BLOODHOUND is GO!

BLOODHOUND's first public appearance was witnessed by **Ian Oliver***

"You'll certainly hear it, but you'll probably not see it in this weather," quipped the man on the gate of Newquay Airport in Cornwall, venue for the first – and only – public runs of the BLOODHOUND car in the UK, which took place in October 2017.

Fortunately, the distinctly autumnal weather improved, enabling three days of intensive testing for the vehicle designed ultimately to raise the World Land Speed Record above 1,000 mph. The world's most advanced straight-line vehicle, BLOODHOUND's high-speed runs in Cornwall marked a significant milestone in a project that has preoccupied project director – and former Speed Record holder Richard Noble – for more than a decade.

The supersonic car dream

The BLOODHOUND tests came 20 years after its driver, Royal Air Force Wing Commander Andy Green, set the current World Land Speed Record of 763 mph in Thrust SSC, in the process becoming the first – and to date the only - person to travel supersonically on land. Noble's next target – 1,000mph – required a radically different vehicle: one that has been ten years in development, and has cost £30 million to date, and counting.

The most complex car ever built, BLOODHOUND comprises more than 3,500 parts, many designed and manufactured specially for the project. Over 110 man years of effort have been invested in the design, build and manufacture of the car.

13.4m long and weighing 7.5 tonnes, BLOODHOUND uses a mix of car and aircraft technology, with the front section being a carbon fibre monocoque and the back portion being a metallic framework and panels. The two front wheels sit within the body and two rear wheels are mounted externally within wheel fairings. Both a jet engine and a rocket, together producing more than 135,000 horsepower, will power the car when it attempts the Speed Record.

At full speed, BLOODHOUND will cover a mile (1.6km) in 3.6 seconds – equivalent to 4.5 football pitches laid end-to-end, per second. That's why the team have selected an 11 mile stretch of lake bed at Hakskeen Pan in South Africa for future runs, and for the record attempt itself.

Prior to the public runs at Newquay, trials were initially carried out with the car chained to the ground, so the team could check the performance of the jet, fuel and electrical systems. These static 'tie-down' experiments were extremely successful, with the Rolls Royce EJ200 engine, normally found in a Eurofighter Typhoon, achieving re-heat despite the fact that the jet intake is designed to work best in air travelling at supersonic speeds of 850mph and above.

BLOODHOUND chief engineer Mark Chapman was pleased. "The Newquay tests have gone better than anyone dared hope and that is testament to the many years of research and design invested in BLOODHOUND. It is a one-off prototype with over 3,500 bespoke parts, so to see it performing so well is a hugely satisfying experience."

"These trials at Newquay take us one step closer to setting the next World Land Speed Record," adds Richard Noble. "They have been a fantastic team effort. The engineers have been on the front line, of course, but supporting them is a host of people who make the BLOODHOUND project what it is."

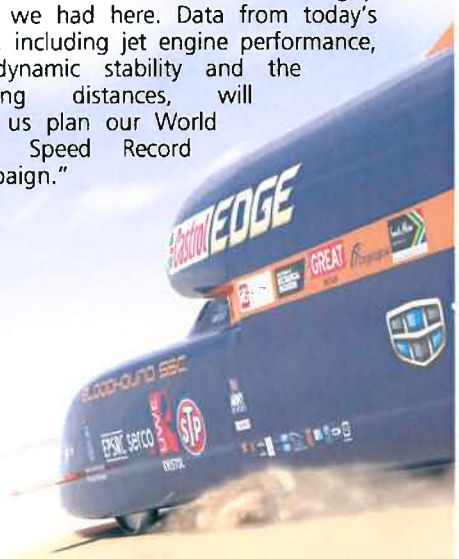
Newquay

3,000 spectators gathered at Newquay Airport in to watch the BLOODHOUND team conduct two runs along the 9,000ft (2.7km) runway. BLOODHOUND accelerated at rate of 1.5g, reaching 200mph from a standing start in just 8 seconds.

"The design and engineering team has done an incredible job with BLOODHOUND," said Andy Green, on completing the first test. "There is development work still to do, of course, but straight out of the box it feels responsive, stable and, above all, tremendously fast.

"Although 200mph is far below the car's ultimate target of 1,000mph, this was a proper workout for the vehicle. The car is designed for high speed on a desert rather than sprint performance off the line, but it still accelerates from zero to 200mph in less than eight seconds. Stopping a slippery five tonne car, running on low-grip aircraft tyres, within a limited space is also a challenge, particularly as the car continues accelerating for several seconds after I lift off the throttle. We have built up to this over the past few weeks, but the performance today was still slightly astonishing.

"When we run on the dry lake bed at Hakskeen Pan, South Africa, BLOODHOUND will be running on solid aluminium wheels with even less grip than we had here. Data from today's tests, including jet engine performance, aerodynamic stability and the braking distances, will help us plan our World Land Speed Record campaign."



On the runway, the car used 84cm diameter wheels shod with pneumatic tyres, originally from a 1960s English Electric Lightning fighter. Specially reconditioned by Dunlop, these have around one-third of the grip of road car tyres.

Running on aluminium...

BLOODHOUND's forged aluminium wheels (see panel) are real attention-grabbers, but aluminium is found throughout

*Marketing and Communications Manager for the Aluminium Federation

BLOODHOUND. Unsurprisingly, given the project's aerospace and Formula One influences, aluminium is the material of choice for a whole host of parts, including the tailfin, large sections of the chassis, and subassemblies. And while the nose section is skinned in composite material, its core is aluminium honeycomb.

