



Q ARE EXPENSIVE WHEELS WORTH IT?

WHEELS OF FORTUNE



IN THESE DIE-CAST DAYS, STANDARD WHEELS ARE ALREADY PRETTY GOOD. SO WHY DO COMPANIES BOTHER MAKING EXPENSIVE WHEELS FROM SPACE-AGE MATERIALS? AND MORE TO THE POINT, ARE THEY WORTH FITTING TO YOUR BIKE?

WORDS: BOB GRAY **PICS:** JASON CRITCHELL, JP & JAYNE



It's fair to say we only bolt things on our bikes or change them in some way if we think it'll make them better or faster. It's plain to see (and hear) that an aftermarket exhaust, for example, will give your bike more power. But what about wheels? All race bikes have them fitted so why don't we buy them as readily as a titanium system or Power Commander? Maybe most of us don't actually realise what difference fancy wheels make. Or maybe most people just don't notice aftermarket wheels like they do exhausts – and why bother spending money on something no one will notice?

There's no question carbon wheels are sexier than the OE ones, so *SuperBike* arranged to borrow a pair of BST Carbon Fibre wheels from HPS (www.bikehps.com) for our longterm Suzuki GSX-R600 so as we could put them through a proper test. While they might be trick to look at they're also lighter, which is always good. But trickness and less weight aside, the question remains – do they really make a significant difference in performance?

THE 'I' WORD

Before we talk about wheels we must talk about inertia, the 'I' word. Inertia describes an object's reluctance to change the state of its motion. What that means in 'you and I' speak, is that inertia describes how much something doesn't want to move in the first place, and how much it wants to keep going once it's got moving.

The more inertia something has, the harder it is to change its speed. For example, it's easier to push a roller-skate than a tank

because the tank is heavier and has more inertia. But, if you manage to accelerate both of them up to 5mph, then run in front of them and try to stop them, the roller-skate would be easier to stop because it requires less persuasion to slow down. In terms of motorcycle wheels, inertia is very important. Think about one of your favourite roads. Now forget about where you're going, and think about what happens to the wheels.

How many times are you riding along at a constant speed? Not many? In terms of the entire journey your wheels are almost constantly changing speed or direction. To do 100mph you must have accelerated from 0mph. Regardless how long it's taken, your wheels have changed speed from zero rpm to many rpm.

We know that changing something's speed requires effort. Sprinters use it to accelerate from the blocks, bikes use it to overtake, you're even using it now as your eyes accelerate and decelerate from each word across the page. The

heavier an object is, the more effort it takes to move it. So if we could make things a little easier every time that happened by reducing their inertia – that would add up to a pretty big effort saving. Which brings us to this test.

Our first thought was to datalog a bike fitted with standard wheels, then the BST wheels and go on track. While this is logical, the constraints of budgets, randomness of clear laps on a track days and the potential for slight rider error meant we opted for another solution. That's not to say we didn't do a subjective test – we sent our be-goated tester Dave Smith out, with a GSX-R600 between his cloven feet, to find a clear piece of Silverstone in which to 'feel' if there was a difference. We also took both sets of wheels for performance testing at Bruntingthorpe salt flats and conducted acceleration and braking tests with a MicroSat GPS unit and finally, we rolled the wheels down a gentle slope (no, really, we did). ☐



ROLLIN' ROLLIN' ROLLIN'?

The idea behind rolling the wheels down a slope came from a book by John Bradley called *'The Racing Motorcycle: A Technical Guide For Constructors Vol. 1'* (I got mine from K-Tech Suspension, £38 inc p&p, 01530 810625). In this, Bradley explains a method of measuring a wheel's moment of inertia by timing the wheel down a known slope. Done correctly this is an accurate way of pinning a value on a wheel which you can then use in other calculations – for example how it might affect acceleration and deceleration. We used this value to help verify the acceleration tests were correct and not influenced by outside factors.



WHEELS OF FORTUNE

ARE EXPENSIVE WHEELS WORTH IT?

