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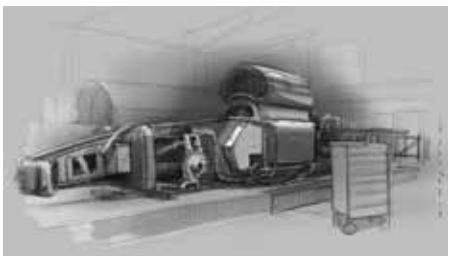

The official Bloodhound SSC commemorative publication
A Forward Move souvenir programme.
Published by West Argyll Technical Publications Ltd

Publisher	Managing Editor	Administration	Designer	Advertising Sales	Bloodhound writer	Front cover
Arthur Moore	Robert McCall	Lynsey Moore	Louise Crawford	Allan McCarthy John Huss	Karen Packham	Stefan Marjoram

BLOODHOUND – A Global Engineering Adventure

The BLOODHOUND Project is a global Engineering Adventure, using a 1,000mph World Land Speed Record attempt to inspire the next generation to enjoy, explore and get involved in science, technology, engineering and mathematics.

Mission statement

Create a unique, high-technology project, focused around a 1,000mph World Land Speed Record attempt. Share this Engineering Adventure with a global audience and inspire the next generation by bringing science, technology, engineering and mathematics to life in the most exciting way possible.

Objectives

The Project has a number of objectives

- Inspire the next generation about science, technology, engineering and mathematics.

- Share an iconic research and development programme with a global audience.

- Set a new World Land Speed Record of 1,000mph.

"Welcome to Newquay"
An introduction by BLOODHOUND Project Director Richard Noble

Welcome to Cornwall Airport Newquay! Thank you for making the trip to share this very special day with the BLOODHOUND Team as we reach a crucial stage in the Project's history – running BLOODHOUND SSC for the first time.

Twenty years ago, Wing Commander Andy Green broke the World Land Speed Record by reaching 763mph in Thrust SSC, which was the first car ever to go supersonic. Nine years later, Andy and I decided we would try to head off Steve Fossett's 800mph US challenge to that record. We estimated that Steve might get his record in five years, and decided that we should aim for 1,000mph. Unhappily, Steve died in an accident in 2007 and his challenge was cut short. But by then, the BLOODHOUND Project – which now centred on an educational programme with huge national potential – was underway, and so we decided to continue.

Record breaking is about innovation on a huge scale. If you are going to produce a traditional racer you will get a traditional result, and that's not how world records are achieved. When we started the BLOODHOUND Project, we didn't know whether we could make wheels that could survive when running at over 10,000rpm, or how we would eliminate the shockwaves under the Car. In the end, 20 companies worked with us to address the challenges of producing the wheels we needed, and Swansea University solved the shockwaves issue by using computational fluid dynamics in a unique way, thus advancing this specialist subject significantly.


633 468
ROYCE
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Trucks

But it doesn't end there. To complete the Project, we have to continue to innovate on almost every front. It's a huge challenge – and one which has become a personal challenge for Chief Engineer Mark Chapman and every one of the engineering team.

Did you know that when we broke the Sound Barrier in 1997 we were the first in the world in introduce website blogs and crowdfunding? Our web followers financed 30,000 gallons of jet fuel every day and our website was the busiest in the world on the day the record was set – 15 October 1997. This was extraordinary innovation in its time and it definitely helped us to get us that World Record.

BLOODHOUND also requires tremendous commitment from our sponsors, who have pledged precious funds on an unusual programme, for which we are extremely grateful. In South Africa, our friends in the Northern Cape Government employed 300 people to clear 16,000 tonnes of stones from the desert floor at Hakskeen Pan in order to provide the best World Land Speed Record course there has ever been.

But the Project is about so much more than building a fast car. The BLOODHOUND Education programme is now the largest STEM (science, technology, engineering and maths) programme in the UK – last year alone we engaged with 129,000 schoolchildren face-to-face. It is crucially important to inspire kids. Learning by rote can be tedious, but get them excited with a project like BLOODHOUND and before long they are learning basic engineering.

Soon, these schoolchildren will have the opportunity to learn a lot more, because when we run for the 800mph record, BLOODHOUND sponsor Oracle Corporation is going to export massive quantities of live Car performance data every time the Car runs. In the 230 countries and territories following BLOODHOUND, schools are going to be studying BLOODHOUND's performance and predicting what will happen next – just how fast will it go on its next run? It's like an online game…but with a huge difference, because the Car is real, the speed is real and so is the driver! And when it's real, it's so much more engaging for every child.

It's going to be fascinating as we know children can absorb data with fresh minds. It wouldn't surprise me if at some point in the future, our Engineering team will be tackling a technical challenge that is affecting the Car's performance at 900mph, only for it to be solved by a 12 year old who has been following the Project remotely, and makes 1,000mph possible!

Britain has a long history of holding the World Land Speed Record. If you look back in history, you'll find great drivers like Henry Segrave, John Cobb and Malcom Campbell. It's a challenge the British have long excelled at. This is what we do!

Curiously, though, it's never been more important than today. In the current political climate, it's vital that Britain boosts our manufacturing sector. Manufacturers, such as those striving to develop new ranges of electric cars, are having serious difficulties in recruiting British engineers. And that's why we are so passionate about the BLOODHOUND Project, because our Team – including all of our fantastic volunteer Ambassadors, who give up their time to go into schools and inspire them through the BLOODHOUND Experience – have seen the difference it can make to children's perception and enthusiasm around engineering and other STEM subjects.

So it's Time for Innovation, Time for Big Change, Time for BLOODHOUND.

You're here because you too are excited about the Project, and we would like to thank you for your support – whether you've followed our progress for years or have only recently learned about BLOODHOUND. Please enjoy the day and make a point of talking to as many BLOODHOUND Team members as you can, and remember to get their autographs. They have all got great stories to tell – this is a very special Team indeed.

Richard Noble
BLOODHOUND Project Director

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When the BLOODHOUND supersonic car team decided to 3D print key components for the vehicle they turned to Renishaw. Both the bespoke titanium steering wheel, which has contours that are precisely designed to match the hands of driver Andy Green, and the titanium nose cone, that will have to withstand incredible forces as the car speeds across the desert floor, have been made using our additive manufacturing systems. The complexity of such parts are helping to inspire a new generation of engineers and show that anything is possible.

And so it has been for the past 40 years – when it really matters to designers and manufacturers they rely on us to help solve their tough engineering challenges, helping them to deliver the fuel efficient car and jet engines from which we all benefit, and the consumer products that we enjoy every day.

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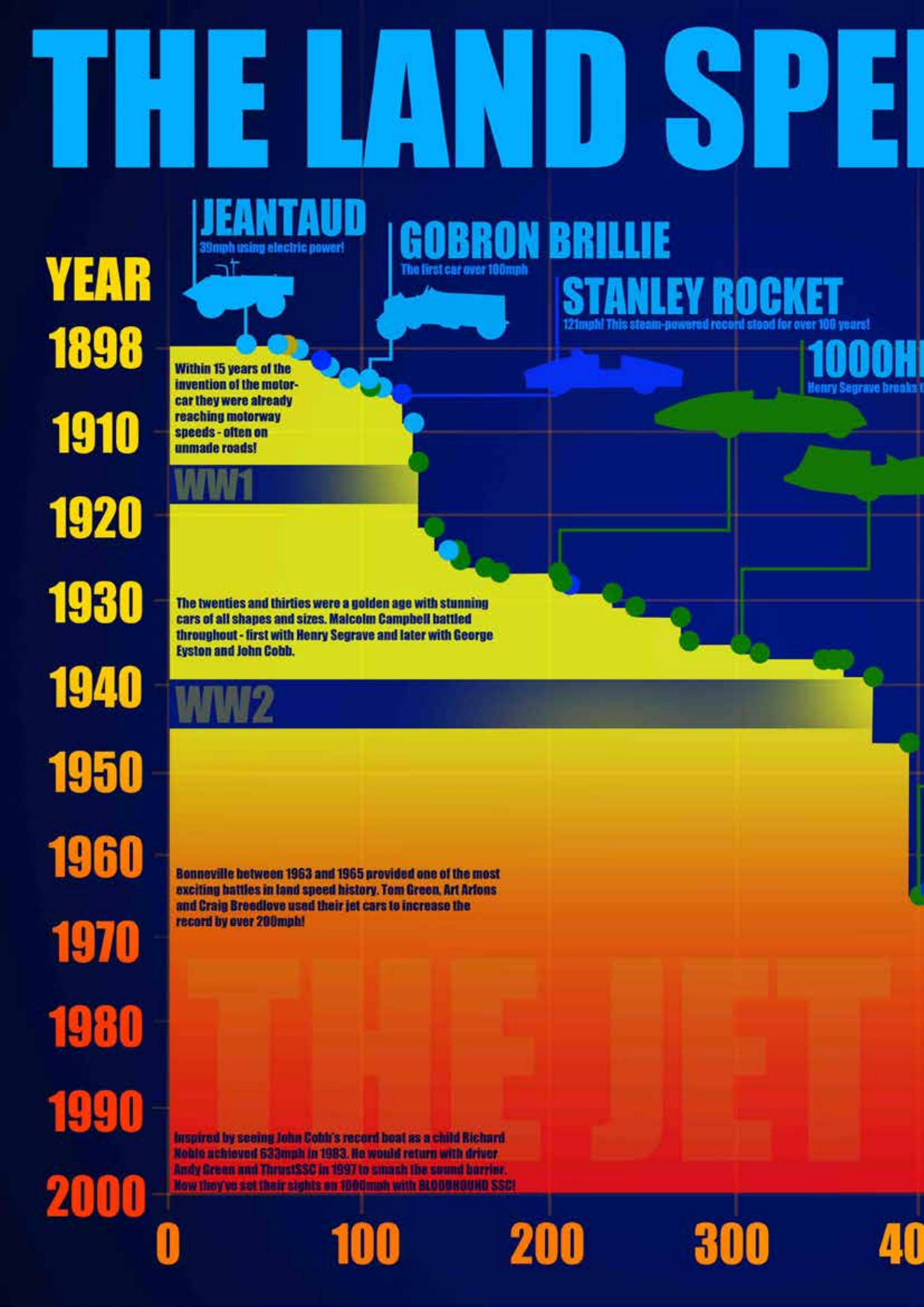
JEANTAUD
39mph using electric power!
GOBRON BRILLIE
The first car over 100mph
STANLEY ROCKET
121mph! This steam-powered record stood for over 100 years!
1000H
Henry Segrave breaks
YEAR
1898
1910
1920
1930
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1950
1960
1970
1980
1990
2000
Within 15 years of the invention of the motor-car they were already reaching motorway speeds - often on unmade roads!
WW1
The twenties and thirties were a golden age with stunning cars of all shapes and sizes. Malcolm Campbell battled throughout - first with Henry Segrave and later with George Eyston and John Cobb.
WW2
Bonneville between 1963 and 1965 provided one of the most exciting battles in land speed history. Tom Green, Art Arfons and Craig Breedlove used their jet cars to increase the record by over 200mph!
Inspired by seeing John Cobb's record beat as a child Richard Noble achieved 633mph in 1983. He would return with driver Andy Green and ThrustSSC in 1997 to smash the sound barrier. Now they've set their sights on 1000mph with BLOODHOUND SSC!
0
100
200
300
40

ED RECORD

AND ITS EXCITING HISTORY

www.bloodhoundssc.com

DRIVER NATIONALITY

- Great Britain
- USA
- France
- Belgium

P SUNBEAM
he 200mph barrier

BLUE BIRD
Malcolm Campbell breaks the 300mph barrier

BLUEBIRD CN7
Donald Campbell follows his father's record breaking with a run of 403mph

SPIRIT OF AMERICA
Craig Breedlove. The first car to break both 400mph and 500mph!

SPIRIT OF AMERICA
Craig Breedlove again! This time with Sonic 1 - the first car past 600mph

BLUE FLAME
Reached 622mph using rocket power!

THRUST2
Richard Noble brings the record back to Britain

THRUSTSSC
763mph. The first car to break the sound barrier!

AGE

The Speed of Sound

00 500 600 700 800 MPH

Meet the Driver Andy Green

The driver of BLOODHOUND SSC is Wing Commander Andy Green. A Royal Air Force fighter pilot, Andy was also the driver in the team that set the current World Land Speed Record with Thrust SSC 20 years ago. No one else has ever driven faster on the Earth's surface.

Andy is supremely qualified to be the BLOODHOUND Team's driver. He studied mathematics at Oxford University, which he describes as the language of all the sciences: "All other parts of STEM – science, technology and engineering – use maths as their core language, so I can talk to the engineers on all sort of aspects that affect BLOODHOUND. For example, that includes talking to Ron Ayers, our head of aerodynamics and performance, about the details of the computer modelling, which leaves me better prepared for what I'm going to see in the car. It also includes practical discussions with our head of stress analysis, Roland Dennison, about the physical loads on Car components such as the tailfin, which lets me understand the limits we can operate to when we run the Car."

Then there's the fact that he's as much at home in a plane as in a car. Indeed, he actually learned to fly before he learned to drive, thanks to a Royal Air Force scholarship and membership of Oxford University Air Squadron. The combination of skills is important, as Andy describes driving BLOODHOUND as about halfway between driving the ultimate racing car and flying a jet fighter.


ROYAL
AIR FORCE

Andy is extremely excited about working on a new World Land Speed Record car, with the opportunity it gives him to work with "some of the world's best engineers solving the problems that go with designing and building a world-beating car from scratch, and then operating it safely". He's thrilled to be testing BLOODHOUND SSC at Newquay and to be able to put the Car through its paces in front of thousands of supporters, including VIPs, sponsors and members of the 1K Club, and via live streaming to a global audience.

"My role at Newquay is to work with the team so that we all know how to operate the Car safely, consistently and effectively, and then deliver the test profile on each run. We'll be facing unknown challenges which the engineers will need to solve, because this is prototype engineering, as well as working on tasks we've already planned. That's BLOODHOUND's biggest strength – our Team can investigate, diagnose and fix anything."

