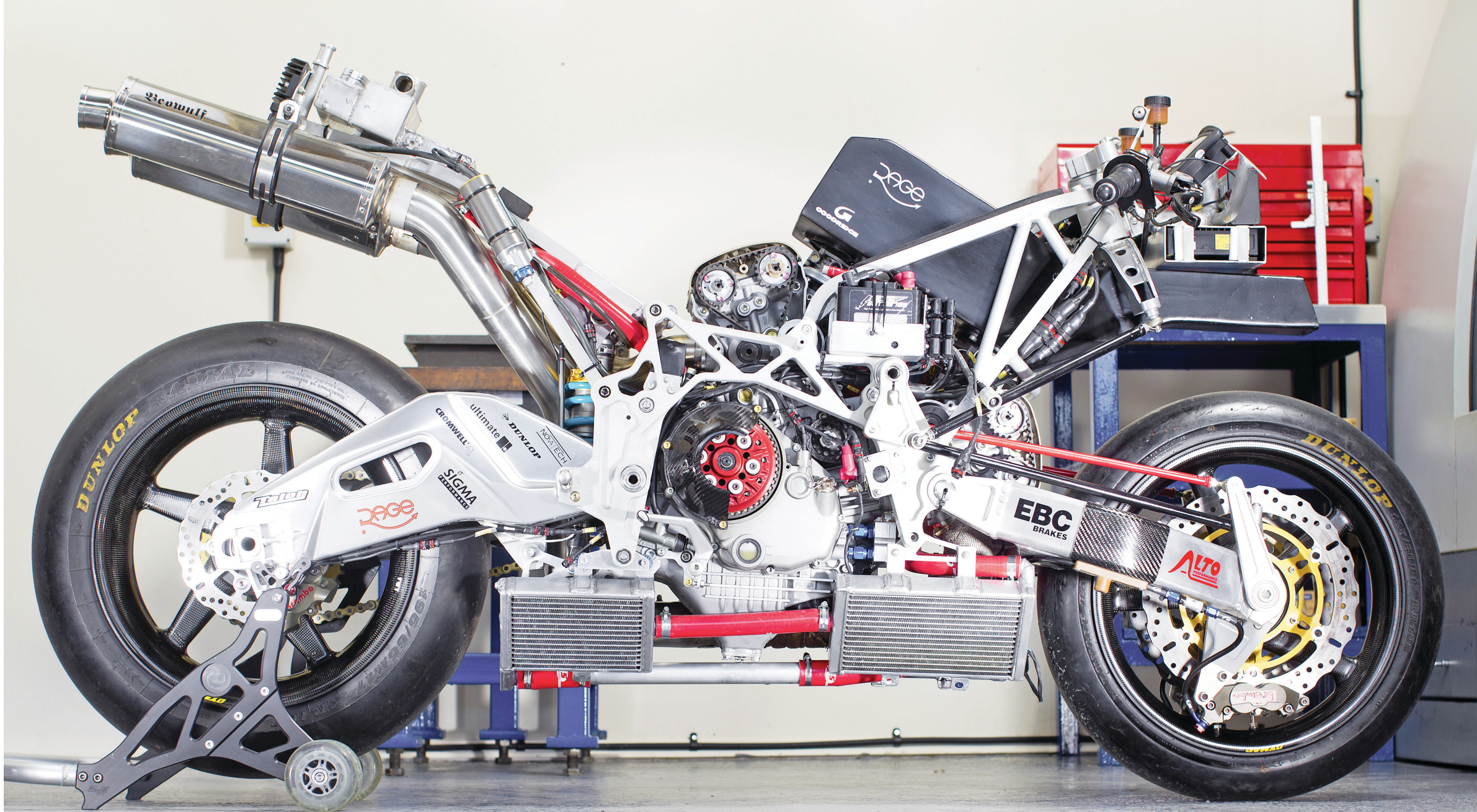
Anonymous parts are works of desire. I could spend hours staring at the TE Deutsch connectors that join the aircraft-spec wiring or the KA sensors that sprout from every single important part of the bike.

'There have been so many companies that have helped us – this is a tribute to British engineering. It would have been impossible without the likes of Goodridge, EBC, Nitron, KA Sensors, Dymag, Smiths metals and Beowulf. We wouldn't have got anywhere without them.'

In a motorcycling world staunchly resistant to change, spending time with Ben is challenging. He's a maverick in the vein of John Britten. His day job is undertaking secret engineering jobs that some of the world's top automotive companies are too scared to do themselves. His mind works at 100mph, constantly questioning everything. Ask him a question and he answers with a question back.

