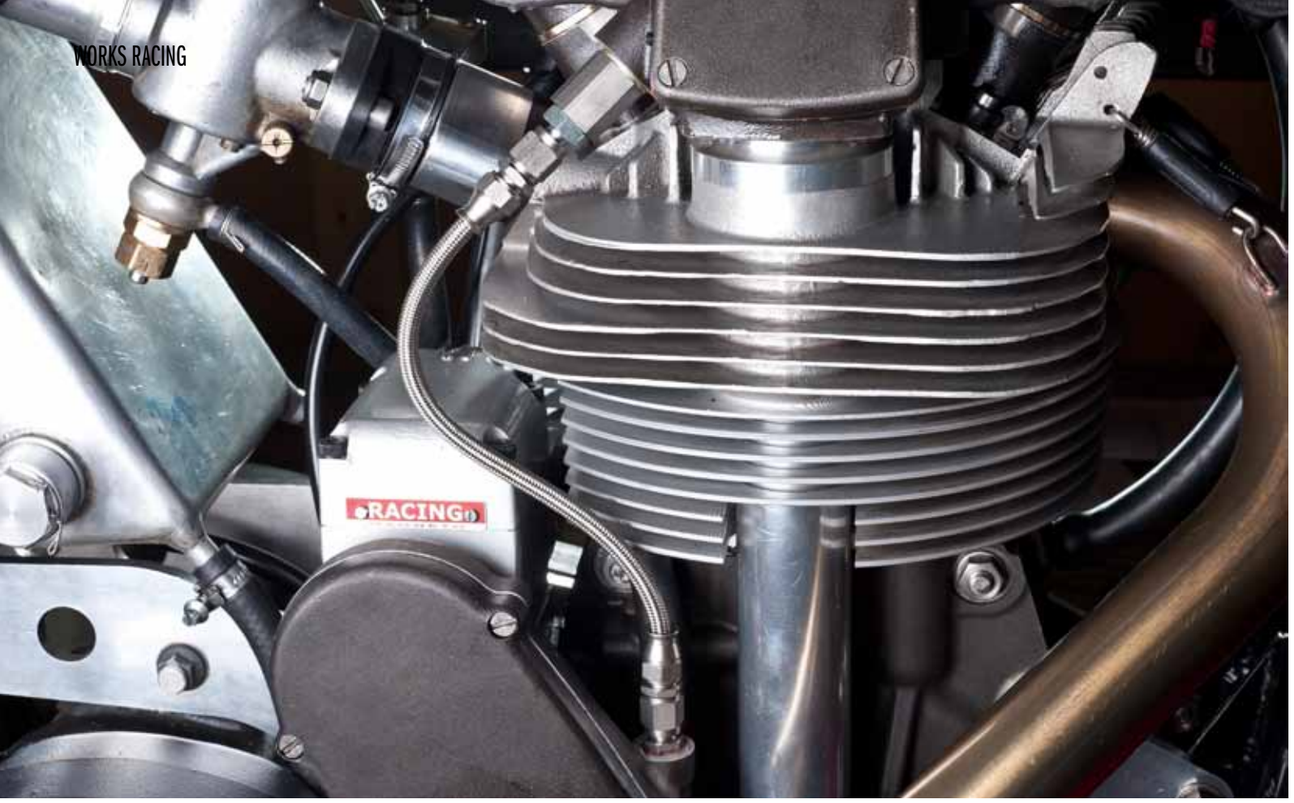
MR MANX

Everything Patrick Walker has ever done, from working for Norton at Shenstone in the Eighties to helping develop Jaguar's XJ220 supercar, has been preparation for his current vocation – engineering the best Manx Norton engines on the planet

WORDS: BEN MILLER. PHOTOGRAPHY: MATTHEW ROBERTS & MORTONS ARCHIVE



Note Works Racing's own exhaust, the machined-from-solid barrel, updated Norton logo on the bevel cover and the utter absence of oil mess

Heads during machining. Like Turner Prize-winning art, only useful

Amid the cutting tools the smile of a man who's found his calling

In 2010 a new Manx Norton engine appeared on the grid of The Lansdowne Classic Series. With its machined magnesium surfaces and ultra-neat castings, it was clearly brand new. But it was also very obviously a Manx engine; a double overhead camshaft air-cooled single with cam drive by shaft and bevels, that distinctive offset carburettor and the unmistakable curving oil line to the cam box. It looked right, it sounded right, and the scrutineers' mark denoted that, to their minds at least, it was right. Conceived over a two-year period and built in a wooden workshop outside Stratford-upon-Avon, the engine represented one man's lifelong passion for Norton fused with decades of engineering experience. With Glen English in the saddle, the new engine won its first six races – no mean feat in the competitive Lansdowne. English said of the engine: "It's like nothing I've ridden before. Some classic race motors feel fast but fragile. This is fast and rock solid." Works Racing Motor Cycles Ltd and the man behind its engines, Patrick Walker, had arrived.