He's also a passionate advocate for the Project overall, with its goal of inspiring a generation about STEM subjects, pushing back the boundaries of physics and developing new technology. This is the first Land Speed Record car of the digital age, using live video and data streaming to show off science in the most exciting way possible, to the widest possible global audience.

When he's not at the BLOODHOUND Technical Centre or out at BLOODHOUND events, Andy's day job involves working at the RAF Headquarters, supporting air and ground training for the RAF and aspects of training for the British Army and the Royal Navy. In his rare time off, his real passion is sailing, although he also enjoys going out for a spin on his Harley-Davidson. What you won't find him doing, however, is anything he considers 'high risk', such as base jumping. Sky diving is fine, by the way, as is extreme tobogganing – Andy was head coach and team captain of the RAF's Cresta Run team for 10 years.

Apart from the World Land Speed Record, Andy holds a few other notable accolades. He was the driver of JCB Dieselmax, which holds the World Land Speed Record for a diesel-engined vehicle at 350mph, set in 2006. He holds an extremely rare FIA speed record licence, which is only valid for attempts at world records and has to be renewed annually. And no-one else has ever been issued a speeding ticket for going as fast as Andy – his was presented to him by a US Ranger after exceeding Nevada's 55mph speed limit by 708mph when he set the World Land Speed Record of 763mph in 1997 in the Black Rock Desert. There's no risk of a speeding ticket at Newquay, but he'll be keeping an eye out for traffic wardens when BLOODHOUND arrives in South Africa.

Leading the Engineering Team – Mark Chapman, Engineering Director

No major engineering project can succeed without a knowledgeable, experienced engineer leading its team. At BLOODHOUND, this is Engineering Director Mark Chapman, who has been with the Project since 2008.

Mark followed a well-trodden road into engineering via science and maths A levels, a year's apprenticeship with BAE Systems and then a degree in Aeronautical Engineering from the University of Bath. Like BLOODHOUND Driver Andy Green, he also had early links with the RAF – in this case as an acting pilot officer for 3 years at Cranwell.

Once qualified, Mark began to establish a solid CV, describing himself as "Lucky enough to work on a wide range of projects, from designing the rotor control actuators for the AB139 helicopter, to a sewage works in Totnes, though this perhaps was pushing the limits for what could be termed fluid dynamics!"

Primarily, though, Mark's jobs were related to aerospace projects, including a couple of years in Seattle in the USA for Boeing with its Propulsion Systems Division, and quite a while based in Bristol working for Rolls-Royce. He also spent nearly 4 years as part of the design team on the STOVL system for the F-35 Lightning II, the Joint Strike Fighter.

Moving into motorsport

BLOODHOUND isn't the first time Mark has worked with Project Director Richard Noble. "I've been involved with Richard on a couple of previous ventures, and I can safely say that they've never been dull! So when I had a call about whether I'd be interested in being involved in a car-based project, it didn't take long to say yes."

It's quite a project to start with as your first professional foray into the world of motorsport. Mark admits, though, that he did once attempt driving a rally car: "I managed to convince my wife (after a little wine or two) that for our honeymoon it would be a great idea to enter a Lancia Stratos replica into the London to Athens World Cup rally, which was – how shall I put it – character forming."

Mark started at the BLOODHOUND Project as Senior Design Engineer, later becoming Chief Engineer and then Engineering Director. His brief is as broad as the Car is long, and it's safe to say that without Mark on

board, BLOODHOUND would not be roaring up the runway at Cornwall Airport Newquay this October.

Solving the unexpected

"Working on BLOODHOUND is a fantastic job. No one knows what the right answer is going to be. For example, when we started, we never would have expected the Car to take the shape it has, but that's what our research and testing came up with. You wake up in the morning and don't know what the problem will be, but more excitingly, you don't know where you are going to find the answer. But thanks to our great Engineering Team and the support of our sponsors, we always find it."

Mark is also passionate about the educational side of BLOODHOUND and is himself a STEM Ambassador, despite the pressures of his role. "It is great to meet 10 year old kids who have really thought hard about the Project. They do research online and come up with some really interesting questions. They seem really excited by it – their eyes light up when they learn about it. If this doesn't get people excited about STEM, nothing will."

10 ASTOUNDING FA
BLOODHOU

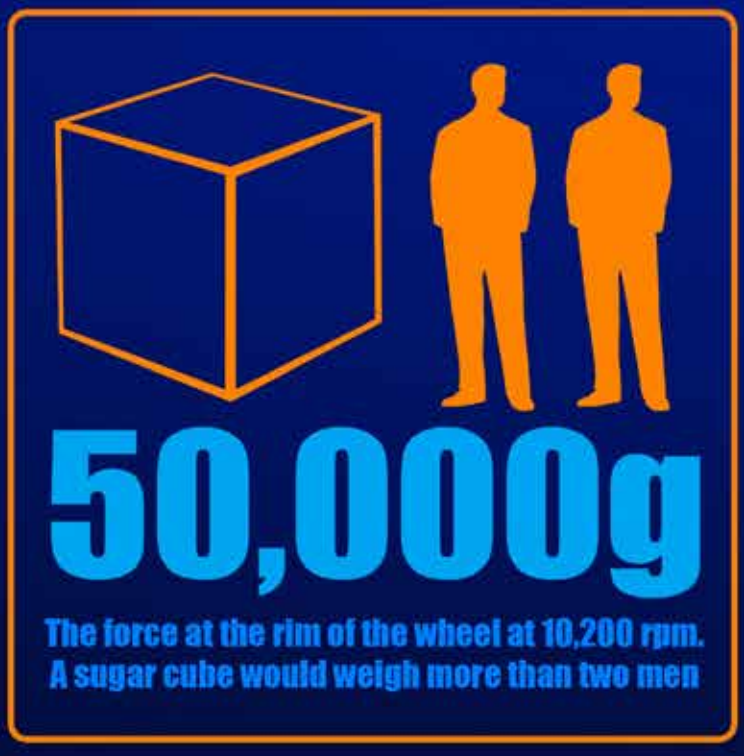
135,000HP*

Bloodhound SSC has 25,000hp more than the QE2

4.1 LACTATING COWS

The equivalent carbon footprint of the Bloodhound Project

The drag on the car at 1000mph



ACTS ABOUT
ND SSC

BLOODHOUND SSC • ENGINEERING ADVENTURE

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25,000 ft

The altitude Bloodhound would reach if it were fired straight up into the air

180 DECIBELS

The hybrid rocket could be louder than a 747 at take off!

3,000 °C

The temperature in the rocket is twice as hot as the inside of a volcano

3.6 SECONDS

Time taken to do the flying mile

64,000 L/SEC

The EJ 200 jet engine could suck all the air out of an average-sized house in 3 seconds

* Strictly speaking you shouldn't measure the output of jets and rockets in terms of horsepower - especially if Ron Ayers is nearby - use lbs thrust instead.

Land Speed Record progress – from before computers to after digitisation

How computational fluid dynamics became accepted as a vital tool in the design of a World Land Speed Record Car

By Ron Ayers, BLOODHOUND Chief of Aerodynamics

I first met Richard Noble in 1992. He was then the holder of the World Land Speed Record, having achieved a figure of 633mph in 1983 in Thrust 2. On learning that I had an aeronautical background and specialised in high speed aerodynamics, he asked me to help him create a car to travel at supersonic speeds – Thrust SSC.

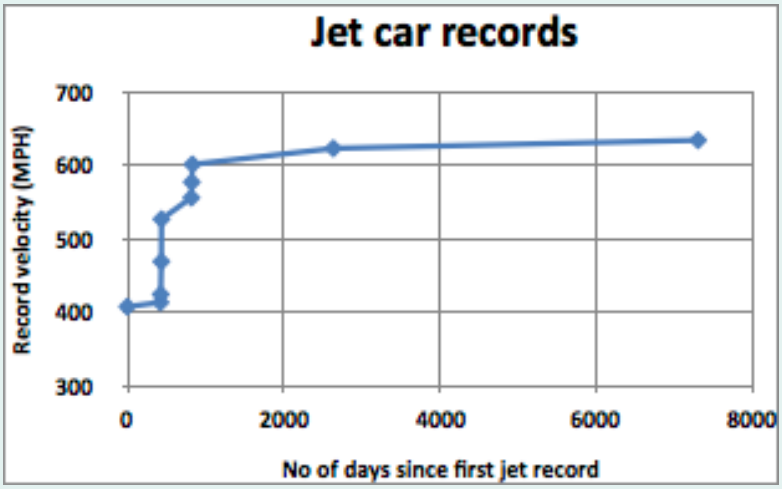
My initial reaction (caused by ignorance of the effects of shockwaves at ground level, and the impracticability of having 800mph rolling roads in wind tunnels) was a strongly negative one. It was only after considerable thought that I told Richard that these problems could, just conceivably, be overcome.

Even this modest reduction of pessimism was sufficient for Richard to introduce me to Glynne Bowsher, an experienced mechanical engineer who had previously worked on Thrust 2, and we started designing. The team was subsequently augmented by Jeremy Bliss, who had extensive experience as a systems and suspension designer for the McLaren F1 team.

Historical research

Having no automobile engineering experience, I needed to find a starting point, so I looked at the history of the World Land Speed Record. And what I discovered was that there are two separate records – wheel driven and jet/rocket driven.

In the half century from 1898 to 1947, when John Cobb reached 400mph (albeit in only one direction), the World Land Speed Record had increased by a factor of 10. In the seven decades since then, the wheel-driven record has increased only by a modest percentage, appearing to approach an asymptote*. You can see a similar asymptotic limit with records set by jet cars if you look at the graph.



PPA | group

Proud sponsor, and supplier of the Bloodhound SSC windscreen and portholes

BLOODHOUND has a highly specialised windscreen custom-made by PPA Group from acrylic. The screen is manufactured using aircraft grade stretched acrylic that is heated and formed to make two layers, these are then bonded together to create a 25mm section, thicker than a fighter jet's windscreen and sufficient to withstand an impact with a 1kg bird at 900mph (1,448km/h).

The driver will be looking through 50mm of curved plastic. The key challenge has therefore been to make the screen robust while maintaining absolute visual clarity.

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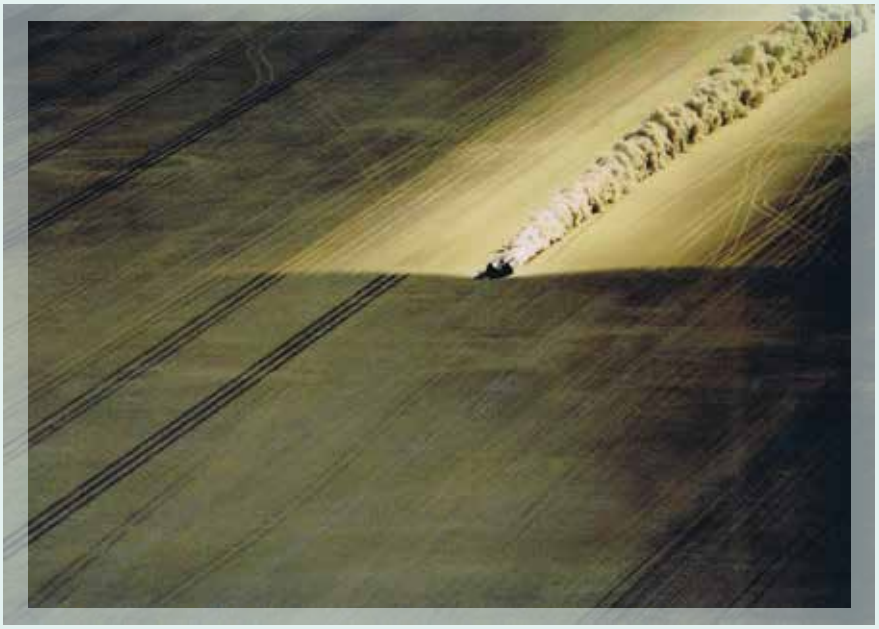


Pendine rocket tests

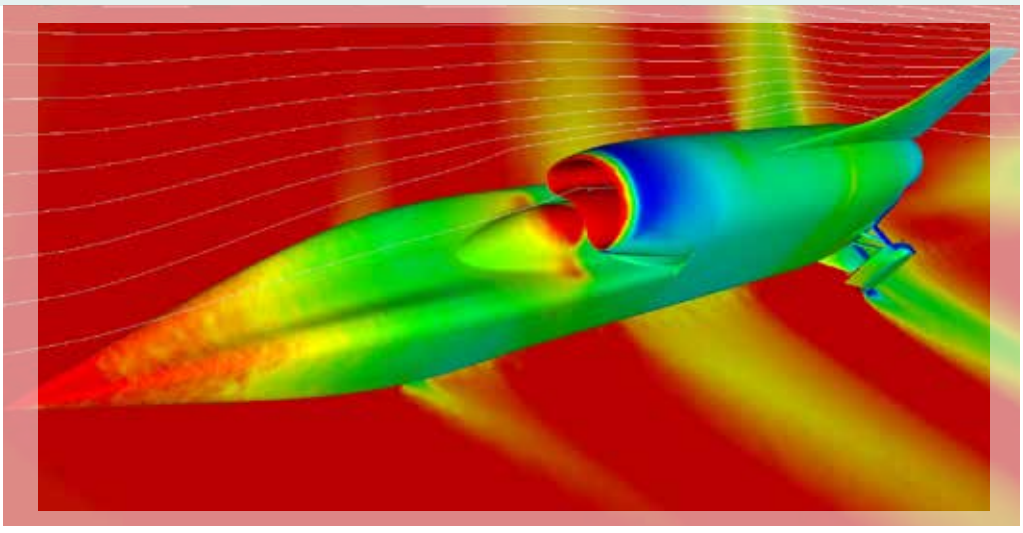
My problem in 1993 was that no-one else had ever trusted CFD for design purposes. Indeed, the opinions I received were of the type: "Oh yes, we tried it once and the results were rubbish so we have ignored it since". As Thrust SSC was the ultimate safety-critical project, I had to find some method of validating the results produced by CFD or we could not proceed. So we designed and made a 1/25th scale model and covered it with high frequency pressure sensors.

