EXCLUSIVE

THE HEWLAND FILE

Current E

YOUR GUIDE TO FORMULA E
A gearbox from British manufacturer Hewland Engineering has driven the first Formula E season (and will drive the cars of “more than one” constructor in season two) but details have been kept under lock and key. Following an exclusive audience at the company’s headquarters, here – for the first time – is the full story.

Just on the bend of an English country road in greenest Berkshire, tucked away behind a leafy screen of gently waving branches, is the home of Hewland Engineering. No grey ribbons of race track for this British motorsport manufacturing institution; no tall chimneys, no sprawling expanses, no military-style security perimeter. Concealed behind the treeline is the swooping roof and curved glass atrium of the purpose-built building, a functional, unpretentious entrance to a company which is very much the same.

Founded in 1957, Hewland is known particularly for its racing gearboxes, products held in such high regard that the business counts just about every major motorsport on its client list. Among those is Formula E. Every one of the 40 Spark-Racing race cars is driven by a McLaren electric motor mated to a Hewland five-speed sequential transmission with “McLaren” stamped on the magnesium casing. Yet it’s a project so engulfed in secrecy that Hewland could not even publicly confirm the number of gears in the transmission until I visited in June 2015, more than a year after the cars had been delivered to teams.

In fact, Hewland’s entire electric racing story has been kept under wraps – until now.
Hewland HQ is a deceptive building, one that seems like a conventional low-rise office block until you’re taken through a doorway into the manufacturing complex. There you find a proper factory floor, with glistening metal shavings, stocks of shiny newly-completed components and machines with windows showcasing mysterious silvery metal parts emerging Excalibur-like from frothy turbulent waters. It’s a vast area, filled with the latest technology and kept orderly by processes more usually found at giant car making plants. There’s even a heat treatment area and air-conditioned facilities for parts whose tolerances are measured in microns.

The entire area has to be vetted before I’m allowed to walk in and I’m not taken into two adjacent areas because there are season two gearbox components being examined; in one of these areas, every single gearbox made in the factory is quality checked before leaving the premises.

In a meeting room sequestered just behind the front desk, I meet William Hewland, son of company founder Mike, and commercial manager Alex Thornton. They’re clearly itching to talk Formula E but, such is the confidential nature of their work and the priority they place on protecting their clients’ information, much of what I’d like to discuss remains out of the question.

Even names are off limits. “We can’t mention any of our partners for season one or season two,” they say. (Despite the McLaren link being common knowledge, not once is the name mentioned by anyone in a Hewland shirt during our discussion.)

The company’s ubiquity in single seater racing (“We supply all of the grids to GP2, GP3, Formula 3 and a number of other projects around the world – from a single seater perspective, we’re a fairly obvious choice,” says Thornton) was a major factor in being approached for the new project. Another was the firm’s relationship with the fastest electric car in the world, the VBB3. Hewland supplied transmissions for both that car and its predecessor, the record-breaking VBB2.5.

Hewland’s involvement in Formula E started early, with the Formulec project in 2009. This was the prototype electric racing car and series concept that was bought entirely to create the basis for Formula E. The Spark-Renault transmission is “completely different from what was in the Formulec car,” Thornton says. “It has parts in common with a Formula 3 unit, but both men are keen to stress it’s not the same thing at all.

“This transmission was pretty much ground-up,” Thornton continues. “There are certainly some Formula 3 components that we’ve used or adapted to reduce costs but there’s an awful lot in there internally that is brand new and designed specifically for this project.”

Hewland concurs. “It was a new gearbox,” he explains. “Some of the parts inside were reused but the casing was designed from scratch.”

While the unit might be new, it stands out as a fairly conventional way to approach a transmission for what could have been very cutting edge powertrain. Hewland doesn’t disagree.

“There’s always a limited timeframe, there’s always a reality budget-wise,” he says. “You do what you can with the time and money available. With year one being a one make formula, you tend not to go nuts in terms of design because all the cars are going to be the same. There’s no point pushing it to the point where it doesn’t work or where you’ll have issues. So we listened to the design brief and came up with something that did that. Design is a bit like joining the dots.”
Hewland’s involvement in the Formula E project adds another august British name to a list that includes McLaren (supplier of the motor, ECU and inverter); Williams (supplier of the battery); Jaguar (the Williams battery shares its DNA with the C-X75 prototype); Alcon (brakes supplier); and Donington Park (home to the sport’s technical HQ).