Patrick can trace his passion for classic British motorcycles back to one moment and one magazine, *Classic Bike*. "A boy in my class at school had smuggled a copy in to read, ahem, between lessons… The cover was pale blue with a picture of a Velocette on it. That was it – at that moment I fell in love with old motorbikes.

Fuelled by epic racing stories and a thirst for speed, Patrick began knocking about with old British bikes, and this new obsession steered him into a degree in mechanical engineering. The sandwich course required a professional placement and without a second thought Patrick made for Norton, then based at Shenstone. Doug Hele, who'd overseen the Manx engine's last years of development in the early Sixties, interviewed Patrick. The apprenticeship that followed would be intense to say the least.

"He didn't get his hands dirty – he wore a suit every day – but he was somehow still very hands-on," says Patrick of Hele. "He made models of ideas he wanted to try and he had his own vernacular, too, like 'jogglocity' – which was his word for just the right amount of clearance. And he was a proper gentleman. On my first day I was priming an oil line with an old can when I spurted oil onto his suit jacket. I was horrified. Doug thought nothing of it."

Patrick spent a month in every department, from stores to welding, before settling in the development department for six months. Sitting next to Hele, he learnt to draw and to solve problems, spending his mornings at the drawing board before pulling on his leathers and evaluating his work out on the test track. There were plenty of problems to solve – this was the mid-Eighties and the company was fighting to survive, developing the Commander police rotary on precious little money. Patrick was straight into the thick of it. "I had no idea about anything. An engineering degree doesn't teach you much about engineering," he smiles. "I learnt more in that year at Norton than I did in the other three at college."

With his degree completed, Patrick returned to Norton – and immediately found himself project-managing the F1, a production superbike based on the all-conquering 588 rotary-engined racer. "We had to build a complete bike in no time and with no money. The engine existed, but that was it. We did the frame, the bodywork, the exhaust and ancilliaries – everything. We built a show bike first and took 120 orders. Norton then made the classic mistake of hurriedly building

customer bikes with next to no development. Everything was compromised. But I was young, I was having a blast – thrashing bikes at MIRA and the Nürburgring – and the F1 looked fantastic. I was in heaven, and I was learning lessons for the future...

Patrick moved from Norton to Tom Walkinshaw Racing, who at the time were working closely with Jaguar. TWR engineered Jaguar's Le Mans sports prototypes and, when Jaguar made the decision to build a Ferrari-humbling supercar, TWR were tasked with making the concept a reality. Patrick found himself durability-testing the XJ220's engine, punishing the 550bhp twin-turbo V6 until it became unbreakable. After the XJ220 came Aston Martin's DB7 and more durability testing, calibration work and engine failure analysis, this time on a supercharged straight six.

The approach at TWR and Jaguar was the polar opposite of Norton's, where Patrick believes the problem went deeper than a lack of resources. "It was the mentality as well. There was a reluctance to confront the truth that the rotary wasn't durable." To the resourceful, pragmatic problem-solving skills he'd developed at Norton, Patrick's work with the XJ220 and DB7 added an appreciation of the worth of thorough development and durability testing, of leaving nothing to chance. He also learnt that a Ford Transit van fitted with an XJ220 engine is untouchable on the M40 motorway...

Patrick's next project was Maxsym, an engineering consultancy and combustion engine think-tank he co-founded and ran for ten years. The firm's first success came with an idea of Patrick's – a compact balancer linkage that enabled single- and twin-cylinder four-strokes to compete with two-strokes on specific output while still blowing them out of the water on fuel consumption and emissions.

"We demonstrated our engines to firms involved in recreational vehicles; snowmobiles, personal watercraft and so on," explains Patrick. "Our engines helped convince governing bodies like the Californian Air Resource Board that two-stroke engines weren't the only option for things like jet skis, and that led to regulations in the Noughties that effectively banned two-strokes in those applications. Maxsym did well, and we expanded to something like 17 staff, but about 12 years ago I started to think I needed a new project. I was proud of what we'd achieved – we did a 1000cc parallel twin that made 127bhp and didn't vibrate – but I didn't enjoy managing people. I did some consultancy work, including a stint developing the paramotor that TV adventurer Bear Grylls flew to the summit of Everest, but I'd also fallen back in love with motorcycles. I'd never left them behind – I ran an SFC1000 Laverda for years, and still owned Nortons – but I started racing again, I was going over to the TT and the Manx Grand Prix and I wanted to do something new.

In 2007 Patrick began thinking about applying all he'd learned about engines to the 30M and 40M Norton racing singles. The following year, at Goodwood, Patrick got talking to lifelong Norton enthusiast and collector Miles Robinson. Works Racing Motor Cycles was born.