This model was accelerated from rest to 800mph in 0.8 seconds, using a battery of rockets.

Amazingly, the results of this pioneering CFD correlated very well with the pressure readings from these rocket tests. Independent experts confirmed that the accuracy of CFD had been reasonably established so we could use it for design work.

Adapted from an article originally printed in The Engineer, June 2016, with thanks.

* An asymptote is a straight line that is approached by a curve, with the curve getting ever closer to the line and the slope of the curve approaching the slope of the line. As the increases in world records (not just the World Land Speed Record) get ever smaller and more spaced out, this is what you would be likely to see if you plotted them on a graph.
† Inviscid flow is the flow of an 'ideal fluid' that is assumed to have no viscosity. It is a very useful concept in fluid dynamics.



From BC to AD - Before Computers to After Digitisation

For almost a century, World Land Speed Record Cars have been designed using the technologies of their day – drawing boards, slide rules, computations by hand and (in some cases) wind tunnels. But by the beginning of the 1990s, electronic computers had taken hold. This resulted in some significant changes in the design of such cars:

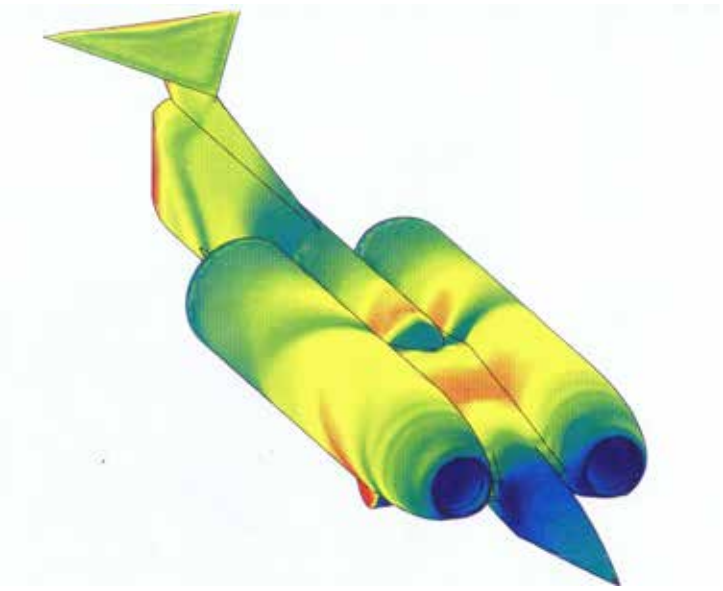
•Computer-aided design (CAD) systems introduced enormous flexibility into the design process by enabling many design options to be considered before any even started cutting metal. I believe Thrust SSC was the first World Land Speed Record vehicle to benefit from this.

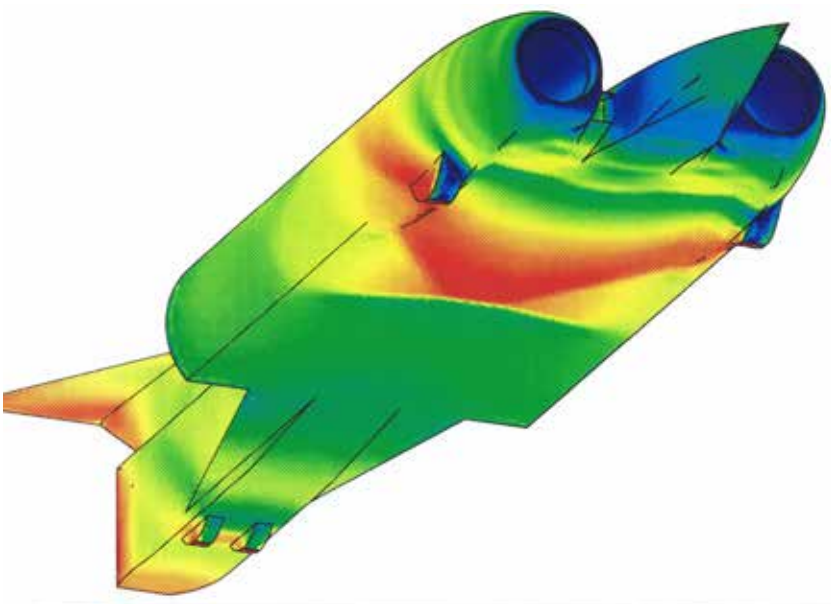
•After being validated by our Pendine rocket sled experiments, computational fluid dynamics (CFD) could be used to explore transonic ground effects and define the outside shape of the vehicle.

•Spreadsheets enable very detailed analyses of vehicle performance, and they can be constantly updated to incorporate the latest design changes and environmental factors. We demonstrated this with Thrust SSC by having our driver, Andy Green, driving the car up to sonic velocities and then bring the car to a stop with the wheelbase spanning the designated turn-round point 13 miles from the start.

•Thrust SSC logged readings from over 120 instruments, enabling detailed analysis of the factors influencing performance and contributing to increased safety.

•BLOODHOUND SSC will have between 500 and 600 instruments, and up to 30 on-board cameras, recording every aspect of vehicle operation. These will be simultaneously transmitted live by 500 HD channels even when travelling at supersonic velocities. This real-time condition monitoring will further add to the vehicle's safety.





From the first jet car record (407.45mph in 1983) to the breaching of 600mph took only 833 days. But the percentage increase over subsequent decades has been very modest indeed. This curve looked to me like a barrier to further progress. In short, my target of 800mph did not look achievable by simply using a 'jet on a trolley'.

Two other possible solutions looked more promising:

1. Use rocket propulsion. Blue Flame – a rocket-powered car that set the World Land Speed Record at 622mph in 1970 – clearly had not achieved its full potential, so this was a possible route. But unfortunately I did not have access to rocket technology at that time.

2. Use two jet engines.

A pair of Rolls-Royce Spey 202s was available for a few thousand pounds, so this was our chosen solution. These amazing engines ran 66 times, often ingesting sand, and never once presented us with the slightest problem.

The advantages of a two-jet solution

The layout of a single engine jet car presents the problem of where to locate the driver. He can hardly sit astride the engine like a jockey, so the unattractive choice is between having the driver out-front, as with Spirit of America (in which the driver is very exposed), and having the driver on one side, as with Thrust 2 (which results in a big vehicle frontal area). With two jets the solution is obvious. The driver can be located at the vehicle's centre of gravity and be protected by the enormously strong steel structure holding the two engines. The ratio of jet intake area to total frontal area is also much greater than for single jet layouts, with obvious benefits for performance.

Engines – front or back?

For structural reasons the engine mass had to be supported either by the front wheels or the rear wheels. Benefits, and problems, could be seen for both layouts. As our design team was so small – consisting of two unfunded people at that stage – we could only explore one option and had to make a choice.

Our chosen layout, of mounting the engines over the front wheels, had immediate benefits with regards to stability, but necessitated the use of rear wheel steering. It also exposed the rear body panels to the jet efflux from the two jets. These problems did, indeed, subsequently prove to be severe. Rear-mounted engines have avoided these problems, but would we have encountered stability or other difficulties instead? We will never know.

Computational fluid dynamics

The problem we had to explore was that of 'transonic ground effect'. We could not investigate that using a wind tunnel because such tunnels could never be fitted with an 800mph rolling road! Instead, Swansea University agreed to use computational fluid dynamics to do the research we needed.

Swansea University's Cray computer, which was state-of-the-art at that time, could process 1 million space elements, and that proved to be just sufficient to handle symmetric configurations in inviscid flow†. The following is a pressure picture produced in 1993 – long before anyone else was using computational fluid dynamics (CFD) for design purposes.

The strong shock wave visible across the middle of the body in the image produced by the computer subsequently immortalised itself when the car was at the Black Rock Desert, as shown in the following picture taken from a microlight.

Your questions answered

Since this article first appeared in The Engineer, I have been asked many questions – here are the answers to some of the most common ones.

You justified the twin-jet configuration of Thrust SSC, so why did you start again and create a totally new configuration for BLOODHOUND?

Quite simply, what worked at 763mph would not work at 1,000mph. Even with two of the magnificent EJ200 engines, we could not achieve 1,000mph in the restricted space available. The combination of jet plus rocket was what was needed.

So why do you not simply use one enormous rocket?

This is technically feasible. Indeed, one our competitors (Rosco McGlashan of Australia) is trying this route. In the UK we do not have the luxury of large mud flats or salt flats on which to do test runs. We must do all of our development testing on UK airport runways as it would be impossibly expensive to do all the low speed runs oversees. Airport authorities are (understandably) not notably enthusiastic about the use of enormous rockets on their runways, so having a mix of jet plus rocket gives us the flexibility we need with the Car's development.

What configuration problems did you encounter?

Finding a shape that would stay on the ground from 0mph all the way up to Mach 1.4, without ever going to the other extreme of crushing the suspension. The computational fluid dynamics (CFD) analysis by Swansea University on our behalf to solve this took 3 years and required extensive use of some of the largest computer clusters in the country.

Any other problems?

Plenty! Like designing a structure that is strong enough and stiff enough to deal with the enormous aerodynamic forces involved while still being as light as possible. Also, designing and testing wheels that would survive up to 1,050mph (the design maximum speed). There is also the 'packaging problem'. That is, fitting a jet engine, up to three rockets, a turbo-pump, a Jaguar engine (to power the turbo-pump) and assorted tanks to accommodate fuels and oxidants, electrical systems, extensive instrumentation and a driver plus his life support system into the smallest space possible.

Will BLOODHOUND suffer the same 'spray drag' problem that was experienced by Thrust SSC?

The strong shock wave under Thrust SSC certainly threw up an enormous quantity of dust that significantly added to drag and hence reduced performance. Thus forewarned, with BLOODHOUND we have used CFD, not just to design the Car for its performance and stability characteristics, but also to minimise its interaction with the desert surface. Time will show just how successful we have been.

Earlier record attempts only broke the record by a small percentage. Why do you aim for such huge increases?

Because we are aiming to enthuse a generation of students to study STEM subjects ([science, technology, engineering and maths] by showing that they are exciting as well as useful.

Any problems still on your 'to do' list?

Dealing with cross-wind gusts at 1,000mph.

Adverts to come

Sharing the Story: how Project BLOODHOUND Reaches the World

When asked why he had wanted to set a new World Land Speed Record, Richard Noble famously replied, "For Britain and the hell of it." The goal of the Thrust SSC team was to officially break the sound barrier on land.

Project BLOODHOUND is the first land speed endeavor where going fast isn't the main aim. Its job, first and foremost, is to inspire young people by showing maths, science, engineering and technology in the most exciting 'real world' setting possible. That involves sharing the story with the biggest audience possible.

Mettle is the content and communications company that helps The BLOODHOUND Project do this. Our extended team includes animators and writers, TV producers, photographers and film-makers, PR professionals and aerial filming experts. There's an Oscar winner in the mix too.

Our involvement began with a cryptic phone call. We had been happily doing (award-winning) publicity and films for museums, the science world and space sector when we got a message to "…go and meet a man called Noble. He's doing something unusual...". As understatements go, this turned out to be a good one.

We had met Richard some years before, flying him back from the testing Thrust SSC in Jordan so he could stand next to Trevor McDonald on a glass bridge and launch a new gallery for the Science Museum. He didn't remember us but that didn't matter. He pitched the idea of BLOODHOUND and we said we wanted to help. "I can't pay you, not for six months at least," he added. "We don't care, we'll do it anyway," we replied. And so began an extraordinary, challenging and fascinating nine year journey…

We announced the Project in October 2008, at the Science Museum, London. A special report ran on the BBC 10 O'Clock News the night before, and on the morning, breakfast shows broadcast live from our launch, which was attended by journalists from every type of media. In the days that followed, 11,000 people came to see the few drawings and models we had to show at that time – an early indication of the Project's incredible public appeal. An animation we produced, showing the car racing a bullet, went around the world, wracking up millions of views.

Those first few days set the template for what would follow: a commitment to 'talking human' and presenting BLOODHOUND in the most engaging and accessible way possible; using computer generated imagery, film and other means to put the extraordinary numbers into a context anyone could understand; presenting the Project as an adventure and a journey of discovery, not just 'a car thing'…

BBC Online ran a news story that was the precursor to Andy Green doing a unique monthly diary for their science pages. It is still going strong, and by itself, makes BLOODHOUND one of the best publically documented engineering projects in history. NASA was sufficiently impressed they wrote about us in their in-house journal.

If you have a moment, take a look at that first animation. It tells an interesting story quite apart showing what '1000mph' looks like. You will spot immediately that the car here doesn't look like the BLOODHOUND we have today. The intake is different and it has grown a rather substantial tail. That speaks to the years of research and design that have been

poured into the car's creation, a rollercoaster of effort, exasperation and inspiration captured in the BLOODHOUND book, The Science Behind the Speed, which Mettle co-wrote, edited and designed (and which is available to buy this weekend and from bloodhoundssc.com – all proceeds help fund the Project).

Glance at the background of the film and you will see mountains. At the time we had no idea where we would run the car so we used some artistic license. Finding a track was to be become Andy Green's particular obsession for the next two years: he understood better than anyone that without a viable run site, the Project would come to a halt. What we didn't know at the time was how few good options there were, or how far the search would take him. Nor did we have any inkling that the worst financial crash for 75 years was just a few weeks away and set to rip through our fundraising plans like a hurricane.

Despite the occasional cashflow induced slow-down, the Project has pressed on, undaunted and indefatigable. In similar fashion, we have done our best to keep the story going and the profile high.