The Hewland project team began work on the Spark-Renault transmission in late 2013. “We were involved with the design, the testing, and dyno testing,” says Hewland. “You take what you learn and build that into the production version, but there was little difference between those two.” Pretty much all of the stuff that’s running now on track was running in the first prototype.

The focus was on keeping the weight down, essential in a car in which the batteries alone weigh around 300kg. “For this car, the transmission is all about lightness, efficiency and packaging,” Thornton says. “We’re trying to come up with something that is exceptionally light.”

Many have asked why the car needs to use a gearbox at all, given that electric motors do have a wide torque band. Thornton is diplomatic on the matter: “We delivered according to what’s required. As far as the multi-speed question goes, it’s all down to the characteristics of the motor.”

Hewland is a little more bullish. “We were asked to,” he says. “They wanted to try and make the motor function quite similarly to an ICE for the drivers. Plus, whatever anyone says, electric motors do have an optimum power band. It’s not as accentuated as an ICE but it’s there. So if you want to get the most out of it, you still do need to go for the sweet spot and gearing can help accomplish that.”

IMPACT AND REGEN CHALLENGES

Preseason testing and the first two races, in Beijing and Putrajaya, threw up worrying problems for the gearbox. Internal components seemed to be sustaining damage under regenerative braking and the units failed altogether when drivers touched the concrete walls. At one point, it looked as though each driver might need a new gearbox per race – rather contrary to the stated goal of using the ‘box for the entire season.

The Hewland team puts the issues down to teething issues, design compromises made to keep weight down and the dearth of track data available about the new tracks before the season began. “It’s not difficult to design a transmission to deal with any given load – but you need to know that before entering the design phase,” says Hewland. “Real world use was frankly different to what was expected: the aggression from the drivers, the nature of the circuits, the regeneration characteristics.”

“All of the gearboxes essentially passed all the pressure crash tests so there was nothing structurally wrong,” Thornton says of the impact fragility. “It was just the loads we saw in Beijing were not what we were expecting as a technical group.”

“The street circuit racing nature of Formula E is very individual,” Hewland notes. “No series in the world has only street circuits. When you go off into a gravel trap, you don’t put much suspension load into a car. But when you go off and hit a wall, even just routinely, there are loads going into the car that we were not expecting. The quickest solution was a chassis brace, which deflects the load elsewhere and not into the gearbox. It was the best, most economical mid-season fix.”

Another unexpected issue was how the teams deployed regenerative braking early in the season, something that has also caused headaches for battery supplier Williams.

“When you’re running regen, you’re putting in load the opposite way through the final drive to normal racing,” says Hewland. “The crown wheel and pinion is designed to be highly stressed in one direction and less so in the other but Formula E adds significant stress in both directions. You also have a situation where the crown wheel and pinion is constantly under load. In conventional racing, under braking you don’t have those loads. In Formula E you do. So it’s constantly under load and the load is the other way around, with significant torque. Effectively, you get premature wear.”

The issue caused commotion throughout preseason testing, with teams taking to stripping down their gearboxes daily to inspect for damage.

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“The solution was more strategy rather than mechanical,” Thornton says. “It’s not so much turning the regen down; it’s more a question of managing where it’s used, at which speeds and in which gears. As far as I know, after the Beijing race the issues haven’t been seen.”

“It’s a bit of a learning curve for all of us,” Hewland admits. “It’s a brave new world and with that comes people who want to push the envelope. The teams looked at the optimum strategy for how you can wring the most out of this thing on the day but no one quite realised they would use it quite in that fashion. You can destroy a gearbox with a couple of wrong presses on a laptop — and we only tend to get data when there’s an autopsy.”

MULTIPLE CONTRACTS FOR SEASON TWO

In the second season, development opens up: eight new constructors enter the fray, each able to bring in their own motors, transmissions and rear suspension. Although the company won’t say how many or who they are, our sources indicate that Hewland is supplying six constructors and eight teams.

“We’re proud to be working with more than one partner in season two,” says Thornton. “The constructors have very different ideas about what makes a fast Formula E car. They’re looking for different performance targets around different areas of the transmission. We have a wish list too.”

Such is the secrecy around the projects that the company has altered its management structure and created “walls within walls” to stop information flow between design teams.

