

Right: *Despite carrying a 60kg penalty at Snetterton, the Ecoboost Focus impressed on its Championship debut*



» The British Touring Car Championship has conformed to a variety of regulations over its existence from FIA Group A to FIA Supertouring and Super 2000. The latest NGTC regulations were phased in from the start of the 2011 season, before being enforced across the entire grid from 2014 onwards.

Motorbase has been a regular front-running team in the championship, across all the regulation iterations, and has had a Duratec powered Ford Focus as its car of choice since the start of the 2011 BTCC season.

"The NGTC format had just been born and we went testing

with a BMW at the time. We came across an NGTC car at the same session and quickly realized we couldn't compete against it," explains Oly Collins, team manager at Motorbase Performance. "We did a deal with Arena Motorsport and bought its cars toward the end of 2010. We ran the Duratec engine in S2000 format for the first season of all, but the following year we realized that things had progressed quite rapidly with NGTC. We then built our own car in the summer of 2012, and got it out for the second half of that season.

"The Duratec engine was very good, but fundamentally it was a naturally aspirated

engine converted to LPG power, then converted to an NGTC-specification turbo engine," Collins continues. "It was always good on power, but we could never really get the drivability we wanted from it. It served us well, but we knew we needed something else in the car."

A solution came from Motorbase's long-term technical partner Mountune, which proposed a new engine to the team, based on the latest-generation of EcoBoost units from Ford.

"The main difference between the two engines is that the old Duratec was port injected and it didn't have variable valve timing," explains



Tech spec

FORD 2.0-LITER ECOBOOST

CONFIGURATION: Inline-four

DISPLACEMENT: 1,999cc

VALVETRAIN: DOHC, 4 valves per cylinder, independent variable cam timing

BORE X STROKE: 87.5mm x 83.1mm

CRANKSHAFT: Cast-iron, 47mm diameter crankpins

MAIN BEARINGS: five @ 52mm

CAMSHAFT DRIVE: single chain

COMPRESSION RATIO: 9.3:1

LUBRICATION SYSTEM: Wet sump

Boosted beauty

Motorbase is a regular front-runner in the British Touring Car Championship, and for 2015 switched to EcoBoost power for its NGTC-spec Ford Focus

WORDS BY JOHN O'BRIEN

David Mountain, founder and technical director of Mountune Racing. "Ford has two versions of the new EcoBoost engine. The 'classic', which is what we use, is fitted to the Ford Mondeo and Land Rover Evoque and has a separate, conventional manifold that bolts to the head. The newer 'value' model, which is what is fitted to most of Ford's new road cars, has a cast-in manifold. As a result, the turbo almost bolts right to the side of the head, which is an absolute killer to us in terms of engine performance. We did a back-to-back between the two versions and we lost 35bhp using the cast-in version."

After adopting the earlier specification EcoBoost unit as its base, Mountune began working on the unit, pitching the idea to Motorbase in early 2014. The NGTC specifications dictate the amount of work that can be undertaken on the engine, calling for the factory head to be retained.

"You are allowed to change the piston, con-rods and crankshaft," explains Mountain. "With this engine we have changed the piston and con-rods, but not the crankshaft. The earlier Duratec was a normally aspirated engine rated at 150bhp, and we knew from our previous experiences that the crank was reasonably weak, so in that application we replaced it with a steel billet crank. The EcoBoost, however, is built to be turbocharged from the factory and as we've had a fair bit of experience working with Ford in terms of looking at finite analysis of components, we knew that the production crank could be carried over."

Because the factory crankshaft was retained, the bore and stroke remained the same. The engine's lubrication is a wet-sump system, again carried over from the road car. While the crankshaft was retained on the grounds of its strength and relatively low cost, the sump system has been retained because of the NGTC regulations.

"A lot of time, money and effort was spent making the wet sump work so that we didn't end up with oil surge. Or to put it another way, we managed the oil surge so that it works well," explains Mountain. "The bulk of work on the engine was in the development of the direct-injection system. That took in working on the combustion chamber shape, hole shape in the piston, and a different fuel injector with a revised nozzle to correct the spray pattern."

As a result of the tight regulations, the engine's performance was advanced in small, incremental steps. "The piston work was absolutely critical and has been quite a steep learning curve," reveals Mountain. "We do have some direct-injection experience, but it is limited, so creating the new piston bowl shape in CFD, and working with Bosch for the injector spray patterns, were probably the biggest challenges we had in development. Although the cylinder head has to remain standard, most of the air motion is created by the piston. As the design of that is free, we spent a lot of time to ensure we got it right."

As with any forced induction engine, correct thermal management is critical to overall performance. "There's a hell of a lot of heat under the hood from the turbocharger, so

that's something we worked on quite heavily," says Collins. "The engine performs so much better when it's cooler, so it was critical to get it right on both the water-cooling and intercooler sides."

"By using the earlier direct-injection unit, we were able to build a proper stainless-steel replacement and tune the primary lengths and diameters, and position the turbo where we actually wanted it," adds Mountain.

As Motorbase and title-sponsor Airwaves parted company at the start of 2015, the team opted to sit out the first half of the 2015 season. In the car's limited appearances so far this season it has performed well. Once the car shed its 60kg penalty for missing the opening half of the season, the car has qualified in pole position, achieved an overall race victory and had another three podium finishes.

"Had we contested the full season, and found ourselves in the hunt for the title, then we would have approached it very differently because sometimes you settle for places to salvage points on a bad weekend," concludes Collins. "We don't have that. We purely want to go out and win races! It's a slightly different approach, but our target is purely to win as many races and as much silverware as we can!" <



Engine equality

> NGTC regulations aim to create a level of parity between the entire 34-car grid. By strictly policing the engine regulations, the British Touring Car Championship has seen eras of domination become a thing of the past, with recent seasons creating several race winners and pole sitters. David Mountain, founder and technical director of Mountune Racing, explains the technical process behind the regulations:

"I think they use Lotus Engineering modeling software, so they monitor airflow through the cylinder head, enter that into the equation with the area under the curve on the cam profile, and then that gives them a boost figure."

"So they give you a baseline boost figure, and then the Balance of Performance (BoP) works through adjustment of success ballast. To be honest, although we were very skeptical, if you look at the lap times they are all very close and it does seem to work quite well."

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For independent teams, the championship offers the use of a crate TOCA engine.

"Teams can lease a Swindon-supplied, GM-based NGTC engine, which is quite cost-effective," explains Mountain. "Or as we, Honda and BMW have done, develop your own from your own base engine. The TOCA engine is the only one that can be fitted into any car. It is the three manufacturer engines that they are trying to equalize against the TOCA engine, so it's nominally a 330bhp formula. Although there are a few fudged factors in the process, the grid does generally come up quite close." <