As well as coming up with ideas to create coverage in everything from The New York Times to The Beano, we made sure BLOODHOUND embraced the then new-fangled social media, such as Twitter. We also committed to charting the progress of the Project on film. Our regular BHTV episodes capture the big moments, such as the forging of the wheels, while also celebrating the less obvious details that make BLOODHOUND so engrossing: the role of sensors, why Andy would be worse off with an ejector seat and the debt owed to the humble rivet.

Over the years we have staged many media events: flying a jet over speeding cars in Hakskeen Pan; demonstrating the forces involved in a 1000mph record attempt using a stunt plane; getting famous magazine editors to make mugs of tea for the engineers to better appreciate what really fuels the world's fastest car… But nothing we have done is as big, or as important, as this weekend.

With help from partners Cisco and Oracle, we will stream the test runs live via a ten-camera outside broadcast set up that has been months in the planning. We will also look after the needs of 100+ media who have come from all over the world to report on this milestone event. Richard, Andy, Mark, Ron and the rest of the engineering team will do hundreds of interviews, adding to the many thousands they have done before, to give this engineering adventure an authentic, passionate human voice.

It is all part of sharing the story and an essential dress-rehearsal for what we will be doing when we go record breaking. You'll join us for that, won't you? It will be quite a show.

Overall

Length: 13.4 metres

Weight: 7.5 tonnes

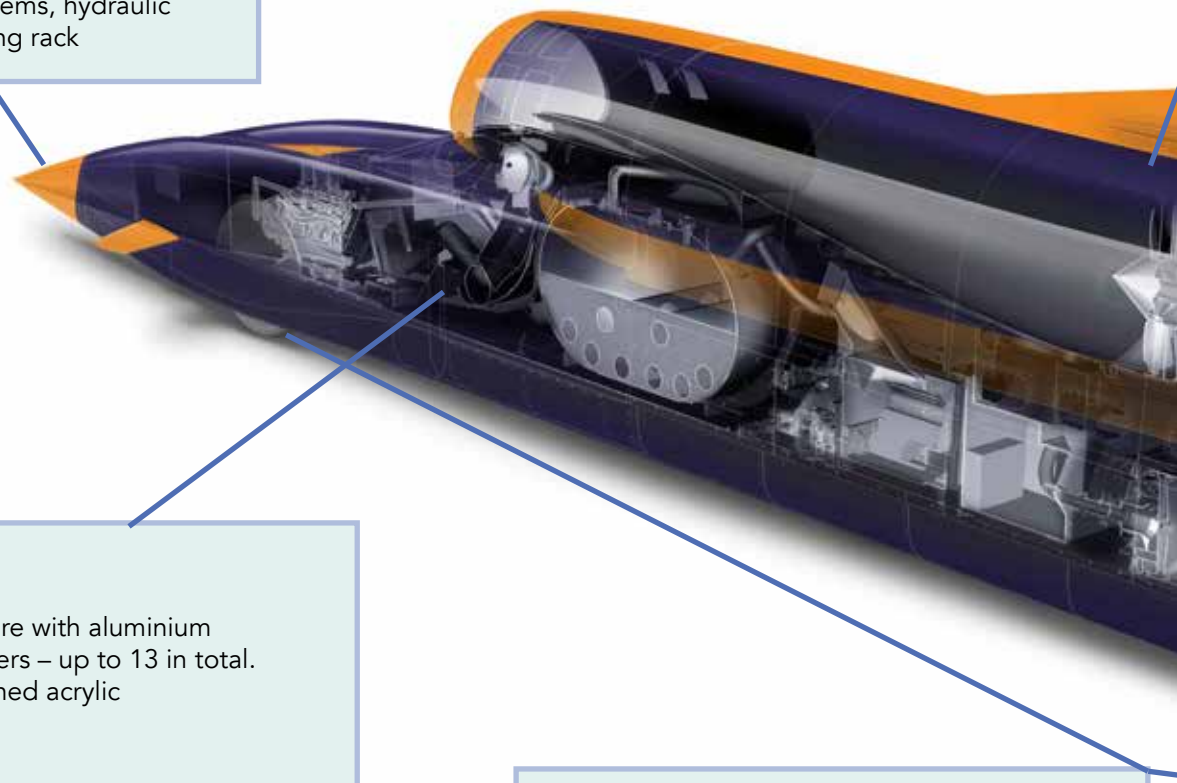
Parts: Over 3,500 bespoke parts, plus 22,500 rivets

Nose

Material: Carbon fibre with a titanium tip

Construction: The titanium nose cone was made using a 3D printer

What's inside? Front suspension, wheels, wheel uprights and bearings, brakes, control systems, cooling tanks, pneumatic systems, hydraulic accumulator, batteries, steering rack



Cockpit

Material: Carbon fibre with aluminium honeycomb core layers – up to 13 in total. Windscreen is stretched acrylic

Thickness: 25mm

Strength: Withstands up to 10 tonnes per square metre; canopy latches up to 2.5 tonnes

What's inside? Solid carbon seat, five-point harness, air supply, pedals, levers, Rolex speedometer and stop watch, control panels, fire suppression system

Brakes

Newquay

Wheel brakes: Carbon discs and pads (all four wheels)

South Africa

Airbrakes: 1 metre tall, perforated; deployed by hydraulic rams; 3 tonnes of load

Parachutes: 2 metres diameter on a 20 metre line; 9 tonnes of drag

Wheel brakes: Steel (front wheels only)

Chassis

Material: Aluminium, titanium and steel

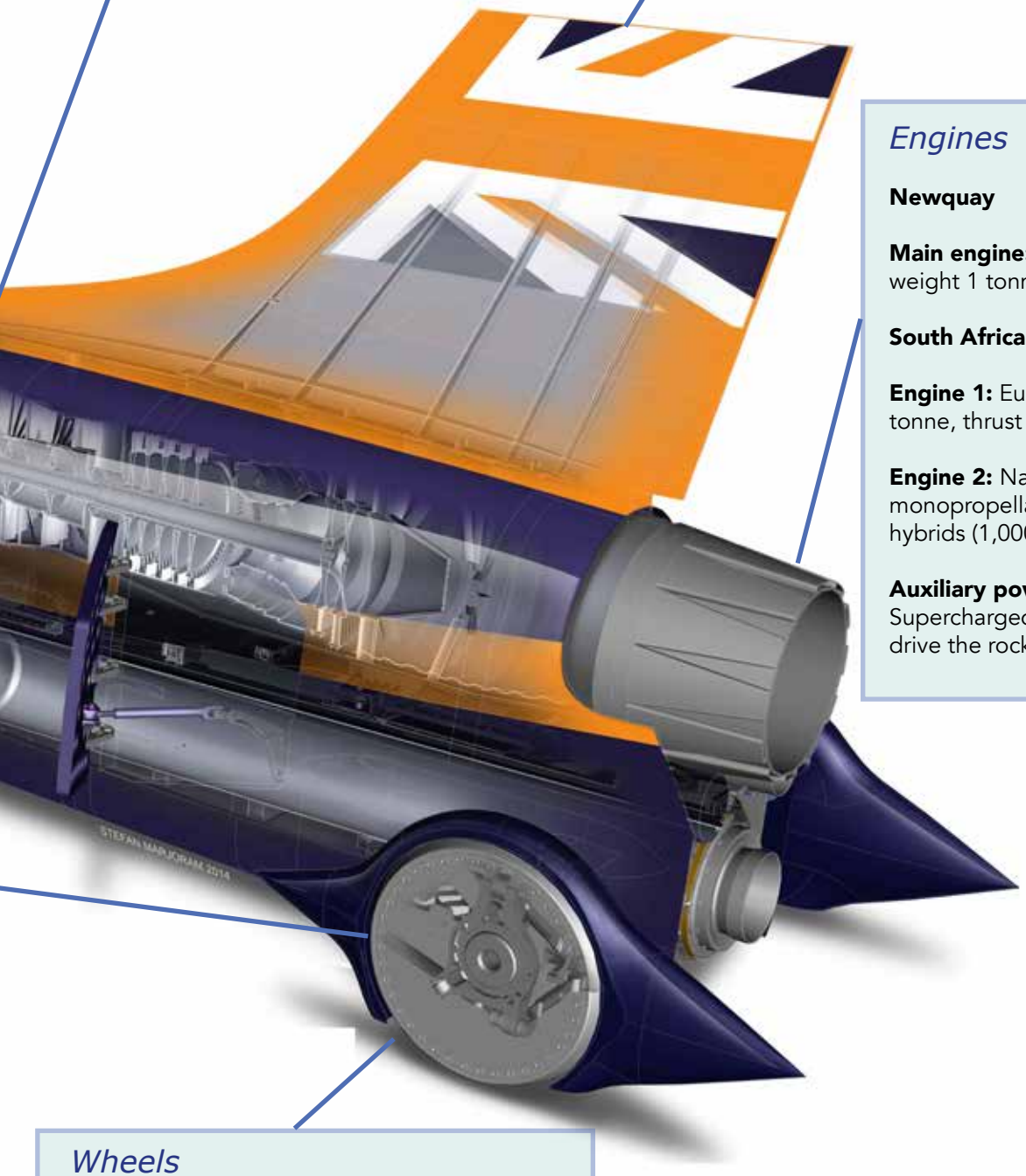
Construction: Upper chassis – aluminium ribs, titanium stringers and a titanium skin, held on using glue and rivets. Lower chassis – aluminium frames and bulkheads and a steel skin, held on by rivets and glue. Underside front – titanium. Underside rear – steel sheet.

Fin

Material: Aluminium

Construction: Around 100 parts including fin spars, with an aluminium skin attached by over 1,000 rivets. Assembled in its own purpose-built jig.

Size: 2 metres high



Engines

Newquay

Main engine: Eurojet EJ200 turbofan, weight 1 tonne, thrust 9 tonnes

South Africa

Engine 1: Eurojet EJ200 turbofan, weight 1 tonne, thrust 9 tonnes

Engine 2: Nammo rocket – single monopropellant (800mph) and three hybrids (1,000mph)

Auxiliary power unit: Jaguar Supercharged V8 engine, 550bhp – used to drive the rocket oxidiser pump

Wheels

Newquay: Runway wheels with rubber tyres (from a batch originally made for Thrust 2 in 1979)

South Africa: Aluminium-zinc alloy; forged. Weight 95kg each.

What makes a 1,000mph car?

BLOODHOUND SSC is designed not only to go faster than the speed of sound (supersonic) but to go over 1,000mph (1,600km/h). It will cover a mile in just 3.6 seconds.

It requires novel engineering to produce a car capable of this level of performance. Here we present some of the facts about BLOODHOUND SSC – the next World Land Speed Record breaking car.

Design

BLOODHOUND SSC is a mix of car and aircraft technology, with the front section being a carbon fibre monocoque (like a racing car) and the back portion being a metallic framework and panels (like an aircraft).

The Car is a hybrid construction. The front section consists of a carbon fibre monocoque, which provides the driver with a very secure, rigid safety cell. It is also the most efficient way to form the complex curved design of the Car in front of the cockpit and main jet engine intake. It is made from five different types of carbon fibre weave and two different resins. Sandwiched between the layers of carbon fibre are layers of aluminium honeycomb core, which provide additional strength.

The rear of the Car has been constructed separately as upper and lower halves. The upper chassis houses the Eurojet EJ200 jet engine and the intake duct, and has a 'rib and stringer' construction, similar to that used in the aerospace industry. The ribs are machined from aluminium and the stringers that run the length of the structure are made from titanium. The outer skin is also titanium in order to reduce the weight at the rear of the Car but keep it stiff.

The lower part of the rear structure houses the auxiliary power unit, the jet fuel tanks and the rocket system. It is made of a series of aluminium frames and bulkheads that are skinned in steel. The rearmost portion of the lower structure forms the 'rear subframe'. The rear suspension is mounted on this, together with the 'rocket thrust ring' which transfers the thrust of the rocket into the chassis, and the parachute cans, attachment points and the air brake door mechanism.

The underside of the front of the Car is titanium, while the floor of the rear of the Car is made of steel sheet. Both materials were chosen to prevent the belly of the Car from being worn through by the desert silt.

Power

During the runway tests at Cornwall Airport Newquay, BLOODHOUND is being powered solely by the EJ200 jet engine. But in South Africa, the Car will be powered by both a jet engine and a rocket, which together will produce more than 135,000 thrust horsepower: that's more than six times the power of all the Formula 1 cars on a starting grid put together.

The EJ200 jet engine is a very advanced military turbofan engine normally used in a Eurofighter Typhoon plane. In BLOODHOUND, it is housed in the back half of the Car in the upper chassis, above the rocket. It weighs approximately 1 tonne and produces 9 tonnes of thrust, which provides the initial power to take the Car to 650mph.

The BLOODHOUND Project has been loaned three EJ200s by the UK's Ministry of Defence – these are 'early development' engines which are close to the end of their flight hours.

The rockets that will power BLOODHOUND in South Africa are still being perfected by specialist Norwegian company Nammo. It is expected that for the 800mph runs the Car will have a single monopropellant rocket, whereas in the 1,000mph Car there will be a cluster of three hybrid rockets.

In order to accelerate the Car to 800mph, the monopropellant rocket will produce around 40kN of thrust and the EJ200 jet engine will make 90kN in reheat. For the 1,000mph runs, the Nammo hybrid rockets will provide a thrust of 123.75kN, generating about 212kN in total.

There will be a third engine in the Car when it runs in South Africa: a 550bhp Jaguar Supercharged V8 engine, lubricated by Castrol EDGE, which will act as the auxiliary power unit to drive the rocket oxidiser pump. This will supply the high test peroxide (HTP) to the rocket.

The Car will need around 400 litres of jet fuel and 800 litres of rocket oxidiser (HTP) for each 1,000mph run – the pump will supply this HTP in just 20 seconds, which is equivalent to 40 litres (over 9 gallons) every second.