“We wanted to make sure that we didn’t have any cross-fertilisation between the projects,” Thornton explains. “We have a new technical director who’s come from F1 — Jon Dean. He’s very experienced in this kind of thing. We’ve given each project different teams. Very few of us in the company have any knowledge what’s going on between them. There’s a Chinese wall policy to stop cross-fertilisation.”

SECOND GEN CONCEPTS

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The burning question for season two tech is this: with all second generation powertrains still using a common battery from Williams, can an advantage really be gained with the transmission and motor? The clever chaps at Hewland think so.

“Next season will be really good; you will see more of a difference between performance at different tracks,” says Thornton. “Our bit, between the motor and the wheels, comes down to relatively small optimisations but these can translate into big performance gains.”

Thornton points out that selecting the number of gears and deciding ratios was difficult in the first season because the tracks were brand new. Now, with a bank of data built up over a season of racing, constructors are in a much better position to refine their transmission options and choices.

The options are broad. CVTs are not permitted under the regulations but that leaves constructors free to try out anything from simple speed units to multi-speed transmissions similar to the existing one.

“There are various schools of thought,” Hewland confirms. “Our job is to provide tailored suits. Now show me who I’m cutting it around. We’re not going to sell something that doesn’t work but equally a lot of it is down to what the customer needs, where the suspension is going to bolt on and so on. You can only start designing something once someone gives you the direction. It’s not always apparent what’s ‘better’ and it depends on what they want to do with the gearbox.”

A tentative approach at first from the new Formula E constructors has resulted in a condensed design and development cycle for the gearbox, with Hewland going from paper to physical products in merely weeks.

“This has been very tight for season two – exceptionally tight, even by motorsport standards,” Thornton says. “Multi-million pound investment in producing stock towards the end of last year however (“We have enough on the shelf now to supply all our major clients for a season,” Thornton says) has cleared the decks for these last minute projects.”
“As any F1 designer will tell you, it’s the longest lead item of an F1 car but often it gets left til quite late,” Hewland says. “And then we have to pull an enormous rabbit out of a hat. But we do. That’s why there aren’t 50 other companies doing this.”

While the company won’t reveal any details about the second generation of Formula E transmissions, “it’s fair to say that everything is fairly conventional from a materials point of view,” as Hewland puts it. “It’s all good, high quality racing stuff and the changes tend to come in shape.”

Efficiency is a major driver in Formula E and Hewland has been acquiring new plant to advance its capabilities here. “We’ve just invested in a spiral bevel grinding machine,” says Thornton. “Part of the reason for that is that we’ve realised that the efficiency gains we’re making on the Formula E side translate quite well into other things too.”

“Efficiency is found in paying attention to the shape of the gear teeth, the accuracy to which they’re produced, bearings, seals, weight,” Hewland says. “It does us good to have a transmission that has a pushy design brief. Some of the stuff we make has plateaued. It’s cost driven. People want the same gearbox that you designed six or seven years ago that works very well. Here, it’s different.”

The gearboxes will be sealed for season two, meaning that teams won’t be able to take them apart. Hewland thinks this will give them greater control over their parts and is confident that there won’t be any repeat of the issues experienced in season one. “If we hadn’t done season one, doing season two would have been really dangerous,” he says. “There’s no substitute for experience. No matter how clever you are, how big you are, no one would have had the experience before season one. Formula E is one of the few categories in motorsport that has a lot of room for innovation within the regulations,” Thornton agrees. “We already have a lot of ideas for season three and we’ve started having discussions.”

The sport has already done the business good – and not just in firing up the imaginations of its designers. “Around 25% of our enquiries are about electric vehicles now,” says Thornton. “Formula E has been a great halo project. Most of the EV projects we work on are pretty secretive as they have technology which goes into prototypes or niche vehicles. But the PR in Formula E has been phenomenal and it reaches the X-box generation, the YouTube generation. The way Formula E has engaged audiences has been fantastic. And that’s critical: there is no motorsport without sponsors, and there are no sponsors without a market. We’re also working with clients now to help them develop EV technologies that can be scaled up for mass production.”

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“We did Formula E partly because it was interesting and partly because it was work,” Hewland sums up. “There was a fair amount of cynicism in the industry before Beijing. We thought, if we do this and the series gets pulled, we supplied some gearboxes and it shows we’re up for doing something different. And if it keeps going, we keep learning. We’re on the rollercoaster ride now and we’re not looking back.”
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