"The Manx Norton is a fantastic bike," gushes Patrick, eyes bright. "If you boiled a modern race bike for a month you'd reduce it to a Manx. There's nothing superfluous on them, and that's why they're so satisfying to ride and so fast – still. They're compact, light, nimble and there's just enough power; you can use every single horsepower. With Works we wanted to build the best Manx engine we could – not the cheapest, the best. But at the same time the fundamentals had to stay true to the last production engines Norton sold. Every part had to be interchangeable with an original motor."

Patrick's first step was to build the Manx engine in SolidWorks, a piece of three-dimensional CAD (computer aided design) software. He then began scrutinising and developing every single part of the virtual engine he's created.

"I literally took each and every component and assembly, from the piston to the oil pump, and worked to improve it, to make it special. My valve pushers are a

Works Racing was born at the Revival

Mill alone represents £40k of investment

good example. They're interchangeable with the original part, but they're tougher, lighter and they're coated with diamond-like carbon, which is as tough and as slippery as glass. They're recognisably still Manx valve pushers but they're better, taking a little friction out of the valvetrain.

In some areas the improvements were subtle, in others more substantial. While one-piece cranks to replace the original Norton five-piece items are not a new idea, Patrick's works with his conrod and piston to reduce frictional losses while also giving smooth, reliable power.

"The piston and the reshaped combustion chamber are key to the performance gains we've achieved," explains Patrick. "A Manx racer from the early Sixties would recognise the top of the piston but not the underside, while a modern motorsport engineer would be baffled by the shape of the crown but perfectly at home looking at the bottom of the piston, with its cross-braced bosses."

Patrick's experience was brought to bear on the new project, refining everything from the valve guides – "They're Colsibro, a tough bronze alloy" – to the oil pump. "I've done a lot of work on lubrication systems. I calculated the oil flow velocities in the Norton pump and found they were horrifyingly high. That effectively boils the oil, causing cavitation and ensuring that the oil reaching the top end is full of bubbles – not ideal. My pump's externally identical, but I've significantly altered the porting and design of the galleries to get the flow right."

Fred Walmsley consulted on the project and helped Patrick establish the kind of power characteristics the new engine should exhibit. "Fred was adamant a strong midrange was key – you want a bike that accelerates hard long before peak revs, to ensure the bike's quick on any circuit."

Bikes under the bench include a very original 350 and 500 – "Essential reference," says Patrick

Devilsome details

It's a Manx Norton engine, right? Well, sort of...

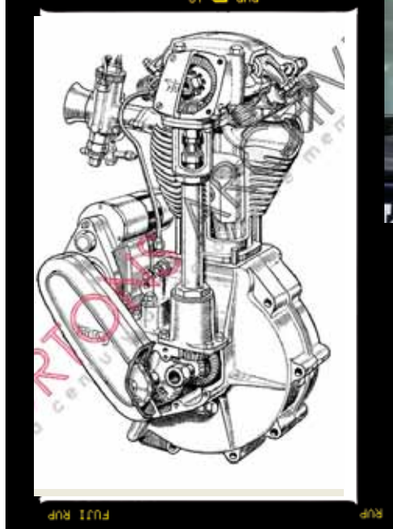
MODERN MATERIALS

"The crankcases and covers are machined from accurate magnesium castings," says Patrick. "Magnesium brings great weight benefits but you have to be careful machining it – it loves to burn... The key is to keep the cutter moving – you want it cutting, not rubbing. For that you choose a low cutter speed and a high feed rate; 6mm/min for magnesium as opposed to say 0.5-1mm/min for steel."

The barrel is machined from solid. Forged alloy piston with two rings and cross-braced pin bosses are supplied by Omega, and link to the one-piece nitrided EN40B steel crankshaft via a forged steel conrod.

1 FIVE AXIS PORTING

Port shape helps dictate gas speed and an engine's volumetric efficiency. Hand-finishing is the traditional method of making cast ports more accurate and effective, but Patrick is now finishing his heads with CNC machining – no mean feat given the complex forms involved and the difficult access for a milling cutter. By teaming up with Denis Welch Motorsport, Patrick can now finish his ports exactly as he wants them, time after time, to an accuracy of +/-0.05mm.



2 MAGNETO

"It was magneto failure that put me out at the 2008 Manx GP with 12 miles to go, so I suppose you could say I've over-reacted by designing our magneto..." says Patrick. "From the outside it's absolutely a 2MTT mag, which was important – we even obtained legal permission from TRW Automotive, who own the Lucas trademark, to badge it correctly."

