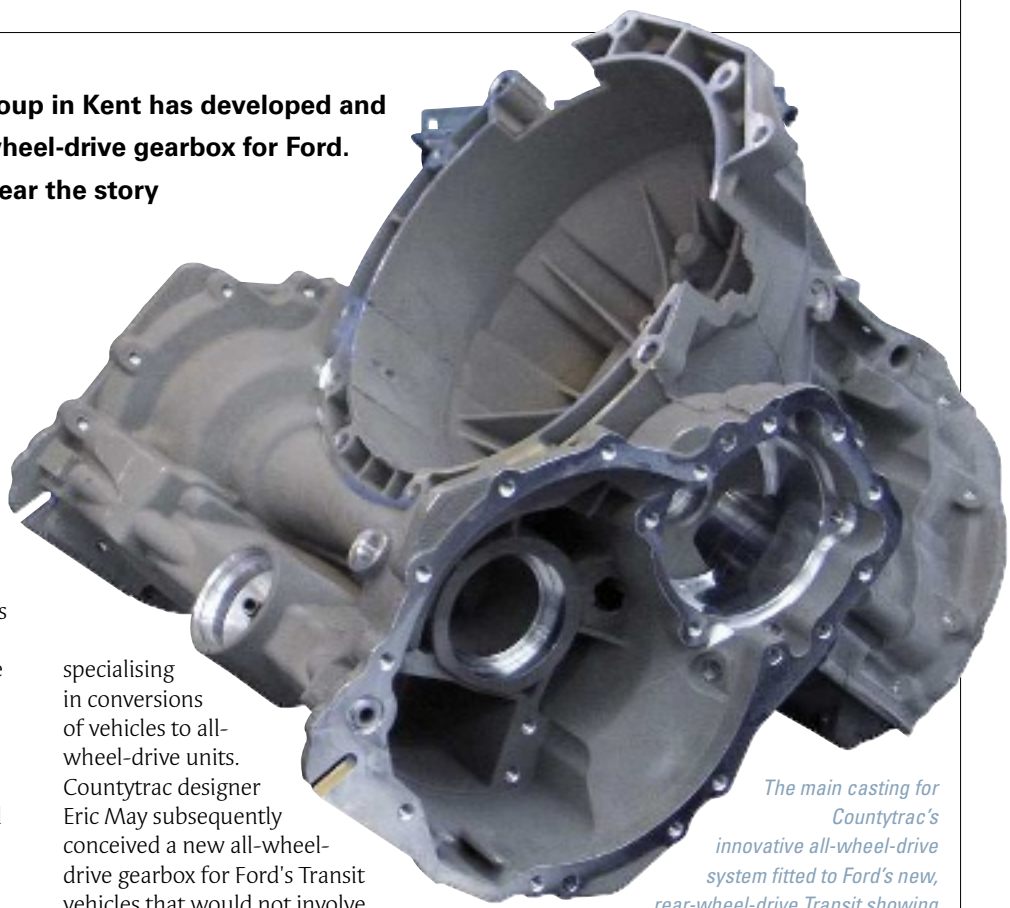
Automotive adventure

A medium-sized engineering group in Kent has developed and is producing an innovative all-wheel-drive gearbox for Ford. Andrew Allcock paid a visit to hear the story



The main casting for Countytrac's innovative all-wheel-drive system fitted to Ford's new, rear-wheel-drive Transit showing one of the front-wheel-drive clutch locations

MJ Allen Group of Ashford, Kent, is a surprise find in a town where new houses, retail parks and the Eurostar passenger terminal are increasingly its most prominent features. The group boasts facilities more often associated with the Black Country – its own pattern shop, foundry and even a small blacksmith's shop. The company's machine shop is geared towards the machining of its castings – up to 2 tonnes for cast iron and 250 kg for SG iron – in low batch quantities. Some 70 people are employed in these two activities, but overall MJ Allen has around 250 employees spread across a number of activities (see *www.mjallen.co.uk*).

Established in 1957, the family-owned business has carved out a niche for itself machining large, complex castings. "This keeps us out of the area in which China, India and other low-cost operators are active," says managing director Tim Allen. This work takes in parts for animal feed (and wood) pelletising machines, large marine diesel engines, naval gun yoke and plinth castings, high-tech medical equipment – and there is a possibility of wind turbine gearbox castings work.

But this year MJ Allen has also entered the world of 'production' machining with the award of an all-wheel-drive gearbox contract for Ford's new Transit. And the resulting production cell, based on a Heller MC16i horizontal machining centre, is a distinctive feature in the company's jobbing shop environment.

