



'It's been a great journey'

Gill Sensors and Controls is one of the behind-the-scenes heroes of Formula One, quietly supplying some of the world's best motorsport teams with its range of liquid-level, position and speed sensors. But the confidentiality agreements that are in place with such teams mean that the firm rarely gets to shout about what it does.

That lack of publicity is one of the reasons the Lymington company wanted to get involved with the Bloodhound project. Firstly, it wants the project to be a success as a means of promoting British engineering. But it also recognised that Bloodhound offered Gill the chance to get some recognition for its work.

"It's great to be able to show what we can do," says Simon Peaty, sales engineer at Gill. "We have got some great sensor technology, but when we are providing F1 solutions there are confidentiality agreements in place. Bloodhound allows us to say to customers 'this is what we can do'."

Gill's role on the programme started about two-and-a-half years ago, after Bloodhound engineers came across the firm's technology while taking apart a Cosworth engine. "That was an oil-level sensor," says Peaty. "But as conversations progressed, we talked about other products such as capacitive liquid level sensors, which have no moving parts and so are highly reliable. Those ended up as being the products fitted on the main and auxiliary fuel tanks to measure the volume of fuel onboard." Other level sensors on Bloodhound, meanwhile, are installed on the coolant tanks.

The Bloodhound car will feature a

rocket that comprises a solid fuel made from synthetic rubber similar to that used in aircraft tyres (HTPB, or hydroxyl-terminated polybutadiene,) with metal powders and burning rate modifiers added to the mix. This is contained within a composite case slung beneath Bloodhound's other powerplant – an EJ200 jet engine.

The fuel needs oxygen pumped into it at a furious rate. A previous sensor solution couldn't give quick enough readings, so the Bloodhound team chose to fit two stainless-steel Gill sensors that give accurate and

timely readings, despite the forces being applied during the running of the car.

"The sensors needed to be ultra-reliable as they are fitted in a unit that is installed right behind the driver," says Peaty. "If the sensors don't work when they come to run the car, then it's game over. The Bloodhound team would have to split the car open to get them out."

As well as level sensors, Gill is also supplying rotary, angular and linear position sensors for the project. The firm's Blade 360 rotary sensors, for instance, will reveal the angle of the front/rear winglets to enhance aerodynamic performance.

There are also sensors fitted on the front and rear suspension deflection, enabling the car's wheels to penetrate the surface crust of the desert where the car will run to just the right level, without cutting into the softer sand underneath. "The sensors tell Bloodhound when the car's wheels are going too deep," says Peaty.

In addition, inductive position sensors are being used as brake retraction sensors for the car's disc brakes, while Gill's Blade 360 rotary sensor tells engineers how far the hydraulically activated air-brake doors have opened.

One final application of Gill's technology is the use of its linear position sensors on the accelerator and brake pedals. "The car uses drive-by-wire technology, so when Andy Green [who will drive the Bloodhound] puts his foot down, it will be our sensor that tells the whole car to go," says Peaty. "It's the same on the brake pedal. So we are involved right at the beginning and right at the end of the record attempt."

As the Bloodhound project moves towards the first running of the car later this year, Peaty says that excitement levels are building.

"We are proud to be involved. The Bloodhound team have been great to work with. It helps that we have been involved since the very beginning. It's been a great journey."



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Inspiring the next generation

Delcam has been involved with Bloodhound since November 2013 after Mark Forth, the firm's advanced manufacturing product manager, heard about the supersonic car project on a BBC Radio 4 programme. Since then, the Birmingham firm has contributed a great deal to support the project, offering its advanced CAD/CAM software to manufacture some key components for Bloodhound.

"One example of this is the steering support column – an essential component for ensuring that Bloodhound remains on track during its world land speed record attempt," says Mark Gadsden, product marketing manager at Delcam and lead on the firm's Bloodhound sponsorship.

However, the focus has really been on supporting customers that are manufacturing parts for Bloodhound using Delcam's CAD/CAM software, he says. "The Advanced Manufacturing Research Centre (AMRC) at Sheffield University, for example, used our specialist high-speed machining software, PowerMill, to produce the front suspension sub-assembly for the car."

Otherwise known as the goat's head, this sub-assembly is composed of four huge, five-axis machinings that are made from 7075 aluminium-alloy forgings used for the greatest strength and control of residual stresses. Using the latest CNC machinery, the AMRC machined the parts, and removed 94% of the metal, leaving only what was vital for the design. This process reduced the weight for the whole assembly from 924kg to just 68kg.

Conor La Grue, Bloodhound's



engineering lead and commercial and product sponsorship lead, says: "Both the material and the machining for the goat's head have been fully sponsored. This is amazing when you consider that for the price of the materials, project management, programming, machining and inspection you could easily fill a not insignificant garage full of your favourite supercars."

The PowerMill software was also used by manufacturing technology solutions firm Jaivel, in Mansfield, to program more than 50 components for Bloodhound, including the housing and gearbox parts for the car's auxiliary power unit – a Jaguar supercharged V8

engine which pumps fuel to the car's Nammo rocket.

While, as a sponsor, Delcam has received no payment for its contribution to the project, Gadsden says one of the great advantages about Bloodhound is that everything is open-source. "We have produced YouTube videos of the parts we've helped provide for Bloodhound, which has contributed to a return on our sponsorship investment," he says.

The main challenge for Delcam during its involvement with the project has been providing support for Bloodhound while also completing commercial production work, says Gadsden. "To overcome

this, we raised the profile of the project internally, to get more buy-in across the organisation," he says.

Another key benefit for the firm has been the opportunity to engage with the educational sector and help to inspire the next generation of engineers. "We now have several Bloodhound STEM ambassadors who have been lucky enough to receive training at Bloodhound's technical centre and see the car being built," says Gadsden. "Since then, our ambassadors have visited local schools to share their passion for science and engineering, and explain the technology behind Bloodhound."

Gadsden believes that the project has helped to promote the innovation and manufacturing expertise of small firms, proving the country's manufacturing supply chain to be a "world leader in undertaking complex engineering challenges".

Bloodhound has also given the small firms involved a great platform for networking and opportunities to forge stronger partnerships, he adds. For example, Delcam recently collaborated with SGS Tools at the International Manufacturing Technology Show in the US to promote the association that both companies have with the project.

Ultimately, small firms' involvement with Bloodhound is about looking to the wider positive future impact that the project will have for the manufacturing and engineering sectors, says Gadsden.

"Some 2.5 million schoolchildren have already learnt about the project, and inspiring the next generation of engineers is crucial if the UK is going to successfully compete as a manufacturing powerhouse in the decades ahead." >>