Wheels

At Cornwall Airport Newquay, BLOODHOUND will run on traditional wheels with rubber tyres, which are the same tyres that were used on Thrust 2 and Thrust SSC. Originally manufactured by Dunlop for the English Electric Lightning jet fighter, they are ideal for high speed car runs as their profile is very tall and very skinny, and they have a very high load

rating. As a consequence, the runway wheels were made to fit the tyres, rather than the other way around.

BLOODHOUND's high-speed wheels have been specially designed for use in the desert at Hakskeen Pan, South Africa, where they not only have to carry the weight of a 7.5-tonne car, but also must not fall apart when spinning at over 10,000rpm and subject to a force of 50,000g at the wheel rim. The shape of the wheels – and in particular the rim – is very important as they must not sink into the surface of the desert, but do need to have sufficient grip to avoid the Car sliding all over the surface.

The desert wheels were forged using using 6 tonnes of pure liquid aluminium, because forging makes them denser and stronger than if they were made from cast aluminium. They were then milled into the final design in Scotland and one was 'spun' on a test rig, during which both thermal and centrifugal expansion were measured to check they would perform OK when spinning on the Car.

Braking

For testing at Newquay, BLOODHOUND has been fitted with carbon wheel brake disks at both front and rear, which are the same as those used on aircraft and high performance race cars.

In South Africa, however, wheel brakes will not be enough and so BLOODHOUND will have three primary braking systems: airbrakes, parachutes and wheel brakes. These will be used one by one to slow the Car down from its top speed of over 1,000mph:

1,000mph: close the throttle
800mph: start to deploy the airbrake
650mph: deploy first parachute
400mph: deploy a second chute if required
200mph: apply the wheel brakes.

The airbrakes are fitted at the rear of the Car, one on either side in front of the rear wheels. As they fold out they will produce an extra 6 tonnes of drag (roughly equivalent to a big elephant).

The parachutes are stored at the back of the Car and are the same as those used in Thrust SSC. They will be attached by a 20 metre line to avoid the turbulence immediately behind the Car. These provide around 9 tonnes of drag when deployed (that's more than a double-decker bus).

The desert wheel brake disks will be made from steel instead of carbon, because we tested a carbon wheel brake on a spin test rig and it exploded! They will be fitted to the front wheels only.

Andy's office

The cockpit sits in front of the engines. It has been custom-built to fit Andy Green, BLOODHOUND's driver, and is just big enough to hold the seat, screens, controls and steering wheel…and Andy.

Everything possible has been done to minimise the potential discomfort caused by the extreme heat, sound and forces that will occur every time Andy drives the Car at high speeds. The carbon fibre monocoque, of which the cockpit is part, will protect Andy from air pressure of up to 10 tonnes per square metre and t

The canopy's design is vital because it sits right in front of (and just below) the air intake for the jet engine, which needs the air that enters it to be travelling below the speed of sound. The shape of the Car's nose and the canopy create shockwaves which blast the air up and away from the Car. Slow moving air bleeds off the back of the shockwave and into the air intake.

The seat has been moulded to Andy's shape and has been positioned at the right height and angle to let him see down the nose of the Car and reach the pedals comfortably, but also cope with the forces he'll experience at maximum acceleration and deceleration.

The possibility of driving the fastest car on earth has gripped the imaginations of many men and women since the first land speed record was set in 1898. Back then, the top speed achieved was just under 40 miles per hour (mph). It currently stands at over 760mph – faster than the speed of sound.

In the Biffa Award Land Speed Record Exhibition at Coventry Transport Museum, you can come face to face with two record-breaking landspeed cars, ThrustSSC and Thrust2. Richard Noble, Project Manager for BLOODHOUND SSC, is also the driving force behind the last two land speed records. In 1983, he drove his car Thrust2 into the record books with a top speed of 633.468mph. In 1997, ThrustSSC, driven by BLOODHOUND SSC driver Andy Green, broke the record, and the sound barrier, with a speed of 763mph.

Experience what it's like to drive through the sound barrier, on the 4D Land Speed Record simulator! Take your seat, buckle up, and discover for yourself what it's like to drive faster than the speed of sound, across the Black Rock Desert in America...

Coventry Transport Museum houses the world's largest publicly owned collection of British vehicles, and tells the fascinating story of Coventry and its people through the rise and fall of its biggest industry. After a £9.5m redevelopment programme, this huge museum offers a whole day out of fun and discovery for visitors of all ages – all in an iconic city-centre building, and all completely free.

Get within touching distance of some of the most amazing vehicles ever invented. See the cars your parents and grandparents drove or explore what you might be driving in the future. Get caught up in the real-life stories of Coventry's innovators and entrepreneurs. Coventry Transport Museum isn't just for transport enthusiasts: it's for storytellers and escapists; speed freaks and thrill seekers; history buffs and culture vultures. Situated right in the heart of the city, with a gift shop and award-winning coffee shop, it offers a uniquely human perspective on the city's motoring heritage, and is one of the Midlands' best days out.

COVENTRY
Transport
MUSEUM

Want to go faster than the speed of sound?

Come face to face with record-breakers ThrustSSC and Thrust2, and experience what it's like to drive through the sound barrier, on our 4D land speed record simulator!

www.transport-museum.com

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WHAT FORCES AND STRESSES WILL T

BLOODHO

www.bloodhoundssc.com

TEMPERATUR

The combined heat
550bhp Supercharg
engine, EJ200 Jet an
will make the interi

G-FORCE +2 G to - 3 G

As driver Andy Green says, "Slowing at 66 mph per second is a crash in most people's books!"

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CANOPY BIRDSTRIKE

The canopy is designed to protect Andy from an 800g bird at 1000 mph It's as strong as the Eurofighter Typhoon windscreen!

SUSPENSION 30 TONNES

As the 7.5 tonne car hurtles across the pan the suspension will be subjected to huge loads - perhaps supporting the weight of a humpback whale!

WHEELS 50,000 G

The solid, 95 kg aluminium wheels will spin at 10,200 rpm - 4x faster than those on a Formula One car!

FLOOR 'SA

For 12 miles eve
will be thrown
sometimes at 1
The floor is ma
materials woul

THE CAR (AND ANDY) HAVE TO ENDURE?

OUND SSC

RE 150 °C

of the desert sun,
ged V8 Jaguar car
d rocket
or extremely hot!

PARACHUTES 9 TONNES

As a backup to the airbrakes the chutes can be used to provide an extra 9 tonnes of drag. That's more than a double-decker bus!

IRBRAKES 6 TONNES

BLOODHOUND exits the measured
le the airbrakes will fold out,
eating an extra 6 tonnes of drag.
at's as much as a big elephant!

NDBLASTED'

ery run, desert dust
up at the car -
000 mph!
de of steel - other
d be eaten away!

BODYWORK 12 T/m²

As the car accelerates the air will exert huge pressure on the structure.

THRUST 21 TONNES

At full power the jet will be providing 90 kN and the rocket 120 kN More than eight times the power of an entire Formula One grid!

The Team

The BLOODHOUND Project team consists of some of the world's most revered engineering talent. The individuals involved have been hand-picked to ensure BLOODHOUND is a global success, bringing together previous partnerships and fostering new talent in one of the most exciting engineering adventures that the world has ever seen.

The Engineering Team is supported by a British Army Team from the Royal Electrical & Mechanical Engineers which rotates every six months.

The Project also has dedicated teams responsible for vital activities including Education, Communications, Sponsorship, Events and South Africa. All those involved, both past and present, are committed to fulfilling the Project's objectives of sharing the programme with a global audience and inspiring the next generation about science, technology, engineering and mathematics.

Richard Noble	Project Director
Andy Green	Driver

Engineering Team

Ron Ayres	Chief of Aerodynamics
Adam Baker	Rocket Team
Rod Barker	Engineer
Mark Blackwell	Assembly & Build
Henry Breed	Systems Team,
Rupert Bryce-Morris	Assembly & Build
Mark Chapman	Chief Engineer
Dave Crabtree	Assembly & Build
Chris Dee	Chief Mechanic
Roland Dennison	Engineering Lead
Tony Dineen	RAF support engineer
Stuart Edmondson	Engineering Operations Manager
Mark Elvin	Engineering Lead - Mechanical Design
Ben Evans	CFD Engineer
Edward Fletcher	Rocket Team
Michael Fowler	Storeman
Jenna Gaff	Design Engineer
Lee Giles	Rocket Team
Terry Godsmark	Assembly & Build
David Haggas	Assembly & Build
Joe Holdsworth	Lead Systems Engineer
Jon Hunt	Lead Engineer – Vehicle Integration
Jess Kinsman	Run Controller
Alan Lear	Assembly & Build
Kevin Murray	Systems Engineer
Frantz Nehammer	Engineering Project Manager
Mark Owen	Engineering
Wayne Parsons	Fleet Co-ordinator
Chris Rickard	Assembly & Build
Milton Roach	Avionics & Electrical Installations
Mark Robinson	Assembly & Build
Martin Roper	Engineering Team Manager
Henry Schofield	Engineering Secondment (Atkins)
Duffy Sheardown	Procurement
Josh Thompson	Systems team
Dave Tuffs	Assembly & Build
Murray Wells	Student Placement
Jack Williams	Engineering Secondment (Airbus)
Jeff Woolmer	Stress Engineer

Communications Team

Andrew Baker	General Counsel
Nick Chapman	Web Manager
Linda Denne	Events Manager
Stella Diamond	Events Director
Sally Elvin	Events Assistant
Patricia Frith	Personal Assistant to Richard Noble
Ian Glover	1K Club President
Ewen Honeyman	Main Partner Sponsorship lead
James Hunt	Finance Director
Richard Knight	Communications Director
Stefan Marjoram	Film-maker and photographer
Lawson Mayor	Show Logistics
Charan Naidoo	Team Doctor
Karen Packham	Editorial and Website Services
Tony Parraman	Head of Sponsor Liaison
Jaswant Thandi	Show Logistics
Jules Tipler	Communications Manager
Penny Walters	Events Assistant

South African Team

Martyn Davidson	Operations Director
Julius Kriel	Compliance Officer
Skip Margetts	SA Film & Broadcast
Schalk Mouton	Communications Manager, South Africa
Rudi Riek	Track Boss
Deon Steyn	Operations & Safety
Altus van Heerden	Operations Director SA
Peter Woodman	Lead Ambassador

Education Team

Kirsty Allpress	Education Programme Manager
Emma Ayres	STEM Communicator
Rob Bennett	STEM Communicator / HSE Consultant
Chris Fairhead	Education Director
Mike Ford	STEM Communicator
Shelley Halperin-Smith	Education Team
Simon Proctor	STEM Communicator
Alan Read	STEM Communicator
Anthony Rhodes	STEM Communicator
Mark Werrell	STEM Communicator

Former Team Members

Engineering team

Ty Astridge	REME
Adam Baker	Rocket Propulsion Consultant
Roxy Ball	REME
Rod Barker	Engineering
Annie Berrisford	Operations and Sponsorship Procurement
Jeremy Bliss	Systems
Chris Bone	REME
Matthew Bradley	RAF
Henry Breed	REME
Pete Broadhurst	REME
Lisah Brooking	REME
Elizabeth Brown	REME
Johnathan Brownlee	Composite Design Engineer
Toby Cabaret	Engineering
Greg Cardwell	RAF
Adam Carter	Design Engineer
Matt Chapman	REME
Rick Constable	REME
Brian Coombs	Engineering Lead - Mechanical Design
Ian Cooper	RAF
Viv Cowley	Assembly & Build
Laura Davies	REME
Luke Dee	Storeman / Metrology
Ken Dinning	RAF
Andrew Duniec	Design Engineer
Matt Dyke	Engineering
Mark Edwin	REME
Rob Fenn	REME
Neil Gallagher	REME
Josh Garrett	REME
Drew Green	RAF
Christopher Hannon	Design Engineer
Simon Harrison	Engineering
Craig Harrop	RAF
Hollie Jenkins	REME
Dan Johns	Engineering Lead- Vehicle Program Architect / University Program Lead
Huw Jones	Engineering
Tom Jones	RAF
Ryan Kerr	REME
Darren King	REME
Conor La Grue	Engineering Lead - Commercial & Product Sponsorship
Steve Laughton	Design Engineer
Alan Lear	Assembly & Build
Mick Lindley	Engineering
James Lucas	RAF
John Macleod	Run Controller
Gary May	Engineering
Oli Morgan	Major, Army Team Leader
George Morris	Engineering
Henry Mower	REME
Kevin Murray	Design Engineer
John Nelson	REME
Jay Nichols	REME
Simon Osborne	Engineering

James Painter	Engineering Lead – Vehicle Integration
Holly Papadopoulos	Graphics Co-ordinator
Rob Pattinson	REME
Matt Pegler	Engineering
Andy Pike	REME
David Pollock	Design Engineer
Jamie Reed	Assembly & Build
Chloe Rhodes	REME
Ben Richards	REME
Stuart Richardson	REME
Tom Robinson	MOD Graduate
Si Ryder	RAF
Andrew Ryrie	Engineering
Graham Sargent	REME
Phil Seward	Engineering
Tom Simes	Design Engineer
Ernst Smit	REME
Lee Smith	REME
Nikki Smith	REME
Siobhan Spiers	REME
Luke Taylor	REME
Josh Thompson	REME
Rachel Trimble	Additive Layer Manufacturing Engineer
Laurence Truscott	RAF
Hywel Vaughan	Graphic Design Support
Andrew Wainwright	REME
Kim Watts	Sponsor Liaison
Tom Williams	Engineering
Kayleigh Williams	REME
Jo Willis	Design Engineer
Harry Wills	Engineering Intern
Jeff Woolmer	Engineering

Communications Team

Natasha Allden	Sponsor Liaison
Jamie Ayliffe	Risk Team
Christopher Boocock	Safety & Reliability
Cathy Brown	Regional Director (STEMNET)
Rick Brunt	Safety Case, HSE
Joanna Coleman	Dep Head - Public Engagement, EPSRC
Sarah Covell	Mission Control Centre - Project Manager / Technical Centre Manager
Neil Dunsmuir	UK Marketing Director, SIEMENS
Anna Goddard	Technical Centre Manager
Karen Hudd	Admin assistant
Neil Larsen	UWE Consultant
John Mason	Defence Aerospace (Rolls-Royce)
Pedro Monteiro-Ferreira	Engineering, UWE
Brian Penfold	Risk Team
Katherine Perricos	Finance team
Sarah Sessions	Head of Sponsor Liaison
Andrew Sims	MOD liaison (technical) / Rocket consultant
Kim Watts	Sponsor Liaison
Rod Williams	Risk Team

South African Team

Father Aloysius	Lead Ambassador Northern Cape
Gavin Coetzer	MTN Communications Liaison
Wendy Maxwell	SA Education Manager
Dave Rowley	BLOODHOUND SSC Education Director – SA

Education Team

Seye Ayadi	Education Team
Jo Beswick	STEM Communicator
Aulden Dunipace	Education Director
Dawn Fitt	Education Team
Simon Haydn	STEM Communicator
Gerry Heather	STEM Communicator
Dave Ingleston	STEM Communicator
Nick Naylor	STEM Communicator
Steve Nevey	Education link to Engineering
Lyn Procter	STEM Communicator
Seema Quraishi	Ambassador Liaison
Ben Sambrook	STEM Communicator
David Shelton	STEM Communicator
Luke West	STEM Communicator


Mission Statement

View from the Newquay hangar

By Frantz Nehammer, BLOODHOUND Engineering Manager

What a difference a year makes. Twelve months ago the programme was kicking back into gear as the announcement of our new partnership with Geely was going global and the Team were setting about stripping back BLOODHOUND SSC after its public debut at Canary Wharf.