An acquisitive company, the ball was set rolling when in 2000 it bought one of its customers, local design house County Transmission Systems (Countytrac) specialising in conversions of vehicles to all-wheel-drive units. Countytrac designer Eric May subsequently conceived a new all-wheel-drive gearbox for Ford's Transit vehicles that would not involve either raising the vehicle height, the conventional solution, or robbing any internal floor-to-roof height, as would formerly have been the case with conversions. Indeed, it would fit into the existing space with minimal chassis modification.

PRODUCTION VARIANT

With this limited modification requirement and the likelihood of greater volumes due to the less specialist nature of the vehicle, Ford integrated the assembly of the all-wheel-drive variant into its production line rather than go for offsite modification – the norm for Countytrac. It was then up to MJ Allen to gear up for the machining of 'production' quantities of the LM25 gearbox castings produced at the Ashford site and to supply them on a schedule to Getrag-Ford, Merseyside.

The term 'production' is relative. The volume that the company has geared up to produce is 1,350 units/year; for a company where 10 is a reasonable batch size and 50 cause for celebration, that is volume. In fact, the success of the All-Wheel-Drive Transit has seen 2,250, 3,600 and even 5,000/year discussed.

The primarily sand casting-based company has thereforefore established a gravity die cast cell, with tooling made by TW Tool, Coventry, to support the project, and this will happily support a volume of 5,000/year.

But at MACH 2006, discussions with machine tool suppliers for a dedicated

Innovative all-wheel-drive gearbox

The all-wheel-drive gearbox is the result of five years' development by Countytrac. It employs a hydraulic free-wheel clutch mechanism that provides intelligent variable torque flow to the front wheels fitted to a standard rear-wheel-drive Transit.

The Countytrac all-wheel-drive system is entirely automatic; as soon as there is any slippage in the rear wheels, the system comes into play. Significantly, if there is one front and one rear wheel in the air, the vehicle will still be able to power out of the situation using drive to the front wheels. Premiered at the Hanover Commercial Vehicle show in 2006, it helped Ford win the International Van of the Year 2007 award. The Turkish ambulance service is an early customer. While there is a Transit assembly plant in Turkey, the MJ Allen/Countytrac gearboxes go to Getrag-Ford in Halewood, Merseyside, to be made into a complete assembly.

The gearbox is based on Ford's MT82 6-speed transmission; indeed, uses the same internals plus additions. The revised gearbox casing takes in the front case – the main housing featuring the main clutch housing; two front wheel hydraulic clutch covers – one each for left and right-hand sides and within which the (Dana) hydraulically operated clutches sit; a new intermediate case that sits between the main and rear cases and partly houses the take-off gear; and the rear case, which is the only existing casting. So four new castings are machined for each gearbox.

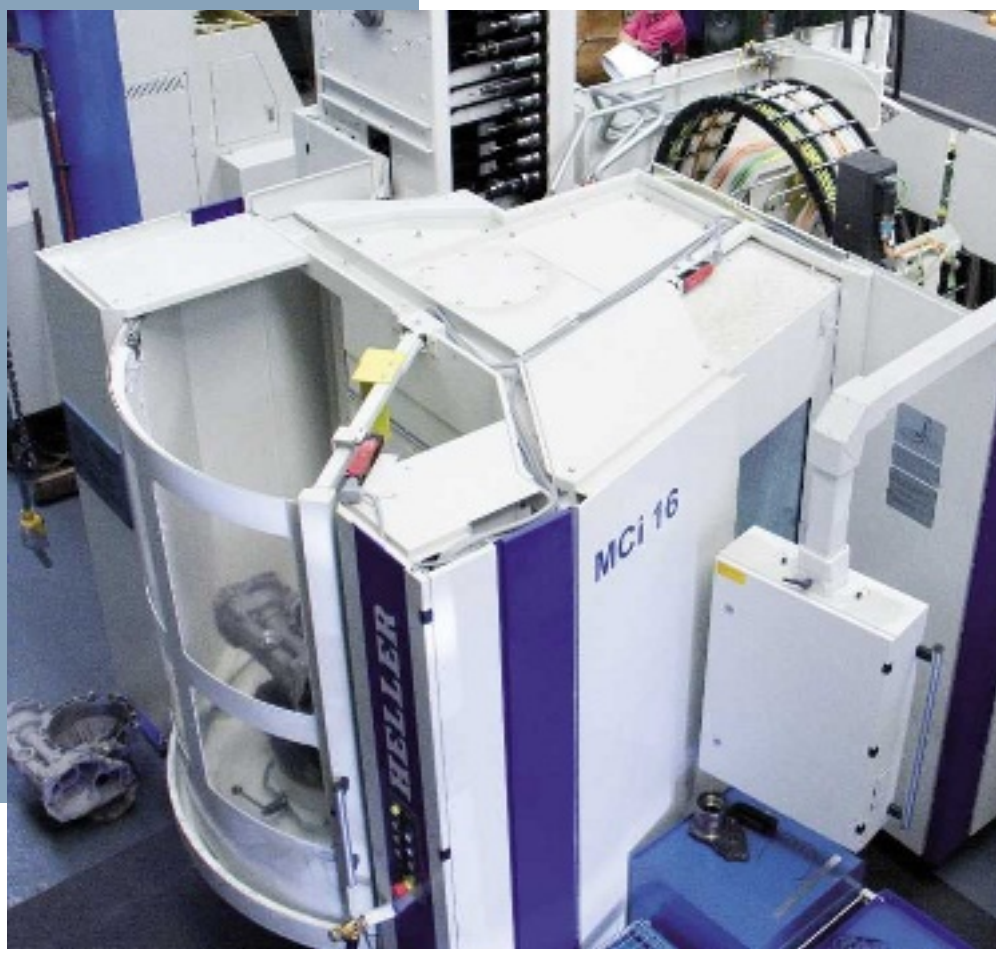
There are four patent applications on the gearbox and the intellectual property resides with MJ Allen. Mr Allen says: "We came up with the idea, took Dana's clutch system and reinvented it, and then took our working prototype to Ford.