He's on a mission to change things and accepts little of the status quo. 'It's frustrating how the world won't change and racing just seems to revolve around old technology, even in MotoGP. Take for example, Ducati's efforts to make a bike fit for Rossi and move away from the carbon airbox chassis, which had some real benefits. I want to change things, to prove to people that there are other ways of doing things rather than just going around in circles.'

This is really just the start. There will be lighter evolutions of this machine and the end result may end up being so radical it'll make your Fireblade seem about as advanced as a Raleigh Gritter. The Rage >Story continues on p70



UNDER THE SKIN THE INGREDIENTS TO MAKE THE RAGE ROAR

ENGINE

Ducati 1098S engine is stock save for Alto Performance's own injector system that gives a better spray pattern, plus their own airbox. The lack of headstock means the air intake has the straightest possible route to the throttle bodies. This is the prototype model and is made from fibre-glass but will eventually be made from carbon. Ben has a non-disclosure agreement with Cranfield University about the airbox, which uses unique technology to harness the pressure waves within. The Inconel exhaust system is to Ben's design but fabricated by F1 exhaust maker Goodfabs. Pipes are of unequal length with diameters tuned to compensate. Cans are supplied by sponsor Beowulf. The bike uses a Sigma slipper clutch, but will be replaced with Alto's mini, F1-style clutch.

CHASSIS

Machined from a solid block of a secret aluminium alloy measuring 600 x 400 x 40mm, each frame spar takes hours to machine. The omega frame, which is designed to be as stiff as possible, houses the pivots for the front and rear swingarms, plus tubular front and rear subframes. The entire frame weighs just 6kg, but the team has already worked out a way to save another 1kg while still getting stronger. The rear subframe is fairly conventional, carrying the seat unit, exhaust pipes and breathers. The front carries all the steering gear, clocks, ECU and fairing mounts. It can be removed in six minutes to give direct access to the heads and barrels.

FRONT END

The front suspension is Alto's own design. With a self-made aluminum box-section swingarm, the bike employs a re-designed and evolved Difazio-style hub-centre steering system. The top 'yoke' is connected via a linkage to a knuckle on the chassis that operates two black pull-rods that connect to the front hub. The machine runs a 1:1 steering ratio, but the linkage means that raising or even dropping the steering rate is possible. The pivoting of the front wheel is made possible by the Alto's own hub, which is effectively a steering head within the swingarm. By changing the length of the brake torque arms (the red pull-rods above the swingarm) you can pivot the hub to alter the bike's effective steering head angle in seconds. The bike runs around a 17-degree head-angle. A Nitron shock is used at the front, built in the UK to Ben's specifications and uses a rising-rate linkage. Because braking forces are passed into the chassis instead of the front diving,

the suspension only has 80mm of travel to deal with load and bump absorption and spring rates can also be softer. In theory, there is no dive on the brakes, but Ben engineers a little in for rider feel. Braking is taken care of by a Brembo RCS master cylinder biting on racing-spec Brembo four-piston calipers with 310mm EBC pads and discs. The Northampton firm made these especially for the team.

ELECTRONICS
Alto runs its own injector system, which is controlled by a programmable Magneti Marelli ECU, which also mandates the bike's traction control and offers alternative switchable maps through Ben's own-made switches. The wiring harness was a one-off build by Aaron and uses aerospace-grade wire and fittings with Deutsch high-density connectors. It is of a higher spec

than on many MotoGP bikes. The ECU datalogging system monitors more than 256 channels of data, including comparative wheel speed, revs, suspension travel, lean angle and acceleration and load on various components.

TANK AND BODYWORK

The test bike you see here has fibreglass bodywork, designed specifically to smooth the air around 6ft 2in rider Phil Read. The fairings have been manufactured by Profibre and use a bespoke screen by Powerbronze. The lack of headstock means that the side fairings can almost meet, giving the fairing a boat-like 'bow'. The rear tail unit is the same as on the Vyrus, but a new treatment is on the books for the third evolution of the bike. The 21-litre tank was designed in-house and fabricated out of aluminum. Careful consideration was made to the shape of the tank so as fuel is

used, it empties into the centre of the tank to avoid altering weight distribution. The cut-outs in the tank allow Phil to brace himself on the brakes.

FIXTURES AND FITTINGS

The Rage is the first bike to run quad bellypan radiators. Fabricated by Radtec to Ben's design, the air runs over them, rather than through them. In between the rads is an electric water pump. The bike is designed to stand up to crashes – a carbon skin protects the front swingarm at its most vulnerable point and alloy sliders protect the precious bits. The footrests, which are also Alto's own design, are sacrificial and designed to snap under impact to protect the frame.