PERFORMANCE

We've already discussed inertia by imagining pushing a roller-skate and a tank. However, if you were to spin your front wheel when the bike is up on paddock stands, you can still feel the reluctance of the wheel to accelerate as you spin it – and yet its speed in mph is still zero because the bike is not moving (unless it's fallen off the paddock stands). So when considering the inertia of something that rotates, we also have to consider its rotating inertia or reluctance to rotational acceleration (called the moment of inertia). The data we gathered for our standard front and rear (Std) and BST wheels is as follows:

	Std GSX-R600 (F)	Std GSX-R600 (R)	BST Carbon Fibre (F)	BST Carbon Fibre (R)
Mass [kg]	4.7751	5.1986	2.5059	3.8663
Moment of inertia [kg/m ²]	0.154117	0.146595	0.067614	0.081274
Total effective wheel mass [kg]	8.09	8.35	3.99	5.61

The wheel's mass is for the rim and bearings alone – no discs and no tyre. The moment of inertia is just that, and the total effective wheel mass is how much the wheel would effectively weigh if you're trying to do a force = mass x acceleration calculation. Which we can do now.

Using the data above we can play around with some numbers and see how the wheels perform. For instance, how much torque would it take to accelerate each wheel to 60mph in three seconds? Remember this is for the rims only (it'll take more with the additional mass of discs and tyres).

	Std GSX-R600 (F)	Std GSX-R600 (R)	BST Carbon Fibre (F)	BST Carbon Fibre (R)
Torque [ft/lb]*	3.45	3.28	1.51	1.82

*required to accelerate wheel to 60mph in three seconds

Already you start to see things shifting very much in favour of the carbon fibre wheels, which require significantly less torque to accelerate at the same rate as the standard wheels. Putting this into context of you on your bike means less throttle for a given rate of acceleration, or more acceleration for the same amount of throttle. The only other ways to achieve this are to reduce the weight of your bike, increase the available engine power or reduce friction.

TRACK TESTING

At this point we should look at the Bruntingthorpe data to see how the wheels affected the bike in a real life test. The data was collected using the same rider, on the same bit of track and riding in the same direction repeatedly for an hour. We chose a top-gear roll-on test because it's consistently repeatable. The rider got the bike into top gear, was upright and tucked in at 35mph and then opened the throttle to the stop. This avoids any influence he might have.

Again the carbon fibre wheels have a clear advantage in acceleration, as the roll-on data we collected suggests they should. It's hard to discern in the first five seconds, but there is an advantage there as speed increases.



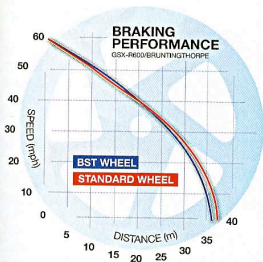
If you could compare both these bikes side by side (in the same way computer games show a ghost of your previous lap) there would be no way to catch the BST-wheeled machine. The difference is small to begin with, but the carbon wheels get the bike to 50mph in one metre less than the standard bike. It then builds with time and by 60mph the BST wheels have taken 3.5metres less, at 100mph they have

- a 13 metre advantage
- and by 150mph they
- are a full 108 metres
- ahead. The carbon
- fibre wheels performed
- better during normal
- acceleration tests as
- well. Up to 60mph the
- time was 0.1 seconds
- quicker and by 140mph
- the improvement
- had increased to 0.5
- seconds.

- It's the same story
- in braking tests.
- Remember our tank
- example? Just as it
- takes more effort to
- start heavier wheels

- so it takes more to
- slow heavier wheels.
- Because the total
- amount of brake force
- on the bike remains
- the same, the rider can
- turn this into a shorter
- stopping distance – and
- we're not just talking
- about a single bike
- length here.