"I said, we are prepared to put a lot of our own money in to prove that the design works, thereafter we will share the development costs, but we want to keep the IPR. We want to earn money via a licensing agreement on every unit. The other thing I am keen to do is look for products that use the skillsets within our factories – I wanted to dilute our reliance on sub-contract and that was the attraction of this venture, although it was high risk.

"We spent a lot of money with no guarantee of a successful outcome. It's taken a long time to get here." In fact to get to the 5-speed working prototype, MJ Allen invested £500,000, the managing director reveals, although much of that was spent in-house.

cell to deliver the process stability, quality and volume required were based on the smaller volume, 1,350. Sophisticated tooling and fixturing would be important supporting elements. And it was the attraction of being able to put the whole project with Heller that was "a main attraction", says Mr Allen.

Indeed, it was not the machine spec and capability that dictated the choice of supplier: "There are lots of machine tool companies out there and they all make good machines – in the end it almost comes down to the choice of colour. What I needed, more than anything, was somebody who was going to walk me through the process, how I was going to machine it, what fixturing I needed, and what cutting tools would be best. We

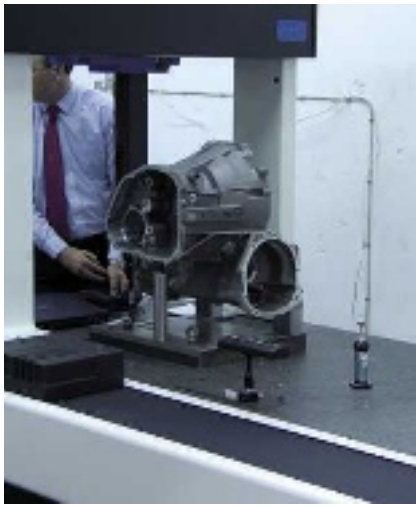


The Heller MCi 16 is located in a newly cleared and prepared area in the company's existing machine shop

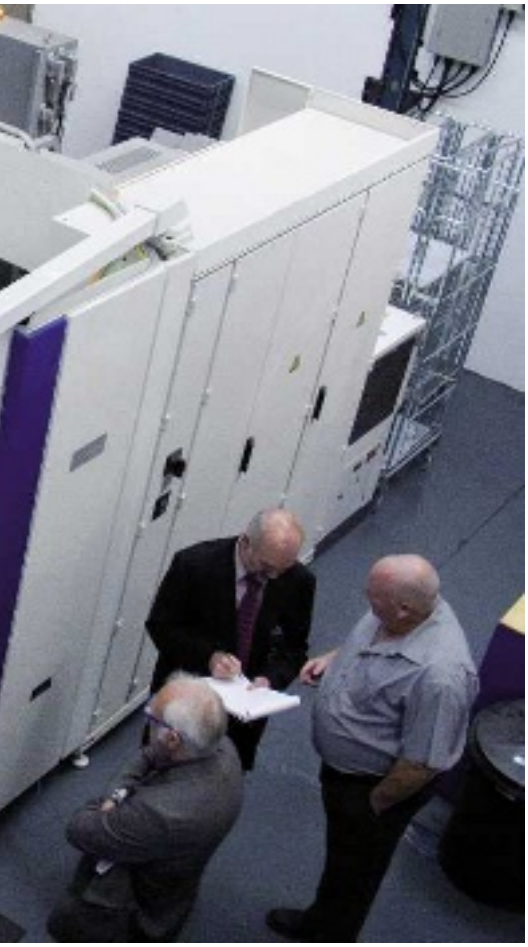
know how to machine things a certain way, but we don't know how to machine them in terms of volume. Heller was more interested, more motivated and more able to give us that help than the others," explains Mr Allen.