The Expo car, with most of the large components fitted, showed off the magnificent form of the extraordinary vehicle with some cockpit display screens demonstrating what parameters our driver Andy Green would see when driving through a typical run profile. The EJ200 fitted was a non-running jet engine, used to verify mechanical fit into the upper chassis. So the task at hand was to give BLOODHOUND SSC a pulse and get it moving under its own jet power. This would be no mean feat.

On the road to Newquay

After months of focus and sheer hard work with parts design, systems integration and progressive testing, this awesome machine was ready to depart the BLOODHOUND Technical Centre (BTC) for Newquay Aerohub on the back of a modified Oldbury Slider, courtesy of sponsor Arthur Spriggs and Sons.

The Car had been completely rebuilt with functional systems, including one of the two operational engines (on loan to us from the Ministry of Defence and kindly supported by Rolls-Royce), with seals and bearings in place, and high grade imperial and metric fasteners all properly specified and torque-tightened.

This time the Car would be leaving the BTC to show us what she could do, rather than us showing to the world what we had done.

Setting up our new workshop

Thanks to the fantastic support from Aerohub at Newquay Cornwall Airport, we set up a home-from-home workshop in Hardened Aircraft Shelter No. 7, which had enough space to complete preparations to commence our programme of Phase 1 (static) and Phase 2 (dynamic) trials of this jet car on the airport grounds.

We had already successfully completed 'dry-cranking' of the EJ200, which involves spooling the engine up using the complete startup sequence – except for pumping and igniting jet fuel, since this wouldn't go down well on a small industrial estate in Avonmouth. Now it was time to start the engine fully under static tie-down conditions.

As with any testing of one-off creations, there are always problems to solve. That's the nature – and, quite frankly, the thrill – of development trials. If you try to see off all problems at the outset, you can struggle to make progress and end up nowhere fast. So trials allow an important incremental approach to reveal problems, with the key being to expose issues quickly and efficiently in order to continue to make rapid progress.

All problems at this stage are to be resolved, so finding the balance between progressing and resolving issues is ultimately a balancing act involving the management of technical risks. In this case, a tweak of code to manage a sensor that was being subjected to electrical noise allowed the EJ200 to fire up for the first time, and once all inhibiters used to preserve the engine had burnt off, our hearts and chests were pounded by the thunderous power projected from this incredible engine.

Performing beyond expectations

The relief and elation at reaching this point was written on the faces of every single member of the team. In fact, the elation went further as we soon discovered our in-house designed intake (for which Engineering Director Mark Chapman was responsible) demonstrated engine performance that surpassed our expectations –the Car was capable of operating at full reheat (maximum thrust) while the car was still shackled to the ground.

After this, the engine started with ease, and we realised had reached another significant milestone: BLOODHOUND SSC was now breathing fire and it was time to unshackle the beast to make the wheels turn under jet, rather than human, power.

The dynamic trials (Phase 2) included assessment of the drivability and handling characteristics, steering, suspension, braking and stopping distances, as well as assessing performance against modelled data.

This was science in action: make your informed predictions through mathematical modelling; then, using the vehicle, compare your original predictions with real-life data to generate more informed predictions and calculations for different conditions and scenarios.

For example, using narrow tyres at low pressures (lower than when they are typically fitted to a much heavier English Electric Lightening aircraft) gives a different contact patch with the ground – and a different coefficient of friction on a dry airfield, as it turns out, of about 0.3 to 0.4. This is much lower than a typical road car, which may be around 0.7 to 0.9. So BLOODHOUND's stopping distances on runway tyres are much longer than a road car (and will be unquestionably much, much longer with desert wheels).

The first dynamic runs

With Phase 2 preparations complete, it was time to start the Car ready for its first dynamic run.

As a member of the Recovery Team responsible for receiving Andy and the Car at the end of a test run, I was privileged to be faced with an image that I will remember for the rest of my life: seeing BLOODHOUND SSC powering towards us, growing steadily from a tiny version of itself and then, ever so gently, gliding to a smooth but deafening stop just a few metres from my safe position. The image that is imprinted in my memory is of the Car looking almost exactly like the digital animations made years ago which showed the Car approaching the end of a run in the desert.

Although it was without its tail fin and was being driven on runway wheels with panels removed, the emotions and imagery were simply surreal. Unlike any animation, however, there was the smell of hot burnt jet exhaust wafting across from the thundering rear of the Car and our bodies were pulsating with the engine noise, softened only by our ear defenders – which, if you smiled, as you couldn't help but do, caused a muffled spear of roaring noise to leak into your ears.

After placing the chocks under the rear wheel and completing the necessary checks for leaks or other problems, I could stand clear of the gulping intake and await engine shutdown. In an instant, Andy was given the all clear for routine engine shutdown and soon the idling engine power was eased off and the Car sank back into the retaining chock. The engine dropped down to a light windmilling speed and Andy popped the hatch open for us to clear his exit.

"That all went rather well, didn't it?"

And another historic moment on the Project had passed in quick succession.

History in the making

Over the course of the rest of the week, we were able to run the Car seven more times, resolving a front right braking issue and gathering much needed data from the Car to validate the models and instrumentation. With increasing speed, Andy was able to bed in the brakes, and by the end of the week all tyres were laying rubber evenly.

We were then readying ourselves to take the Car well over the 100mph mark in the following weeks. This would be another historic moment on the journey toward breaking Andy's current World Land Speed Record of 763.035mph.

BLOODHOUND SSC

SPEED COMPARISONS OF THE FASTEST THINGS IN THE WORLD

28 mph USAIN BOLT

The maximum speed **USAIN BOLT** reached when he set his 100m record of 9.58 seconds in 2009

48 mph SIR CHRIS HOY

11 time world champion **SIR CHRIS HOY** can reach speeds of over 48mph using pedal power alone!

317 mph SPIRIT of AUST

KEN WARBY built his jet-powered boat in his back yard in Sydney. His record has stood since 1978!

763 mph THRUST SSC

In 1997 **ANDY GREEN** became the first and only person to drive a car faster than the speed of sound!

833 mph FELIX BAUMGA

FELIX BAUMGARTNER had to jump from a height of 38,969 metres to reach these very high speeds!

988 mph RED BARON

The low altitude record is held by **DARRYL GREENAMYER** in his F104 - which he built out of scrap parts!

1050 mph BLOODHOUN

At peak speed **BLOODHOUND SSC** will be faster than a bullet from a .357 Magnum!

4510 mph NASA X-15

The rocket powered **X-15** flew so high that two flights counted as space flights!

24790 mph SATURN V

SATURN V 160 times more powerful than **BLOODHOUND SSC** - generating 21.6 million Thrust HP at launch!

Notice how most of the really fast things achieve their speeds very high up where there is little or no air resistance (drag). The lower you get, the more dense the air becomes. At top speeed Bloodhound could experience almost 20 tonnes of drag!

Why the second time round is 'easier'

By Andy Green, BLOODHOUND SSC Driver

I remember the first time I climbed into the cockpit of the F4 Phantom. This legendary supersonic jet fighter was simply huge. At 57 feet and 7 inches long, it was 20 tonnes of screaming aluminium beast that needed a ladder just to climb up the side to reach the cockpit. I was more than a little daunted. The world-famous 'bent-winged monster jet' was known as much for being difficult to fly as it was for its prowess in air combat. My future career rested on getting to grips with this monster right now, today, or I'd be looking for another job by next week.

My first supersonic car

Ten years later, approaching Thrust SSC for the first time in the autumn of 1996 felt much the same. I was climbing into a twin-jet supersonic car weighing 10 tonnes, a vehicle using not one, but two Phantom engines and steered by the rear wheels (yes, really). A vehicle that had never run before. A vehicle that was due to go supersonic after a handful of test runs, attempting a feat that some of the world's leading experts said was impossible. I had to learn how to control this uniquely powerful and fast vehicle, to learn how to work with the engineering team on the suspension set-up and aerodynamic balance, to learn how to go supersonic safely.

The big difference from flying was that I had no pilot's notes to refer to, no hugely experienced thousand-hours-upside-down-at-the-top-of-a-loop instructors to talk it through with. I had to teach myself to drive what was about to become the world's first-ever supersonic car, and I had minutes, not hours, of test running available to do that. Compare that with conventional motor racing: Lewis Hamilton gets more track time on the first morning of the first day of pre-season testing then I would be getting in Thrust SSC in my whole life.

If I was daunted the first time I flew the F4, then I was really nervous for the first test run of Thrust SSC.

Second era symptoms

The second time is much easier. When I converted to the Tornado F3, I already had over a thousand hours in Phantoms. Flying the F3 was challenging, but I knew what was coming, I knew I could do it and I knew that flying jet fighters in the RAF was perhaps the best day job ever invented. I loved it.

I have the same feeling about driving BLOODHOUND SSC for the first time this October on the runway at Cornwall Airport Newquay. Despite the disbelief of everyone who asks (including my wife, who probably knows me better than anyone), I'm really not feeling nervous, just proud and excited. Like flying a supersonic jet fighter, running a prototype supersonic jet car will be challenging, but we've done it before. I know we can do it again and do it well.

For the first runs, we will be live streaming video and data from the Car, which (thanks to Oracle and Cisco) will reach a worldwide audience. Millions (tens of millions?) of people will be marking our homework in real time, but this doesn't bother me. As the soon-to-be world's fastest car accelerates at Formula 1-type speeds, I'll be far too busy to worry about who's watching our global 'Engineering Adventure'.

Thrust SSC set a supersonic record back in 1997, a record that still stands today. With Project BLOODHOUND, the World Land Speed Record is happening for a new generation and it's more exciting than ever. I can't wait!

Reprinted with kind permission of Top Gear magazine.

How it feels to drive BLOODHOUND SSC for the first time

By Andy Green, BLOODHOUND SSC Driver

We set the current World Land Speed Record 20 years ago this month. It is still the only supersonic world record and is by some margin the longest-standing record in history. The fact that no-one has come close in 20 years is a measure of just how technically challenging this achievement really was.

When Thrust SSC made its debut

I can clearly remember the first time we tried to run Thrust SSC. Starting up the engines was the first problem, with the fuel system struggling to supply the massive Rolls-Royce engines with enough fuel, and the air intakes limiting the power available. Eventually we were ready for dynamic tests, rolling the Car out onto the runway at Farnborough for its first slow-speed runs.

We had confidently invited hundreds of people, and the ITV News cameras, to watch the event. A couple of fuel and hydraulic leaks later, plus some steering and brake chute problems, nothing happened and everyone went home again. This Car just didn't seem to want to run…

We finally got Thrust SSC running properly and completed its dynamic testing up to 200mph. This Car had some impressive performance and I remember very clearly testing full reheat – the acceleration from 150mph to 190mph took just 1 second! As a 'race car' about to compete in the oldest form of motor racing, it would be fast, but it didn't feel much like a racer. The handling was less than precise and the throttle response was average at best. This was less of a sports car and more of a large family saloon (albeit a very fast one).

The BLOODHOUND contrast

Jump forward two decades to BLOODHOUND SSC's first runs at Cornwall Airport Newquay. BLOODHOUND was rolled out for its first static engine tests right on time at the end of September. Rolls-Royce had told us that the EJ200 jet engine, having spent the last couple of years 'inerted' (in storage with special preservative fluid in the fuel system), would take three or four attempts before it started for the first time. In fact, the jet almost started on the first attempt and burst into roaring life on only the second try.

The following day, we ran the jet engine up to see how much power we could get. BLOODHOUND's intake is designed to work best at supersonic speeds, so Rolls-Royce had told us to expect some severe power limitations below 200mph. Not a bit of it. The engine wound all the way up to maximum power, giving a massive blast of full reheat, and appeared to be giving us more power in the Car than it had on the test bed. Now that's a good problem to have.

The start of October saw BLOODHOUND move under its own power for the first time. Right from that very first run, the Car felt right. Great throttle response (the EJ200 is, after all, the world's best military jet engine), superb chassis and suspension feel, precise steering – this was more like it. This felt like a race car and it clearly wanted to run, and run well.

Oh, and the performance? Move over Thrust SSC, there's something faster in town.