3 CONCENTRIC BOSS

"This is only a small detail, but you look at most Manx Norton engines and the boss in the crankcase casting around this bolt and nut is always eccentric," explains Patrick. "Sometimes they're miles out. It doesn't actually matter much – it's merely a product of the accuracy limitations of the original tooling – but you'll see they line up nicely on our engines."

4 BEVEL GEARS

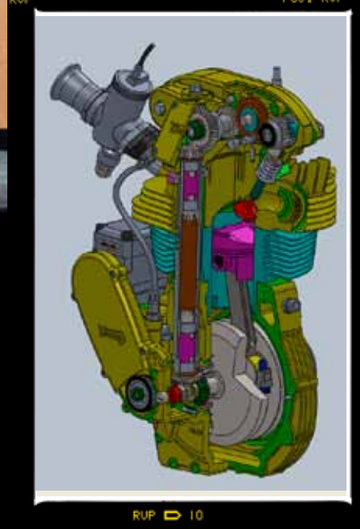
"This is one area in which Miles' stickling for originality won through," says Patrick of his engines' cam drive set-up. "Straight-cut bevel gears are just a no-no from a pure engineering perspective. They're noisy and inefficient – helical bevel gears reduce the frictional losses by something like 50%. But Miles insisted it'd be plain wrong to pop the cover off and see Ducati-style helical bevels in there, so we've stuck to straight cut; same diameter, pitch, everything. Obviously we've specified a better material and surface finish, but the parts remain interchangeable with the originals."

Works' engines use a splined tube set-up on the cam drive shaft. Norton moved to this design in the late-Fifities, replacing the troublesome Oldham coupling.

5 SPRING COVERS

"Manx Nortons have leaked oil from here for as long as anyone can remember," says Patrick. "The springs used to run exposed, out in the breeze, and you'd get oil all over the place. I designed these covers in magnesium, so they weight next to nothing, with proper oil drains and O-rings top and bottom."

Patrick's first job was building a CAD model, working from genuine drawings and parts. Some details have been fudged in order to keep them secret...



This brief, together with a lack of time, meant Patrick's engines initially ran with Norton's standard cam profiles. "Of course the engine worked just fine on those cams, but I've since been able to design my own and that's given the engines more power still. Cam design is extremely mathematical, as you might imagine, and it took around three months to do all the calculations and come up with the best profiles for this engine.

"The profiles are quartic elliptic, that is they're made up of a series of ellipses joined together tangentially to give the profile. I considered everything – velocity curves, acceleration curves, rate of change of acceleration curves, rate of change of rate of change curves – and came up with the cams we're now using, as well as retro-fitting them to the engines we've already sold. That's one of the great things about operating on this scale and only building engines in tiny batches – you can make changes very rapidly, and implement developments straight away. Much of the time I make engines one at a time, so we don't have to wait to finish a batch of ten engines before making a change. The other great thing about Works Racing is that, while I couldn't have done it without Miles, day-to-day it's just me and my machines in my shed – heaven."

The vast majority of the work that goes into each engine is done by Patrick in his beloved shed. His 3D CAD designs were translated into the CAM program Edge Cam. Brand new tooling was cut, ensuring superb accuracy. These castings arrive at Patrick's premises before being fed into his Haas Mini Mill 2, a four-axis CNC machine that's anything but mini. There, under Patrick's watchful gaze, components of extraordinary beauty emerge, ready to be either sent out individually or assembled into a Works Racing engine.

At the centre of it all Patrick wears the genuine, easy smile of a man who's doing the job he can't help but feel he was put on this Earth to do.

"It's such a contrast to Norton the first time around," he smiles. "We have absolute faith in our work and that matters – customer satisfaction is everything in the classic racing world. It's competitive, but people go racing to have fun. If your bike's giving you grief, that takes the fun out of it. I attend most of the race meetings my UK customers attend, to support them. And I'm always at the end of the phone if my international clients need me. The web shop offers same-day dispatch and I carry all the parts right here, so there's no wait. They've paid £11,500 for their engine and we make sure they're delighted with it."

'We build engines in small batches. That way we can implement developments straight away'

Works Racing's future plans make for exciting reading. The current product line-up includes the engines, carburettors, exhausts, tanks, clutches, gearboxes, engine plates and rearsets, and next on the list are hubs and road bikes…

"A customer with a tatty old ES2 came to me wanting a Manx engine for it. All I've done is fit a little decompressor, drop the compression ratio from 14:1 to 10:1, fitted a 36mm Mikuni in place of the original GP Amal, so it idles, and added a kickstart. Now I've got the knack, it kicks first time. And it's fast…

"These engines don't need a lot of looking after, either – just change the oil for fresh fully-synthetic Silkolene 15/50 as often as you can. A road-going Manx fitted with one of these engines is so much fun. Just don't ask me how I know that…"

www.worksracing.co.uk, 01789 750105