WHEELS

Wheels are bespoke carbon Dymags with hubs and spindles to suit the hub-centre system.



LEFT
If the 256 channels of data that can be recorded by the ECU aren't enough, the dash has capacity for another 128...

RIGHT
Beowulf silencer booms like you wouldn't believe

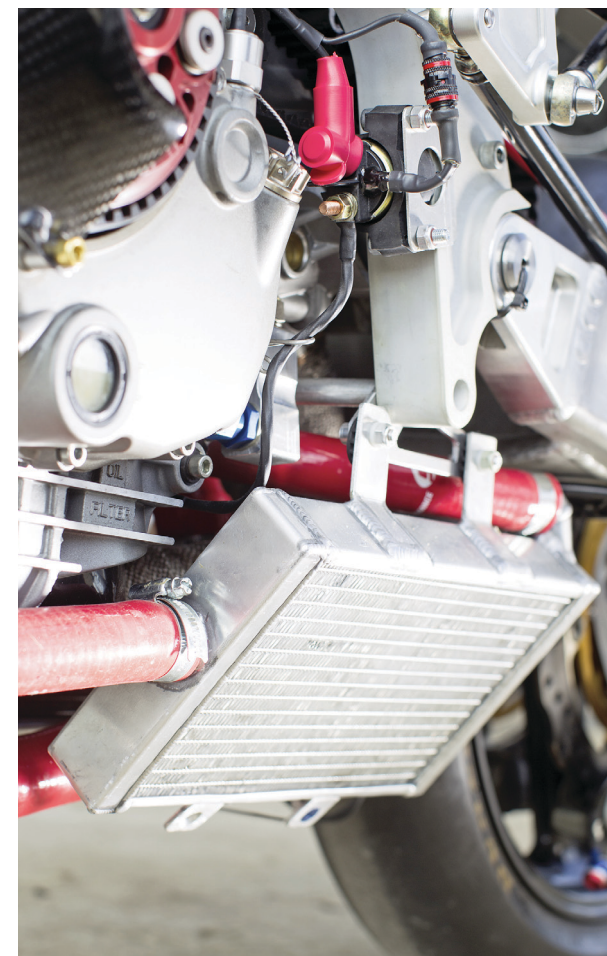


ABOVE
Stunning dry-break, quick-release brake line is courtesy of sponsors Goodridge. Two-piece Brembos have GP origins

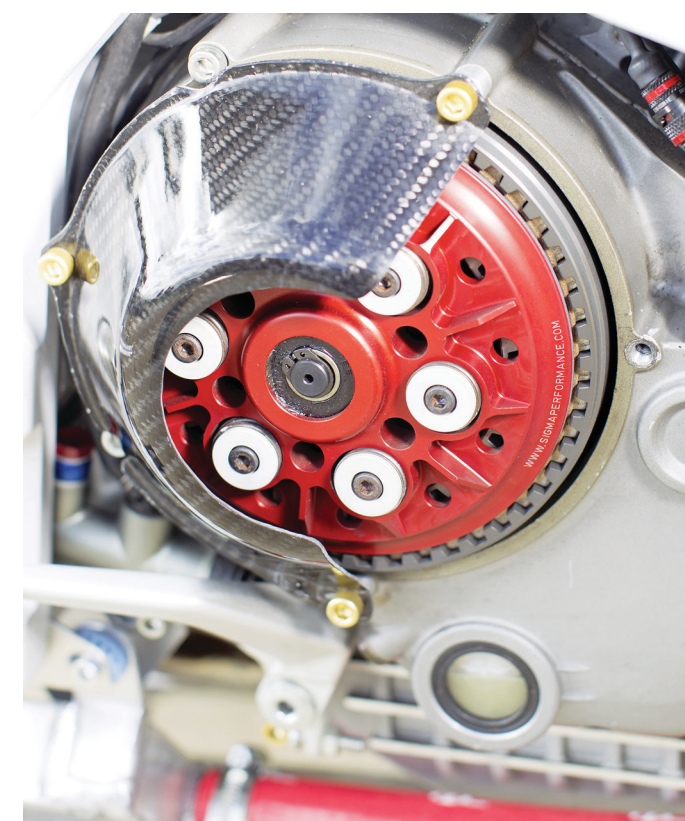
RIGHT
Buttons on the left bar are for traction control and fuel map settings



FAR RIGHT
Probably the best special we've ever featured. Agree?