- Repeating the
- pattern across
- several tests showed
- (in real terms) that
- the standard wheels
- actually slow down
- more quickly for the
- first 20mph, but then
- get outdone by the
- carbon fibre wheels
- to 0mph. In one sense
- you might prefer the
- OE wheels – certainly
- if you only ever scrub
- off the 20mph. But the
- carbon fibre wheels'
- ability to stop sooner
- in an emergency, when
- you've over-cooked it,
- or someone pulls out
- in front of you, means
- that extra bike length
- of distance can make
- a very significant
- difference indeed.

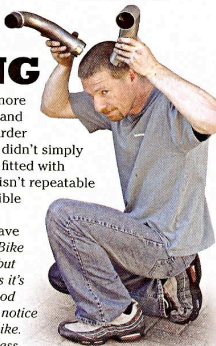


THE GOAT SPEAKS HANDLING

So, your bike will change speed more readily, but what about handling and suspension? This is one of the harder areas to evaluate. The reason we didn't simply data-log the suspension of a bike fitted with both sets of wheels is because it isn't repeatable enough, there are too many possible variables we can't scientifically control. So instead take it from Dave the Goat, former racer and *SuperBike* tester: "They were slightly better, but not as much as I expected. Perhaps it's because the GSX-R600 is such a good handling bike already – you might notice the difference more on a 1,000cc bike.

"The bike did turn in with a bit less effort and I felt it took less effort when flicking through a chicane, but I didn't notice any other improvement. There are some bumps going in to turn one at Silverstone (where we tested) and I thought the bike might behave differently over these but it didn't."

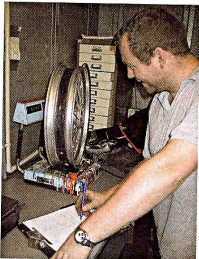
When asked if he'd buy some for his bike knowing what they were he said, "Yeah, I think I would, but only if I had the budget and the bike was being done up anyway." ☘



Dave Smith. Acting the, er, goat

WHEELS OF FORTUNE

ARE EXPENSIVE WHEELS WORTH IT?



STABILITY AND COMFORT

Finally there's stability and comfort. Your bike's ability to follow the road depends largely on the ratio of sprung to unsprung weight. A rough guide to which is to bounce a bike up and down. If something moves closer to the ground when you sit on the bike then it's sprung weight. If not, then it's unsprung.

As you ride along, gravity does all it can to pull your bike down onto the road. So as the road moves up and down beneath you the bike tries to rise and fall with it. When you hit a bump, the first thing to physically

move is the wheel. There will of course be a little deflection in the tyre but we'll ignore this. The movement then passes through the wheel spindle to the bottom of the fork, which presses on the spring, and whatever movement hasn't been absorbed by the spring is passed on to the frame and rider.

Again coming back to our roller-skate and tank example, we know something heavier is less inclined to begin moving, but is more inclined to keep moving once it has. So when we hit a bump the heavy wheel might be less eager to follow it (it

would compress the tyre a little more), but it would then begin to move and actually move further than necessary because it would keep moving after the bump stops and the bump force has diminished.

In contrast a light wheel would be more inclined to begin moving and to stop once the bump had stopped forcing it to move. So a lighter wheel should be better for following bumps and equally at following dips too. From the rider's point of view this means marginally more tyre contact time – which means more grip or stability.

THE BIG QUESTION SO, ARE THEY WORTH IT?

There's no question that fitting the BST Carbon wheels improved the performance of the GSX-R600. However, the improvements weren't as great as you might hope for, especially given the £1,795 asking price. Acceleration was improved but not by as much as £2K's worth of engine

- modifications might gain.
- Having said that, engine mods won't help you go around corners or

- improve your fuel economy
- – both of which the carbon wheels do, which makes them more of an all round improvement. For people who have the money to spend, yes the

- wheels are worth it. For those who have to spend more selectively, you will probably get a greater

- sense of satisfaction fitting an exhaust and Power Commander and having you suspension re-sprung, re-damped and set-up for around the same amount of money. What you won't be able to say – and what won't be obvious with your internal mods is – "Have you seen my carbon fibre wheels?" 