To finish first, first you have to finish

You may not have heard of superfinishing but when it comes to fine fettling and rider satisfaction there’s little to beat it

I’ll bet good money that as soon as you opened this feature your eyes were drawn to the pictures of shiny things. It’s only human to be drawn to precious-looking objects, but very often they serve no purpose other than to titillate. So, when I was handed a superfinished camshaft during a recent visit to Race Developments I was intrigued and had to know more...

SUPER WHAT?
Mass production techniques have improved tenfold in recent years giving us performance and reliability gains thanks to better tolerances. But the end product can still be improved with some clever thinking and, more importantly, acute attention to detail.

Whenever a part is machined the tooling used will inevitably leave some surface marks. The peaks and valleys, or asperities to give them their posh name, cause a number of unwanted things to happen. Especially where these parts come into contact with others.

The first and most obvious issue is friction. Think of the surface of a crankshaft journal under a microscope. You’d see what looks like the grain in a length of wood. Then think of the bearing that the journal runs in. That also has its own grain caused by its manufacture. These two grains will unavoidably run in different directions. In ideal circumstances a thin film of oil separates these two surfaces. However, that oil is also subject to the effects of the asperities and tries to follow the grain on each component. This creates friction and with friction comes heat and all its associated demons. Wear, frictional losses, tolerance change etc are all factors, and there are great benefits to be had by reducing them where possible. The bottom line is they all rob power so why not find a way to reduce the negative effects?

Improving the surface on a microscopic level also improves reliability and durability because hairline cracks and deformations are less likely to appear – most common engine failures or big maintenance issues can often be traced back to problems such as these.

Superfinishing is the name given to a metalworking process which improves surface finish. More specifically, isotropic superfinishing (ISF) is what Race Developments uses and to great effect. In fact, the term isotropic actually means: identical in all directions; invariant with respect to direction.

The ISF process uses clever chemistry along with a vibratory technique and non-abrasive media to achieve a much more desirable surface finish on engine parts. Now for the science part...

During a typical eight to 12 hour cycle in the machine, various chemicals are repeatedly introduced in controlled
steps. The first chemical coats the part completely, which is then vibrated in a special ceramic medium which removes the coating from the peaks and exposes them so allowing for their removal. This is repeated a few times until the surface is flat. Then a final chemical is added and the parts flushed to remove the original solutions, leaving behind the bright shiny surface you see in the pictures here.

During this whole process, typically one to four microns of material are removed, depending on the original surface – a human hair is around a hundred microns wide. Importantly this ensures that the geometry of the part is maintained.

Fi have extensively tested and used ISF for over a decade now and bikesport is using it more and more. Yoshimura offer it as a service in the US and Japan. At first it was banned by the rule-makers who considered it to be too high tech and so beyond the reach of anyone but the teams with the biggest budgets (Mat Mladin was banned in 2008 from an AMA race for its then illegal use). But now the technology is much more affordable and its benefits are becoming more widely recognised. Even NASA has conducted tests which have increased component life by four times.

I didn’t need much more convincing about the theory. In fact even with my worn digits, and my eyes closed, I could tell the differences between a superfinished camshaft and a standard one. It was almost as if the part had been coated in a thin film of oil, but of course it hadn’t.

The even better news is that within an engine, basically any component subject to interaction with another will greatly benefit from superfinishing. So, being as my 2003 R1 engine was already stripped down for cylinder head work it seemed rude not to get some first-hand superfinishing experience.

So, I handed over what felt like every single internal component in my engine to Race Developments’ Tim Radley and within a few days he gave me back a box of shiny treats that gave me eye-ache when I opened it up. Even my missus said: ‘Oh, they’re pretty,’ when she caught me caressing the various components.

Building the engine back up was a joy. Not since I started my spannering career have I enjoyed assembly so much. That said it did seem a shame to hide everything out of sight. When I spun the gearbox shafts within the cases ever ything felt freer and loose, but not in the same way I’d associate with a worn and/or aged set-up. Turning the engine over by hand while timing camshafts and setting valve clearances, I normally use a 12-inch bar and socket, but here I was using a seven-inch ring spanner… it was that easy.

Due to the extra cylinder head work the bike was having done at the time, it’s impossible to present a dyno graph showing the before and after effects of the ISF treatment. Tim says: ‘I regularly see gains of 2-3bhp at peak from 600s that I’ve treated, and slightly more from litre bikes.’

But yet again the dyno doesn’t tell the whole story. Tim continues: ‘You’ll feel the difference more than see it. There are ways it can be shown on a dyno but I use these display techniques for my engine development and would rather not give away valuable information like that. Trust me, you’ll know your parts have been superfinished.’

SUPERIDE

Before I could test ride the bike for the first time it needed running in on the dyno and the fuel injection mapping for the new headwork. Superfinishing is beneficial here also as component mating is faster, break-in essentially already having been achieved.
Discovering things that change the whole riding experience is pretty rare, but this is one of them.

With the necessary done and results on the wall (more on that in Project Bikes next month) it was time to see if I could feel a difference…

Back home the following day I found that just spinning the back wheel took less effort while it rotated the transmission in neutral.

The improvements continued when I was warming the bike up and lightly blipping the throttle. The pickup was immediate – a friend of mine who had come along to see what all the fuss was about even commented on how noticeable it was. It felt closer to a modern thou with its eagerness to climb revs and settle again.

Out on the road I was tentative for the first few miles because of the fresh winter potholes and I wanted to be sure all was well with my freshly assembled bike. But once I got going the smoothness really took me by surprise – three years ago I balanced the crankshaft in an effort to reduce vibrations on longer trips and it had a small positive effect. Now it felt amazing. I really am staggered that this is the same engine.

The noise is totally different too. It is less harsh and mechanical, yet quieter and softer.

It’s also true what Tim said about the dyno not telling the whole story. Overlaying graphs from before all this engine work, up to about 7k it all looks fairly similar. But it doesn’t feel it. The motor is so much keener to pick up and build revs faster. It’s really, really obvious how much friction has been reduced. It now feels like a modern 600, light and electric. Cruising around at town speeds, every rider knows their own bike’s ‘sweet spot’ in a particular gear/rev combo and now this engine has blurred the edges of that.

CONCLUSION
Discovering new things for me is what working on bikes is all about.

I’ve found, but this is one of them. The isotropic superfinishing has made a magical difference to the bike, and got me thinking of other possibilities. There’s no reason it needs to be limited to engine internals alone. I’m sure suspension and steering bearings, forks and shock internals would all benefit not just in outright performance but in everyday, real world durability and lifespan.

I wouldn’t hesitate to recommend this to every type of performance bike rider, track or road. Riding a bike is all about what makes you smile and makes you happy. This has done both in spades. Go on, treat yourself to something shiny.

THANKS & CONTACTS
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