LEFT
Attached to the Nitron front shock is a potentiometer to measure suspension travel and speed. Attached to the rod between the linkage and swingarm is a load sensor, which is used to measure force under braking and cornering



ALTO RAGE RACER

has a pioneering new pressure-wave technology for the airbox, and there are also plans for a new type of brake caliper 'that will change everything'. Ben also talks not only of the use of carbon frames but also the use of plastics in motorcycle technology – the Rage uses plastic for the front stand mount and there will be more to come.

If all goes well, in a handful of years the ultimate incarnation will have Alto's bespoke engine, which will be a stressed member, so there will be no need from a frame. The plan is for it to also have active suspension and some truly advanced electronics.

'This project has taken over mine and Aaron's life for the last three years. Because of the other work I do, we only have weekends. We've spent every weekend day flat-out for 15 hours. It's been tough – my brother now has his own room at our house and my wife has had to book a day with me weeks in advance. We couldn't do it without the team of crazy people that back up our crazy ideas.

'It takes a lot of time to design or manufacture a single bracket or a fuel tank. A bike is something else entirely and there have been enough setbacks here to last a lifetime. This isn't an easy road.

'We've just to prove that it works. This is not about creating art, this bike is not an ornament – it is about engineering solutions and being ridden as hard as it can. I want to prove to people that there are other ways of doing things and pushing bikes forward. The racetrack is the way to prove that it works. If we can prove people wrong and win some races then we really will have achieved something.'



THE FIRST RIDE ON THE RAGE

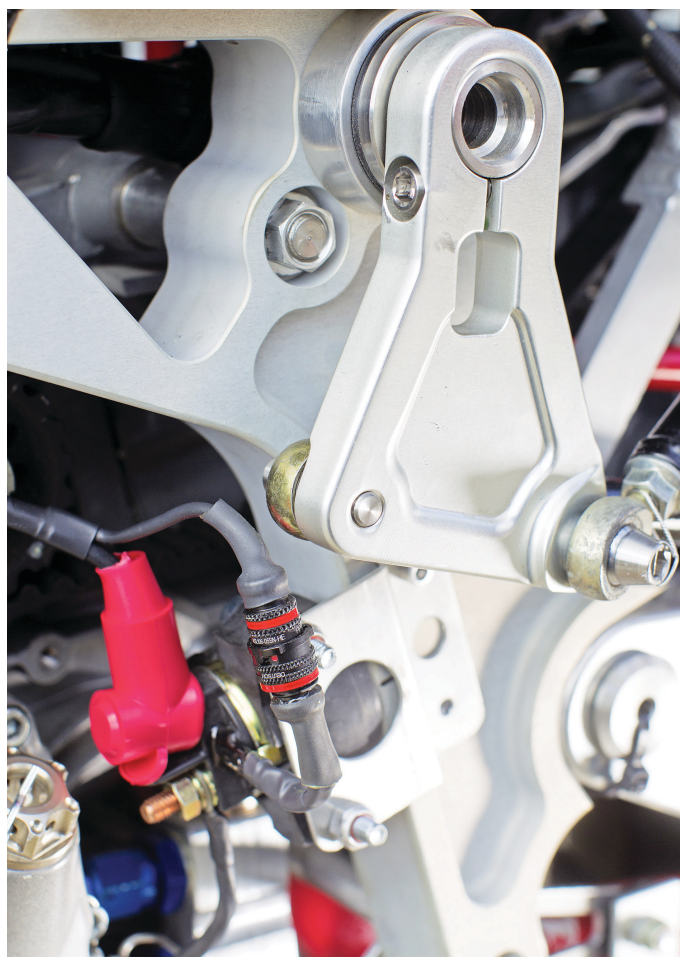
'I'D LITERALLY JUST started her up,' says Ben, 'and pushed her into the van before Phil Read Jnr rode the bike. Talk about getting in at the deep end. There were a lot of questions. Would the radiators work? Had we designed the subframes strong enough? Did the completely new suspension work? What about the new electrics? But all we had to do was adjust the clutch span.'

Rider Phil Read Jnr takes up the story: 'For the bike to run so well out of the box was remarkable, but Ben and Aaron know what they are doing.