10 AMAZING FACTS ABOUT THE HAKSKEENPAN

This dried lake bed in the Northern Cape of South Africa has been chosen as the ideal location to run BLOODHOUND SSC at 1000mph

40cm

12 MILES

With so little undulation over the full length the pan is effectively smoother than a pool table

21.5 MILLION

... square metres of desert were cleared by hand. The same as 3,000 international football pitches!

20,000

Swansea University created a bespoke computer programme to scour satellite earth observation imagery and assessed over 20,000 potential sites

A **PAN** is a dry lake

HAKSKEEN means **HEEL** in Afrikaans

6,000 TONNES OF ROCKS

The team picked up every stone - however tiny!

APPROX.

50CM

The pan regularly (almost every year) floods under this much water. This is what makes it so smooth.

317 PEOPLE

From the local community cleared stones for 120 days

The surface is made of 1-2cm thick plates of sun-baked mud. These sit on more mud which has built up over 1,000's of years.

The Pan's crust is so hard the sharp metal wheels of the 7.5 tonne car hardly leave a mark!

STATS

Age.....10,000-20,000 years
Altitude.....794 metres
Av. annual rainfall.....200mm
Av. temp. range.....-6 to +45°C

This classified ad in the The Times was a take on one by Shackleton 100 years earlier*...

People wanted to clear desert track for 1,000 mph car. No wages, constant heat, tough work in beautiful but remote Hakskeenpan, Northern Cape, South Africa. Scorpions may be present. Inspiring next generation of engineers the reward.

*Actually no one has been able to find the original & there's a $100 prize if you do!

Turning a desert into the world's fastest racetrack

By Skip Margetts, Broadcast Consultant, South Africa

Working in the film industry, I have been very privileged to see some stunning places in the world, but without a doubt, working on the BLOODHOUND Project has led me to see the most interesting ones.

Right off the bat in 2008, we went to the most logical place in South Africa to run a land speed record car, Verneuk Pan. This was where Sir Malcolm Campbell unsuccessfully tried to break the World Land Speed Record in 1929 (parts of his track still exist today). I shot a TV commercial there in 2001 and remembered it well, mainly getting lost.

It became quickly evident, however, that the workload to complete the track at Verneuk Pan was going to exceed the human and financial capital that existed then. With literally a few days to go before the world found out where the fastest place in the world would be, we started the search, again….

Discovering Hakskeen Pan

Luckily, my good friend and colleague Rudi Riek had another look at Hakskeen Pan. This location had initially been remotely viewed by Andy Green but dismissed due to a road running through the middle of it – apparently that was a bit of a show stopper. Rudi decided to take a six hour detour and check there was no way we could squeeze the 20km track in somehow. To his surprise (and my relief) he found the show-stopping road had now been closed and a brand new road built at the very top of the Pan. We were back in the game!

There was still a Herculean task ahead though, as the Pan was almost entirely covered in rocks and stones. Now, however, all you'll find there are meteorites because 317 workers have removed those rocks, mostly by hand, to clear a strip 1km wide and 20km long.

The race to create the best surface for Andy to drive on has also taken me to Edwards Air Force Base in California. Their Pan is almost identical to ours and we wanted to see how they repair damage. We basically do it the same way, but we use people and they use machines. And we use a mixture of water and the local surface deposits to make a slurry.

Panning for popularity

As work continued on Hakskeen Pan its popularity grew. In 2010, Top Gear wanted to film a segment there. Unfortunately for them (and fortunately for us) it had had rained the week before, so we shot it just to the south of our Pan.

We now routinely travel to the Pan to check the progress of work and advise on any related quality control issues. These trips usually take three days and involve driving around the Pan in segments very slowly, looking for any sections that have been missed or any stones that have come to the surface over time. We camp on the Pan and barbecue for breakfast, lunch and dinner.

Work is now almost complete and some high speed driving has already taken place, with several commercial film shoots for various BLOODHOUND sponsors. The most exciting (so far) was with a fast prototype car, a Czech training jet and a helicopter – what could possibly go wrong…..?

Visit us at the Pan

The Pan has seen a lot of traffic as we prepare it for BLOODHOUND, including the local community, workers collecting stones, local and national dignitaries and film crews both large and small, but this will be nothing to what we expect in the future. Thousands of people, from all over the world, will descend on the Pan to hear the sounds and see the sights that will live on forever.

For me though, Hakskeen Pan will always be the most beautiful place in the world, where the sky meets the earth and the stars are the brightest you will ever see. I look forward to welcoming you there.

What does driving at 1,000mph feel like (if you're normal)?

By Richard Knight, BLOODHOUND Communications Director

This is one of the questions Andy Green gets asked most often and that's entirely understandable: it is so far removed from our everyday reality that of *course* we're curious. But here's the thing: there's no point asking Andy what traveling absurdly fast *feels* like. He's a fighter pilot and operating complex machinery at silly speeds is entirely normal for him. There's no point asking Richard Noble either, because this is a guy who taught himself how to operate a jet-engined car by reading a book….

No, to get a proper account of what a record attempt will feel like you need someone *without* the Top Gun training, with healthy levels of cowardice and reaction speeds more akin to those of a well-fed labrador than a striking cobra. To that end, may I present…me. A prime example of un-übermench.

I do have *some* experience going quickly. I have occasionally taken cars and motorbikes onto race tracks and I did once drive a Formula 1 car – although within three corners I couldn't keep my head upright so didn't achieve any really glorious speeds. The greatest *sensation* of velocity I have ever experienced was on a bicycle, racing down a mountain in Italy. I stopped looking at the bike's computer when it indicated 60mph and focused instead on a point far down the road… all the way back home, in fact, to the pub that I hoped to *live long enough to see again.*

Given these rather unimpressive exploits, it may come as a surprise to hear that I have four 1,000mph record attempts under my belt. Not, it must be said, in BLOODHOUND SSC, but in something very nearly as bonkers.

Andy Green has access to an Extra 300, a two-seater aircraft designed to win aerobatic world championships. He uses it Extra to practice doing BLOODHOUND record runs, flying a variety of manoeuvres which recreate the forces experienced on the way up to 1,000mph and back. He invited me along one day I so could get a better appreciation of this whole record breaking thing. It would only take a couple minutes, plus take-off and landing. How bad could it be?

Really quite bad, as it turned out.

Walking towards the Extra on a soft, sunny day, it looked sleek and lean and almost unthreatening, especially in its cheery yellow and white livery. An elegant four- bladed propeller sat up front and it had windows in its floor. Andy explained that the carbon fibre wings were, to all practical intents, unbreakable, and it could rotate around its horizontal axis one and a half times *per second*. It was an impressive piece of engineering and, as I was shortly to discover, an extremely efficient means of converting a regular human being into an incoherent, wobbling mess.

Nerves started chirping as I was (firmly) strapped in. It seemed far too small and fragile for the task ahead; an impression heightened by seeing the latticework of spindly tubes that made up the aircraft's skeleton.

The jet-fighter style canopy provided an uninterrupted view, but also a strong sense of being exposed. Feelings of vulnerability went off the scale when the huge 8.8 litre engine erupted into life, the propeller now a roaring blur just a few feet ahead. The plane shook and buzzed with furious energy as we taxied to the take-off zone. All too soon, Andy buried the throttle and the Extra flung itself down the bumpy grass airstrip seemingly free of inertia. My mouth was dry and my brain already scrambled. I forced down some deep breaths.

We haven't even started yet. Get a grip…

We climbed swiftly to 2,000 feet before doing some warm-up turns. Fear gave way to fascination as I looked at the scene around me: fields in every shade of green spanning the horizon and buildings scattered amongst them like so many pieces of Lego on a carpet.

"Are you OK? Give me a thumbs up and we'll begin the run profile."

Having checked that the sky around us was clear, Andy pushed the Extra into a gentle turn. "BLOODHOUND SSC is rolling..."

He described every action and its results in carefully ordered, unhurried progression, his voice coming calm

and measured through the headset. "The 12 mile track is stretching in front of us… Now doing 100mph and engaging full reheat…"

The horizon flipped as Andy inverted the aircraft. I strained my neck to look up… only to look *down* onto the bucolic scene of a church amongst trees and a tractor in a field.

"We're now doing 1G, accelerating at 20mph per second. Looking for Stage 2 rocket – now."

My reverie was brutally interrupted by the wings tipping closer to vertical and the G forces spiking up as we carved a tighter turn. "We now have 12 tonnes of thrust and are accelerating at 40mph per second. Climbing through 400, 500… Coming up on supersonic…"

As the upside down plane drew a never-ending curve, blood rushed to my head and an extraordinary pressure built up behind my eyes. I could feel the pulse hammering in my ears. If Andy was feeling the effects of the G, I couldn't hear it – the beat and tone of his voice were entirely unchanged. I felt a rush of hot, clammy panic and sent out clumsy hands to fumble with the fresh air vent.

"…800, 900, approaching the measured mile which we'll get through in just 3.6 seconds."

Please, make this stop!

"We're through the mile, shutting off throttle, that's 3G deceleration."

To simulate closing down BLOODHOUND's rocket and jet, and the impact of 17 tonnes of unchallenged drag, Andy spun the plane around so it was now the right way up but turning in the *opposite* direction. In the pre-flight briefing he had described this 5G transition as being "a fairly violent experience", something my stomach now confirmed as it did its best to squeeze out of my pelvis. The blood that had forced its way into my skull earlier now cascaded south, leaving me light-headed, grey shutters crowding the edges of my vision.

I tensed my leg muscles as I had been instructed to do, but deep inside, pre-historic senses mistook the tumbling actions of a 21st century flying machine for the effects of eating dodgy elk. My throat tightened and my mouth flooded with metallic tasting saliva.

Oh no, not this. Do not throw up in Andy's plane…

All the time, there was the same, steady beat of that calm voice. "Now launching parachutes, popping the G back up temporarily." The turn tightened a fraction, and through gritted teeth I swore revenge on the pilot.

I. Need. This. To. Stop!

Just when it felt too much, the inside wing came up a fraction, easing the pressure on my compressed spine. I gulped down great gobs of cold air as Andy described BLOODHOUND slowing down to 300mph, then 200, the wheel brakes coming on… And then, calm.

"So, how was it?" he asked, brightly, as if we'd just taken an old MG for a spin around the block.

"Great," I lied.

He knew the reality, and also, that I would be back again. Three times in fact. Not because I enjoyed it, but because I wanted to chase that feeling of living, just for a few seconds, utterly outside the realms of the normal world.

What's it like doing 1,000mph? Horrible. But given the opportunity, you should do it in a heartbeat.

FIND OUT ABOUT THE AMAZING BLOODHOUND EDUCATION PROGRAMME

BLOODHOUND isn't just about a 1000 mph rocket and jet car but inpiring the next generation about Science, Technology, Engineering and Mathematics. Every school child in the UK will get a Bloodhound experience by the time BLOODHOUND SSC does 1000 mph and there will be a Bloodhound lesson for every part of the curriculum - from art to technology.

6000

UK schools use BLOODHOUND technical content in lessons

1000+

BLOODHOUND ambassadors visit schools around the UK

BLOODHOUND inspiration is going global: the project is followed in over

220 COUNTRIES

BLOODHOUND sponsor University of the West of England doubled its engineering undergraduate intake in 2015

533 MPH

Schools worldwide are taking part in the BLOODHOUND Model Rocket Car Challenge. From 88 mph in 2011 speeds are now heading supersonic!

Since the project began students have built and raced over

25,000

K'NEX AIR ROCKET CARS

2 MILLION

children have enjoyed Bloodhound activities

BLOODHOUNDBLAST.COM

Free lesson plans and 10,000 learning resources, available around the world!

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Institution of MECHANICAL ENGINEERS

Find out more about the education toolkits
imeche.org/toolkits

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Education and engagement

The main aim of the BLOODHOUND Project is to inspire the next generation of scientists and engineers.

The BLOODHOUND Education Programme is available to all primary and secondary schools, students in further and higher education, home educators and children's groups and clubs. We also give presentations and demonstrations to adult groups and professional institutions, to promote the Project more widely.

These activities are run by the charity BLOODHOUND Education and form one of the biggest science, technology, engineering and maths (STEM) programmes in the UK. Our various workshops combine hands-on activity with classroom instruction, along with a competitive element to involve and enthuse even the most laconic student.

The runway testing in Newquay will provide valuable data and experience before the BLOODHOUND Team heads for South Africa to chase a new World Land Speed Record. Importantly, it will also provide a real-life science showcase for the 250,000+ young people who participate in BLOODHOUND-related activities each year.

During the past year alone, BLOODHOUND has involved more than 125,000 UK students in its workshops, in both primary and secondary schools, with many more engaged over the years that the Project has been running. Some estimates put the total figure at around 2 million, and with our new Cloud Partner Oracle the ambition is to push this well beyond 3 million.

These activities couldn't happen without our dedicated band of BLOODHOUND Ambassadors, some of whom have worked with the Project for many years. Some were inspired by BLOODHOUND as students and now are Ambassadors in their own right.

On these pages, we share some of the real-life stories from the schools and colleges that we have worked with, and the Ambassadors who have travelled far and wide to share the BLOODHOUND inspiration effect.

If you would like to contact the BLOODHOUND Education Team directly to discuss ways that your organisation can be involved or use the Project's resources, then contact us via email on education@bloodhoundssc.com.






"I was blown away!"

In 2016, BLOODHOUND Ambassador Sophie Lovejoy visited Finborough School to run a rocket car event for the students.

At these events, Ambassadors typically give an overview of the BLOODHOUND Project and the Car, and then discuss relevant engineering concepts such as aerodynamics. Students then get the chance to turn theory into practice, designing and shaping their own cars from blocks of modelling foam, before racing them down a specially set up runway using tiny rockets, at speeds of up to 55mph – or more.

This is an excerpt from Finborough School's story of its rocket car day.

"What an amazing, incredible, exciting day we have just experienced in the Science department! Students and staff alike thoroughly enjoyed a day centred on the BLOODHOUND World Land Speed Record attempt.

