

THE FIM MAGAZINE

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.77 /// FEB. MARCH 2011



ICE RACING
RUSSIAN STYLE

A YEAR OF MANY POSSIBILITIES
FIM MOTOGP WORLD CHAMPIONSHIP

BST BLACKSTONE
BLACK GOLD!



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Lay-out & Printing:
OIKO SERVICE srl
via Po 74
66020 S.Giovanni Teatino
Chieti (Italy)

FIM Magazine n°77
Issued February March 2011

Past issues available on request

The articles published in this magazine do not necessarily reflect the official position of the FIM.

The content of this publication is based on the best knowledge and information available at the time the articles were written.

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BST BLACKSTONE: BLACK GOLD!

JOHANNESBURG, SOUTH AFRICA, IS A CITY BUILT ON GOLD, WHERE THE WORLD'S RICHEST DEPOSITS OF THAT STRANGE YELLOW METAL THAT LADIES LOVE AND MEN ROB BANKS FOR WERE DISCOVERED IN 1878 IN THE MILE-HIGH WITWATERSRAND REEF.

But today, there's another kind of precious substance produced there by BlackStone Tek/BST, whose founders Gary Turner and Ms. Terry Annecke mine the black gold represented by their company's exquisite carbon fibre wheels, whose lightweight yet exceedingly strong design is proven to be suitable for both racing and roadbike applications. For these are the only such wheels in the world which are homologated for street use on motorcycles, approved by Germany's TÜV. Since the company began production in 2002 under the watchword of Engineering the Future, more than 10,000 BST monocoque carbon wheels (each one a single integral structure with either five or seven hollow spokes, not bolted together from separate parts like Honda's mid-'80s Comstar carbon wheels) fitted with CNC-machined billet aluminium hubs have been manufactured via a patented process in its purpose-built 4,900m² Jo'burg factory by a 30-person workforce predominantly drawn from the indigenous African community. This has duly led to several awards - indeed, in 2008 BST was chosen as the 1,000th member of the SA government's 'Proudly South African' Industrial Innovation programme.

BST's products are sold all over the world, with a pair of its street-legal carbon wheels fitted with steel bearings retailing for \$3,750 per front and rear set irrespective of sizes, or

\$4,000 per set with ceramic bearings. But the firm's race-quality wheels are now also used by a steadily increasing number of discerning MotoGP, Supermoto and drag racing teams, even including the MotoCzysz e1pc electric bike for which BST also manufactured the carbon fibre chassis. The fact that, this coming season, that list will include the factory Ducati MotoGP team, whose GP11 Desmosedici will be equipped with BST carbon wheels, speaks volumes for the excellence of the South African products. Valentino Rossi and Nicky Hayden will indeed be part of the 2011 Gold Rush - but it's black gold, though!

However, BST wheels aren't just eye candy. "Carbon fibre wheels are the best bolt-on performance product you can purchase for your motorcycle," says former road racer Gary Turner, 44, the designer of BlackStone Tek's iconic products. "They don't just look nice, but you also get an instant improvement in performance, and it's something the rider feels immediately." This instant gratification comes because, alongside its better-known benefits in handling and suspension compliance, a BST carbon wheel's much lighter rim delivers better acceleration and braking by reducing the moment of rotational inertia. Its lower weight means less inertia to overcome in starting the mass of the wheel moving under acceleration, as well as offering a similar

benefit in stopping it, where there's less rotational mass whose momentum must be brought to a halt. But as well as offering improved suspension compliance via reduced unsprung weight, meaning there's fewer kilos for the forks and shock to dampen, lightweight wheels are also a critical factor in improving a bike's steering, thanks to the diminished gyroscopic mass of a lighter carbon wheel.

OK - but how much lighter? "BST wheels will save anything between 40%-60% in unsprung weight, depending on their size," says Turner. "But more importantly, they have much lighter rims, and carry the bulk of their weight in the metal hub – and the hub has far less effect on the performance of the wheel than the rim, because of what amounts to a flywheel effect. The further the mass represented by the weight of the rim is located away from the rotating axis, the more energy it takes to accelerate it. And that energy comes directly from the bike's motor, which is why a carbon wheel with a much lighter rim than any conventional metal wheel, even a forged magnesium one, effectively improves engine performance via easier, faster, acceleration." BST claims that a standard set of 17-inch cast aluminium wheels fitted to, say, a Yamaha R1 or Honda Fireblade streetbike, weighs a total of 10.0kg, split 3.5kg for the 3.50in front, and 6.5kg for the 6.0in rear, whereas a set of its same-size carbon race wheels by contrast scales in at 5.0kg in total - 2.1kg for the front, and 2.9kg the rear. Halving the unsprung weight is already impressive, but because the bulk of that saving comes from the wheel's rim and spokes, there's an even greater saving in rotational inertia of up to 140%, says Turner, who claims that this is the equivalent of a 5bhp/3kW power saving in accelerating the wheels from zero to 200kph - a significant benefit which anyone who's raced a bike with carbon wheels will confirm is borne out by lower lap times. I demonstrated this to my own satisfaction, by acting as the development rider for British wheel manufacturer Dymag in the 1990s, racing their prototype carbon fibre wheels which later became commercially available for competition use - Dymags were never road legal - before the company later folded, leaving BST to take up the slack. The dramatic