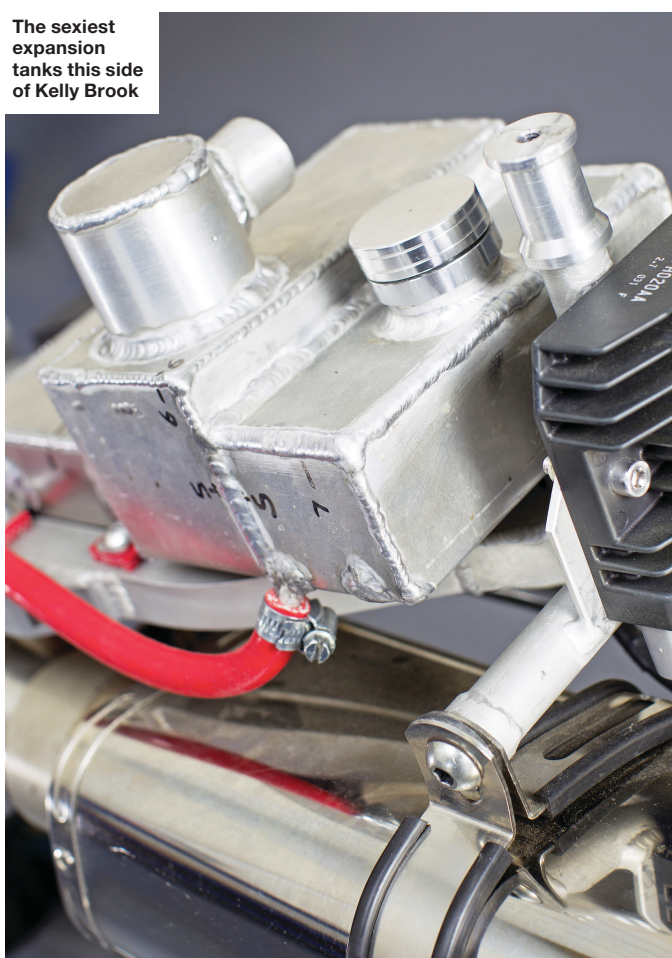
The Rage feels so different to the Vyrus I used to race. This is a proper one-off racer – designed to fit me. The wider tank means I can brace myself better and having some decent aerodynamics will make a big difference, as this was an area the previous bike was lacking.

'I'm looking forward to giving the bike a proper go. We're looking to race at the September Bemsee round at Cadwell Park. Cadwell should really suit the Rage. It will be a big test, but we just need to throw ourselves in at the deep end and get on with it.'



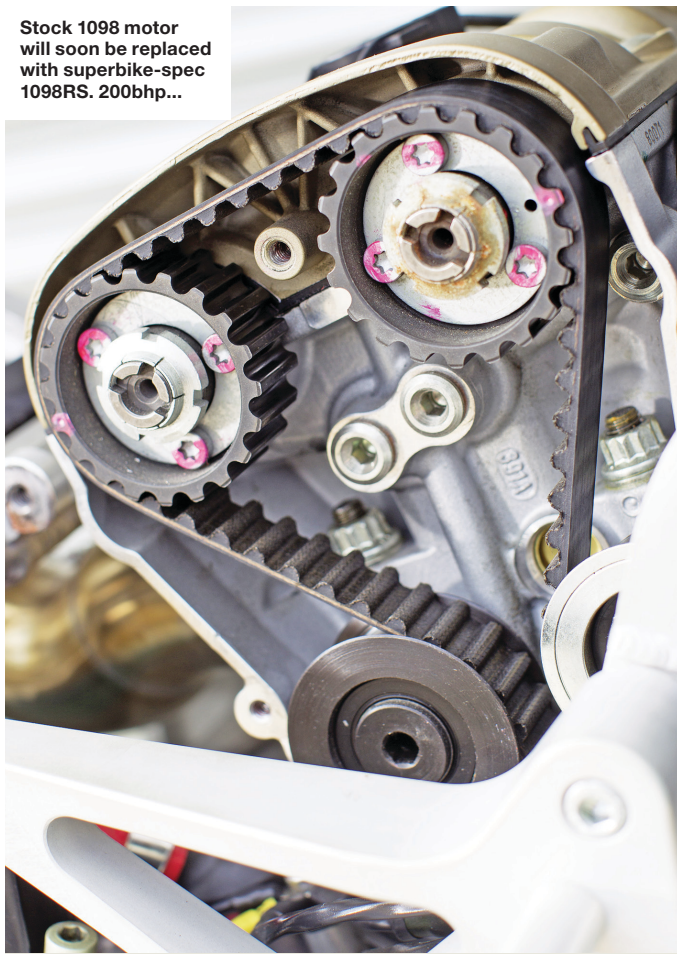


The sexiest
expansion
tanks this side
of Kelly Brook



RAGE AGAINST THE MACHINE

Stock 1098 motor will soon be replaced with superbike-spec 1098RS. 200bhp...



Footrest is designed to snap off in an spill to minimise damage to the frame