Although the BLOODHOUND project's focus is gaining a 1,000mph (1,609km/h) World Land Speed Record, its primary aim is to inspire the next generation of scientists and engineers by showcasing STEM subjects (science, technology, engineering and mathematics) in the most exciting way possible. This was a major factor in the Aluminium Federation – the UK's aluminium sector trade body – deciding to give BLOODHOUND financial backing.

"Education, especially in the STEM subjects, is vital to the future of manufacturing in the UK, and the BLOODHOUND project is doing an amazing job in inspiring young people in this area," explains Aluminium Federation President Giles Ashmead. "But that wasn't the only reason we decided to become a sponsor. Offering a unique combination of strength and lightness, aluminium features throughout BLOODHOUND, most notably in its forged aluminium wheels – the fastest wheels on Earth."

Hakskeen calling

Now that the tests a Newquay's 1.7-mile runway have been completed, the BLOODHOUND team plans to ship the vehicle to a specially prepared 11 mile track at Hakskeen Pan, near the Namibian border in South Africa, in mid-2018.

The 2018 trials will test the car's performance and handling during one of its most vulnerable phases: the point between 400 and 500 mph (640-800km/h), where the stability of the car transitions from being governed by the interaction of the wheels with the desert surface, to being controlled by the vehicle's aerodynamics. The grip from the wheels will fall off faster than the aerodynamic forces build up, so this is likely to be the point where the car is at its least stable.

The desert surface has been prepared by members of the local Mier community. They have moved 16,000 tonnes of rock from 22 million square metres of dry lakebed, the largest area of land ever cleared by hand for a motorsport event.

"The track is 19km by 500m, with large safety areas on both sides," explains Mark Chapman. "This allows us to lay out up to 50 individual tracks side-by-side, which is important, as we can't run over the same piece of ground twice because the car will break up the baked mud surface as it passes. We need multiple tracks so we can build speed slowly and safely – going up in 50mph (80km/h) steps, comparing real-world results with theoretical data – and Hakskeen is the perfect place to do this."

If next year's testing is successful, Green hopes to top 800 mph in 2019 at Hakskeen Pan, beating his previous speed of 763 mph. Then, in 2020, the BLOODHOUND crew will add extra rocket motors for an attempt to set a 1,000 mph Land Speed Record - the project's ultimate objective. ■

The fastest wheels on Earth

Manned aircraft have flown faster than 1,000mph for more than 60 years – the first being Britain's experimental Fairey Delta 2 in 1956. But achieving the same speed on land is a different matter entirely. This is mainly due to the need to maintain contact – the right sort of contact – with the ground at all times. And that means a very special set of wheels - the fastest in the world.

When travelling at 1,000mph, BLOODHOUND's wheels will be rotating at 10,200rpm, and producing a force of 50,000g at the rim.

And despite the best efforts of the team and local supporters, the desert surface will not be totally smooth, nor uniform. In contrast to previous salt flat locations commonly used for record breaking, BLOODHOUND's attempts will be on 'playa' desert - mainly deposits of sand, silt and clay. Playas are among the flattest known landforms, where when filled with only a few centimetres of water, many kilometres of surface may be inundated. It is this process of inundation that develops and maintains the near-perfect flatness, so characteristic of these arid-region landforms. And, the playa has the additional benefit of cushioning the wheels at high speed, unlike harder salt deposits.

Therefore the 'desert' wheels have to be strong enough to withstand extreme rotational force, but also resistant to stone impact - a requirement that ruled out more brittle carbon fibre options.

Unlike with a conventional car, BLOODHOUND's wheels don't transmit power, and there is a relatively small steering requirement, so tyres aren't needed. This is just as well, as the fastest tyred car reaches just 277mph. However, tyres were needed for the runs on the hard runway at Newquay Airport. Bespoke 'runway' wheels were produced in 7075 aluminium, shod with Dunlop tyres designed for the Lightning supersonic fighter of the 1960s.

Aluminium consultant Innoval Technology has been involved from the beginning with the development of the 'desert' wheels. Working with Lockheed Martin, Innoval conducted a series of tests looking at the damage caused by high speed particles, and initially recommended using the aerospace alloy AA7075.

Further research revealed that even stronger aluminium alloys for large aircraft forgings had been developed, and Innoval finally settled on AA7037 aluminium-zinc alloy from Otto Fuchs, who could also produce the large diameter forgings suitable for wheel manufacture.

In the forging process the aluminium was heated to more than 390°C, moulded into discs with a 3,668 tonne hot press, and then a 20,000 tonne cold press to produce a simple round (but large) 'cheese' shape. The next stage was for each wheel to be milled into the final design by Castle Precision Engineering. Each wheel weighs 95kg and has a diameter of 910mm.

In South Africa next October the car will run for the first time with its solid aluminium wheels, specially designed for the desert surface. Designed to spin at up to 10,200 rpm – more than four times faster than wheels on an F1 car at top speed - the wheels have a V-shaped keel, which digs into the playa surface by 25mm when the car is stationary. As speeds increase, the wheels will rise up out of the mud surface and plane in much the same way as a speedboat rides up on the surface of the water. At 500 mph (804 kmh) and above, just a few millimetres of metal will be in contact with the desert surface, and the giant aluminium discs will act more like rudders than the wheels on a conventional car.