As production manager Terry Nye underlines: "No other supplier was prepared to support us in the way that Heller was. From day one we had utmost confidence in the company. The product is not unfamiliar to them and they have a skilled team of engineers supporting their sales people."

But this project has not only been an adventure for MJ Allen, it was also one for Heller. For while 1,350/year is high volume to former, it is not high volume to the machine supplier, where 1,350/week



Investment has also been made in inspection facilities, including this Hexagon DEA CMM; Lighthouse SPC software is another purchase

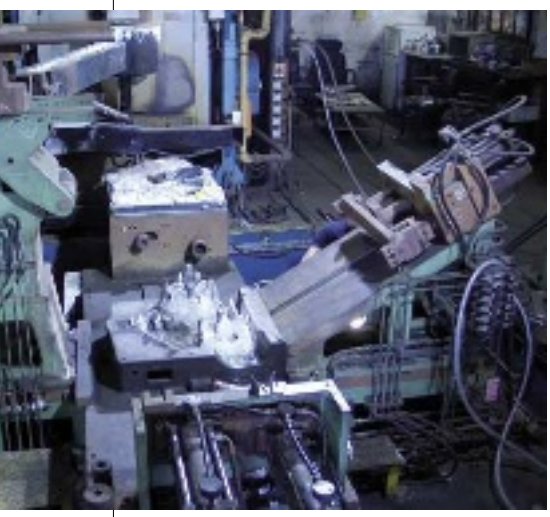


is probably a more common experience. So, for example, the shaving of seconds off cycle time, a normal pursuit, needed to be tempered. With the casing taking around 8 hours on MJ Allen's existing machines, Heller's initial 35 minute quote, with an invitation to spend more to save 30 seconds, was beyond MJ Allen's requirement. "I said you can take 50 minutes, if you like," Mr Nye adds.

FLEXIBLE FORD

The volume issue also impacted on Ford's normal New Part Submission Warrant Acceptance/Production Part Approval Process requirements. SPC had to be introduced by MJ Allen – something else new to the company production environment (supplied by Lighthouse Systems) – but while part acceptance would normally be based on, say, 300 parts, the low volume nature of the work meant that 50 was a more appropriate number. Ford itself is having to apply its rules more flexibly, but highest, consistent quality is still key.

The initial challenge, however, was just getting the main gearbox casing on to the MC16i, for it was already realised that quoting a larger machine would not deliver an economic solution. "The part did fit, just, and the next challenge was to



The company's new die-casting cell was undergoing trials as at Machinery's visit

make sure we could work in a fairly confined area," says Heller's Eric Pollard. It was the main casing that was the initial focus, but with a production volume of 1,350, Heller knew there would also be capacity available for the intermediate casing and the two clutch covers, so these were brought into the equation.

To keep the project "lean and mean", as Mr Pollard puts it, MJ Allen took on direct ordering of Heller-specified tooling or the manufacture of the more simple, manual fixtures.

Key in the machining of the main casing is the production of the two major axes – front to back and at right-angles across the casing for the front drive axis. Mapal reamers and Heller-manufactured hydraulic fixturing are key elements in the solution. Two other more simple operations are supported by MJ Allen-made manual fixtures.

At the time of *Machinery*'s visit in July, only the main casing was being machined, but Heller was working on hydraulic fixtures for the intermediate casing and clutch covers. For volumes of 1,350, single shift working will be adequate for the main casing, which takes 1 hour to complete, but when the clutch covers and intermediate casing are introduced, a second shift will be required. Scheduled deliveries at 30 units/month are due to start this month (September). For the future, additional Heller machines are clearly in view, although space would have to be made in the crowded machine shop.

Successful with this foray into the 'volume' automotive production scene, MJ Allen has, however, no ambitions to become a mainstream supplier. It knows its niche and that is where its focus remains, besides that, the all-wheel-drive gearbox still offers further scope with second generation units involving power take-off, greater integration of electronics and other vehicle platforms as possible future targets, offers Mr Allen.□