drop in lap times the carbon wheels produced on a same day basis - one second a lap or more on a 2.5-mile/4.0km circuit - with no other mechanical improvements to the motorcycle, coupled with reduced rider fatigue via a carbon front wheel's lighter steering, made me a believer.

Indeed, hooking up with the Ducati factory race team to supply them with his products for its 2011 MotoGP bike will square the circle for former road racer Gary Turner. For, back in the mid-'90s he was living in the Netherlands, and racing one of his two Ducati 'half-a-Superbike' singles in the hotly contested European Supermono Championship run as a World Superbike support class. "Carbon fibre had recently started appearing on factory Superbikes, and I was helping pay for my racing by running a company called Pro Carbon, which basically manufactured and sold many different carbon fibre parts to Joe Average - stuff like fairings, mudguards, covers, everything that's since become commonplace," recalls Turner. "I hadn't yet got round to making a wheel - but then you showed up with the prototype Dymag carbon wheels on your own Ducati Supermono, and that got me thinking. The Japanese maxi-singles like the Over-Yamaha and BMR Suzuki were getting punched out to 750cc and more, and our 578cc Ducatis were struggling to keep up. So I thought - well, we've got to get a bit more juice out of the bike, and so I took to developing the carbon wheels as a way of reducing the rotational inertia, which helped improve acceleration and countered the extra torque those big singles had over us exiting a turn. So that's how we got started - it all came from that!"

South Africa had already been active in developing the application of carbon fibre as a material, specifically in creating the Rooivalk ('Red Kestrel') attack helicopter with a largely carbon fibre airframe, which had its maiden flight in 1990. A remarkable chopper design that can fly completely upside down, 12 examples were built by Denel Aviation in its Centurion factory north of Jo'burg between 1990 and 2001, all of which are still in operation today with the SAAF.



The knowledge spun off from that project allowed Aerotek - the aeronautical division of CSIR, South Africa's government-run technological R&D operation, whose job is to seek other applications for technical advances made in aviation design - to produce a prototype carbon motorcycle wheel in 1991 in conjunction with Adept, a local wheel manufacturer, although attempts to commercialise that foundered when Adept disappeared in the mid-'90s.

Gary Turner had got word of the Aerotek wheels, and on returning to South Africa in 2000 tried to track down the remains of the project, only to discover that while it was by now extinct, some crucial technology was still available that he was free to adopt in developing his prototype BST wheels. "I wanted to make a monocoque design, but hadn't yet worked out the technique of doing the hollow spokes," he says. "Eventually I came up with the silicone idea, and then we had to get it all to work. One

good thing is that composites as an engineering material offers you far more flexibility on what you want to do, than any of the metals. It's very difficult to forge or cast a piece of metal in your garage - but up to a certain point you can do a lot of experiments with laminates or composites in your home workshop, and that's essentially what I did in coming up with the silicone idea."

Turner's trick was to create a silicone jigsaw on the inside of each spoke, over which the carbon could be wrapped. But now he had to refine that and form a company to manufacture the result - and meeting Terry Annecke in 2001 saw the creation of BlackStone Tek. A former IBM Systems Engineer turned marketing wiz, Annecke was headhunted by Microsoft to eventually become the US software giant's South African Marketing Director, a job she held for four years before taking a break and looking for something new. "Gary was looking to put the company together when I met him, and he wanted a business partner who'd take an active role in running the company while he focused on the technology," says Terry. "I'm much more marketing and business orientated, so it was actually the perfect match." The two partners today own 75% of the company, although its minor shareholders include some prestige names, like Thales, the French high-tech defence contractor....!



Gary Turner and Terry Annecke today own 75% of the company. ///



BST moved into its new home in July 2002, and the first customer BST wheels left the Jo'burg factory in October 2002, since when production has gradually ramped up to 2,000 wheels per year. ///

BST moved into its new home in July 2002, and the first customer BST wheels left the Jo'burg factory in October 2002, since when production has gradually ramped up to 2,000 wheels per year. These are split between 30 different designs ranging in size from 16in. to 21in. in diameter (with a good-selling 12in. version for Japanese minibike GP replicas!), and in rim sizes from a 125GP wheel's 2.5in. width, up to a US powercruiser's 8.0in. design statement.

These are all however built in the same way by BST's team of skilled assemblers - around half of them women - working in two separate clean rooms with positive air pressure to ensure there's no dust on any of the parts which might compromise the integrity of the finished product further down the line. The wheels are made from special prepreg carbon sheet, with a combination of woven and unidirectional formats, embedded in a resin matrix made from toughened epoxy, with a bonding agent attached to one side of the sheet, and protected by a peel-off backing. This is supplied in large rolls from BST's raw materials partner ACG in the UK, and each BST wheel design is comprised of between 130 and 180 different individual carbon components, each of which must first be CNC laser-cut from the roll of pre-preg material, then individually numbered. The assemblers are provided with a full set of these

parts for the type of wheel they're building, which they then start laying up in numbered order on the half-a-wheel skeleton mould which, like all the metal parts involved in production - including of course the high-precision hubs - BST has manufactured in-house on one of its bank of thirteen CNC machine tools. Each wheel is initially built in two halves, which are then joined together in a strong single unit before baking. Every

step of the process is logged, and the entire history of each wheel is stored with its unique serial number, which means that BST wheels can be repaired or refurbished, even in the event of crash damage or a rim damaged by a careless tyre fitter. Interestingly, the carbon fibre material must be kept cold to avoid degradation, so each new roll is flown out from the UK to South Africa packed in dry ice, then stored in a



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“Carbon fibre wheels will save anything between 40%-60% in unsprung weight, depending on their size,” says Gary Turner. ///

freezer room at -20°C. In this temperature, the material will remain durable for up to one year - but it must be removed from there once a day and warmed to 0°C, to keep the resins fresh. Tricky stuff, carbon fibre....!



The wheels are built by BST's team of skilled assemblers - around half of them women - working in two separate clean rooms with positive air pressure to not compromise the integrity of the finished product. ///

Gary Turner's insistence on the unitary hollow monocoque design of BST wheels, to reduce the weight in the spokes and rim without compromising strength, was made feasible by his invention of the jigsaw of specially shaped silicone intensifier inserts which are laid in the mould's metal spokes, then wrapped with carbon sheet. The silicone comes as a two-part liquid which then sets hard when combined, allowing the jigsaw of parts to be cut to fit. The complete wheel is then wrapped in a special plastic bag, and baked for between four and five hours together with up to seven other wheels at a time in one of BST's pair of pressurised autoclave ovens at 125°C and 6.0 bar of pressure. The silicone expands under heat and vacuum pressure to fill and shape the spokes, but then as it cools it shrinks back to less than its original size, which means the jigsaw of parts can be extracted via the holes left in the wheel's unstressed sections. Very neat.

The cooked - as in, finished! - wheel is now removed from the mould and closely inspected for any visual defects, then weighed to ensure it meets specification. The rough wheel is then machined to spec and finished off, then fitted with the hub unit and bearings and sprayed by a special South African-made Aer-o-Mix automotive paint which is claimed to provide fifty years of UV protection, before being inspected once again. The hub is attached to the carbon wheel using a unique fastening system combining high strength aerospace fasteners with mechanical locking mechanisms, as well as



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high strength aerospace adhesive. All rear wheels are then fitted with an appropriate size Metzeler tyre and pressure tested at 4.0 bar overnight, with zero margin of error - the same pressure must be there in the morning. BST is now also making carbon fibre single-sided swingarms for the Ducati 1098 and, soon, MV Agusta models, including designing and making the complicated tool to wrap the carbon sheeting around it, and other structures follow all the time, like the rear subframe for a modern Moto Guzzi, a KTM RC8 fuel tank, the Confederate Wraith front suspension and chassis, and many parts for the new Norton Commando, including flyscreen, mudguards, engine covers, etc.

To keep checking the validity of its manufacturing process, BST makes regular impact tests which are TÜV compliant, subjecting its front wheel to a 300kg impact load and the rear



The BST products are the only such wheels in the world which are homologated for street use on motorcycles, approved by Germany's TÜV. ///

a 455kg hit. "We maintain our carbon wheel is much stronger, as well as lighter, than a forged magnesium metal wheel," says Turner. There's a comparable twisting test, whereby using special software the cyclic bending moment can be tested by applying up to 540Nm of torsional pressure to the front wheel, and 600Nm to a conventional rear wheel, or 700Nm to an offset wheel for fitting to a single-sided Ducati/MV wheel.

BST makes a product that is rare in motorcycling, one that performs as well as it looks - and its wheels do indeed look great. They're a product the Rainbow Nation can be proud of, as it builds on the success of having hosted the FIFA World Cup so successfully in 2010. However, at least Gary Turner and Terry Annecke resisted the temptation to manufacture a carbon fibre vuvuzela...!

by Alan Cathcart