"With their imaginations primed, our students set about creating their own record-beating rocket cars with nothing but hacksaws and sandpaper to assist them. And soon the Science department was filled with the sound of high density polystyrene being sawn, sanded and hammered. Some of the creations constructed were breath-taking!

"Once the cars were constructed and liveries applied, it was time to see how effective the designs were. A 30m test strip was created, though for the sake of safety the cars were attached to a wire tether. Each car had a small rocket engine carefully inserted and with a traditional countdown the cars were launched down the test strip. With a small burst of flame and lots of smoke the 30m track was annihilated by each and every car to the absolute delight of every participant.

"We'd like to give a massive thanks to Sophie Lovejoy for sharing her expertise with us and ensuring that everyone had an amazing day."

And from the students:

"I really enjoyed learning all the interesting facts about all the people involved in the Project and where they are taking the Car to see if they can reach 1,000mph. Our cars went very fast and I really enjoyed my afternoon and had a fun time."

"I learnt a lot about aerodynamics and I very much enjoy engineering, so I loved this experience. A big thank you to Miss Lovejoy for making this experience."

"My favourite bit was when we let the rocket car off, it was really loud! It was soooo much fun."

"We made a rocket-powered car – we came last, but we had fun blasting it down the track. We learnt that the real BLOODHOUND has 135,000 horsepower; I was blown away!"

"Shouldn't it be better than that?"

The idea was simple: invite one of the world's top motoring journalists to a London school, to race his foam racer against those created by the students. We knew the game was up before he even took his entry out of the box – the expression on his face said it all.

"Oh dear. I think I've seriously under-estimated this…" said Steve. He had just seen the sleek, purposeful racing cars designed by a highly motivated lunchtime BLOODHOUND club: some were seriously aero. Others were pared back to optimise power to weight ratios. It was abundantly clear that these 14 year olds weren't messing around.

"Come on then, show us what you brought," said one of them, with more than a hint of swagger. Steve took the lid of the container and, reluctantly, showed his car to the small crowd that had gathered. It looked like a house brick with wheels. One of the students broke the silence: "What do you do again?"

"I'm a car journalist."

"Right. Shouldn't it be better than that, then?"

"Yes. Yes it should. But let's see how it goes, shall we?"

To the surprise of no-one there, Steve's car fared badly, barely topping 40mph, while the best of the rest were reaching 55mph or more. Making the indignity all the more apparent, the BLOODHOUND Ambassadors elected to run cars side by side, so performance differences were clearly apparent. Steve's car was gloriously, spectacularly slow, to the delight of the kids who offered no shortage of tips on aerodynamics, the importance of getting the axles aligned to cut drag, and where best to take weight out without the car splitting apart under acceleration.

Steve took his lesson with good grace but at the end turned and said, "I want another kit. I'm coming back and this time I'm getting my friends on a Formula 1 team to design it. I don't care if it's cheating. I'll be back…"

From student to engineer via a plastic bottle

Many of the BLOODHOUND Ambassador visits to schools involve the students crafting rocket cars out of blue foam blocks. But there are other ways to build and power a model car. Ambassador Andy Higgs, for example, visited West Leigh Junior School where they designed 'gravity cars', using a ramp to accelerate them from a standing start.

Andy taught the children about aerodynamics in a special assembly, demonstrating the difference between the performance of an unshaped foam block on wheels and one that had been carved into an aerodynamic shape. The children then set about designing their own cars that were built using 'junk modelling'.

"Some of the ideas were very advanced: we saw baffled water tanks to add weight, elastic band-driven propellers and giant nose cones added to their raw materials of cereal boxes and plastic bottles," reported Andy.

"My favourite part of the whole process is to see the students carrying out tests that result in modifications to the designs. They always look amazed when you tell them that the kind of iterative design that they're doing is very similar to how a lot of experimental engineering works."

"The day was an overwhelming success, with incredible feedback from my fellow members of staff as well as the children," reported Mr Loveridge, West Leigh Junior School. "Andy's introduction to the day got the children excited and enthused about their D&T Day. And throughout the day, Andy provided support to help children improve their car designs – it was fantastic for me as a D&T lead in school to see such fantastic work from our pupils."

A great day out!

As an alternative to school visits, the BLOODHOUND Education Team runs half-day rocket car events at the BLOODHOUND Technical Centre in school holidays. These give children and parents a chance to learn about the science and technology behind BLOODHOUND, visit the workshop to see BLOODHOUND SSC being built – and then the children can build a rocket car of their own to race outside.

Future events are advertised in the BLOODHOUND newsletter and on the website.

"What a brilliant day! My son Max had been looking forward to this for weeks, watching BLOODHOUND videos on YouTube every day. He really enjoyed building his rocket car, which achieved 46mph. It was great how you involved everybody, especially the kids. Max now knows how a jet engine works and I'm sure there will be a few engineers from among today's participants. In fact, if you had been my Maths teacher I might have been an engineer rather than a builder!" – Max and Tim

"What a wonderful afternoon! We now have one rocket scientist and one engineer in the making. The talk you gave was perfectly pitched for all ages. It was brilliant to take part in such a fun and inspirational day. Iris and Felix haven't stopped telling everyone about it." – Sarah, Iris and Felix

"My 6 year old son is a bit of a car enthusiast, whereas I am not. However, although it was geared toward the younger members of the audience, the gentleman that gave the presentation – the 'Chief Inspirer' – had the children and adults laughing all the way through, despite presenting on a subject which may seem a little dry. I found his telling of the history of the World Land Speed Record and the construction of BLOODHOUND quite exhilarating. Overall the main focus, simply put, was 'to be the best', but a couple of things that really stood out to me were 'pride in British industry' and 'pride in British achievement'. This was not only a fun and educational day out, but also a chance to be part of what may be looked back upon as an important part of history – I was so glad I had the opportunity to experience this with my son." – David and Franz

Inspired by BLOODHOUND

Jess Herbert was inspired by the BLOODHOUND Project to become an engineer and at the end of 2016 she was named runner-up in the 2016 EEF Future Manufacturing Awards in the South-West, following the successful completion of her apprenticeship at Rolls-Royce. She's also one of our valuable team of BLOODHOUND Ambassadors.

"The BLOODHOUND Project was, and still is, what made me fall in love with engineering. Because of BLOODHOUND, I became a technical engineering apprentice with Rolls-Royce in 2013 and have received my professional registration with the IMechE. Without the support and enthusiasm of the Team and the excitement of the Project I would never have been able to do even half of what I have achieved over the past four years.

"The experiences I undertook as part of my apprenticeship were all possible because of the Ambassadors that first inspired me in back in 2008, and every great achievement of my career to date has been made possible because of BLOODHOUND. So becoming a BLOODHOUND Ambassador was, for me, one of the easiest decisions I have ever made. How else are you able to get involved with one of the most exciting engineering challenges on the planet, spread the passion and enjoyment of engineering and inspire the next generation of STEM students all at the same time? Being an Ambassador is my opportunity to give back to the Project and help to spread the bug for engineering further.

"It's amazing to be able to let people's imagination run wild and challenge the impossible, and watch the excitement grow as a group of students race their rocket car for the first time. After all, it's not often you're given the opportunity to shape the future or inspire the next generation, and there's nothing more gratifying as an Ambassador than hearing that you have helped or inspired someone to get into engineering!"

Taking the story to South Africa

UK BLOODHOUND Ambassador Chris Lowther has visited schools in Western Cape, South Africa, several times in his capacity as a STEM and BLOODHOUND Ambassador.

You can read Chris's reports of his visits on the BLOODHOUND website. A common theme, however, is the limited funding that many schools have and how this affects their abilities to provide activities to inspire children to consider studies and careers in STEM subjects. Hence the resources provided by BLOODHOUND and organisations such as the Institution of Mechanical Engineers have proved invaluable.

"The schools I visited vary enormously, but I am always struck by the unbridled enthusiasm and open-minded attitude to STEM subjects displayed by all the teachers and students in the schools I visit. Everyone there seems to appreciate the importance of the study of STEM subjects, although they may not be fully aware of the opportunities afforded by STEM careers. They have embraced the BLOODHOUND Project and have all expressed their commitment to making use of the BLOODHOUND Educational materials provided and those on the BLOODHOUND website.

"However, there are very few local STEM Ambassadors who visit schools to promote the virtues of engineering careers. This is something where the international engineering institutions can help by encouraging their members in South Africa (and elsewhere in the world) to become STEM Ambassadors.

"The worldwide shortage of professional engineers, scientists and technicians is well recognised and needs to be addressed. All existing STEM professionals and their professional bodies should take some responsibility for the future and this in one way in which they could help."

BLOODHOUND in the US

Thanks to sponsors Swagelok Company and Swagelok Bristol, the BLOODHOUND Project gained its first certified Ambassadors in the UK earlier in 2017.

Swagelok's ambition to inspire students about STEM topics and engineering careers drove an effort to establish a BLOODHOUND Ambassador programme at the company. Fourteen Swagelok associates, including representatives from every corporate function, were nominated by company leaders to take part in official Ambassador training in January, along with 26 representatives of four different school districts in Ohio.

They reached out to teachers and administrators to assess how the district could integrate BLOODHOUND content into a STEM curriculum, while still incorporating State of Ohio teaching standards and requirements.

Hudson became the first school district in the US to formally add BLOODHOUND lessons to its curricula. Throughout the 2016 to 2017 school year, two teams of fourth-grade teachers integrated BLOODHOUND-themed lessons across a range of subjects, including: earth, physical and life sciences; physics; chemistry; language arts; social studies; and English. They also designed, built and raced BLOODHOUND model rocket cars – the first time this had happened anywhere in the US.

Become a BLOODHOUND Ambassador

If you've been inspired by your experience at Newquay and would like to get involved with the BLOODHOUND Project, becoming a BLOODHOUND Ambassador could be the ideal opportunity.

Our amazing team of volunteers, known as BLOODHOUND Ambassadors, play a vital role. They inform, advise and enthuse teachers, students and the general public about the BLOODHOUND Project, both in the UK and abroad:

•STEM Ambassadors engage with students and young people at schools and colleges, and can support us at public events as well.

•Event Ambassadors engage with the public at BLOODHOUND promotional events.

STEM Ambassadors

STEM Ambassadors work with teachers, youth leaders and pupils in schools and youth groups in their local area, on a variety of BLOODHOUND-related topics, such as:

•contributing to a school lesson
•supporting a national STEM activity
•visiting an afterschool STEM club
•taking part in a school 'off curriculum' day
•presenting during a school assembly
•supporting school visits to BLOODHOUND events
•running an activity for Scouts, Guides or similar youth groups.

STEM Ambassadors don't 'teach' lessons, but they do bring their own expertise to the classroom.

Event Ambassadors

Event Ambassadors are the 'public face' of the BLOODHOUND Project. They provide volunteer support at regional and national events, assisting our Events Team and talking to the public and invited guests about the aims and aspirations of the Project.

Could you be an Ambassador?

To be an Ambassador, it helps if you are confident and articulate, but the most important things are enthusiasm for the Project, a sense of fun and a willingness to engage with people of different ages, abilities and backgrounds.

Our Ambassadors have a wide variety of backgrounds – some have (or have had) STEM careers, but not all; a few have been involved in previous World Land Speed Record projects, but most haven't. If you can speak with passion about technical matters, then that helps, but we will give you the training you need so that you can explain the technology behind BLOODHOUND and the manufacturing and testing processes.

Corporate Ambassadors

Some of our sponsors and other large organisations have set up their own Ambassador Programmes that work alongside the BLOODHOUND Project, using our resources and contacts. This often supports their organisation's corporate and social responsibility aims.

Corporate Ambassadors promote both BLOODHOUND and the host company's activity within the Project, and usually work closely with schools and colleges locally, regionally or nationally.

If you would like to find out about becoming an Ambassador or about our corporate Ambassador programme, please visit the BLOODHOUND website or email ambassadors@bloodhoundssc.com

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The 1K Club is the official supporters' club for the BLOODHOUND Project. Support from members of the 1K Club is crucial to the success of the Project.

Thank you to the members of the 1K Club

From Ian Glover, BLOODHOUND Project 1K Club President

As President of the BLOODHOUND Project's 1K Club, I am extremely excited to welcome you to Newquay for the first chance to see BLOODHOUND SSC run!

1K Club members have played a vital role in the Project. Not only have you contributed money through membership and purchases of merchandise, providing a consistent and reliable source of income, you have contributed significantly to the belief that we will successfully run the Car. Your support has helped the Team through some really difficult periods and has demonstrated to the sponsors that the public really believe in what we are trying to achieve. Your support at events – sometimes helping, and also coming to say hello – has helped in ways that cannot easily be described. Your loyalty to, and belief in, the Project has always been uplifting to the whole Team.

I know that a lot of you are also educational Ambassadors, and this has helped to spread our message – and importantly you have shared your enthusiasm for the Project with a new generation. But we always need more, and would love to hear from you if you feel you can help.

As the Club's President, I am as pleased as all of you to see the Car run for the first time in Newquay and look forward to it arriving South Africa. Some of you were also members of the Mach Club supporting Richard and Andy in the building of Thrust SSC. I can vividly remember seeing the Car run for the first time on a cold day in Farnborough with my son and feeling that we were part of the Team and were helping to make history. I hope that we have managed to make this Project accessible in the same way and you feel that you are part of the extended history-making Project Team.

Thank you again for all your support. Without your help it would not have been possible to get this far or this fast….

If any of you or your family and friends are not members of the 1K Club, we would love you to join us. We will keep you up to date on the Project's progress and you will benefit from invitations to meet the Team at the Technical Centre and see them working on the Car, and a chance to win a trip to see a run of the Car abroad. We have three levels of membership – Bronze, Gold and Family Gold. You can find details of these on our website or speak to a member of our Team at the Newquay event to find out more. We look forward to you joining the 1K Club!

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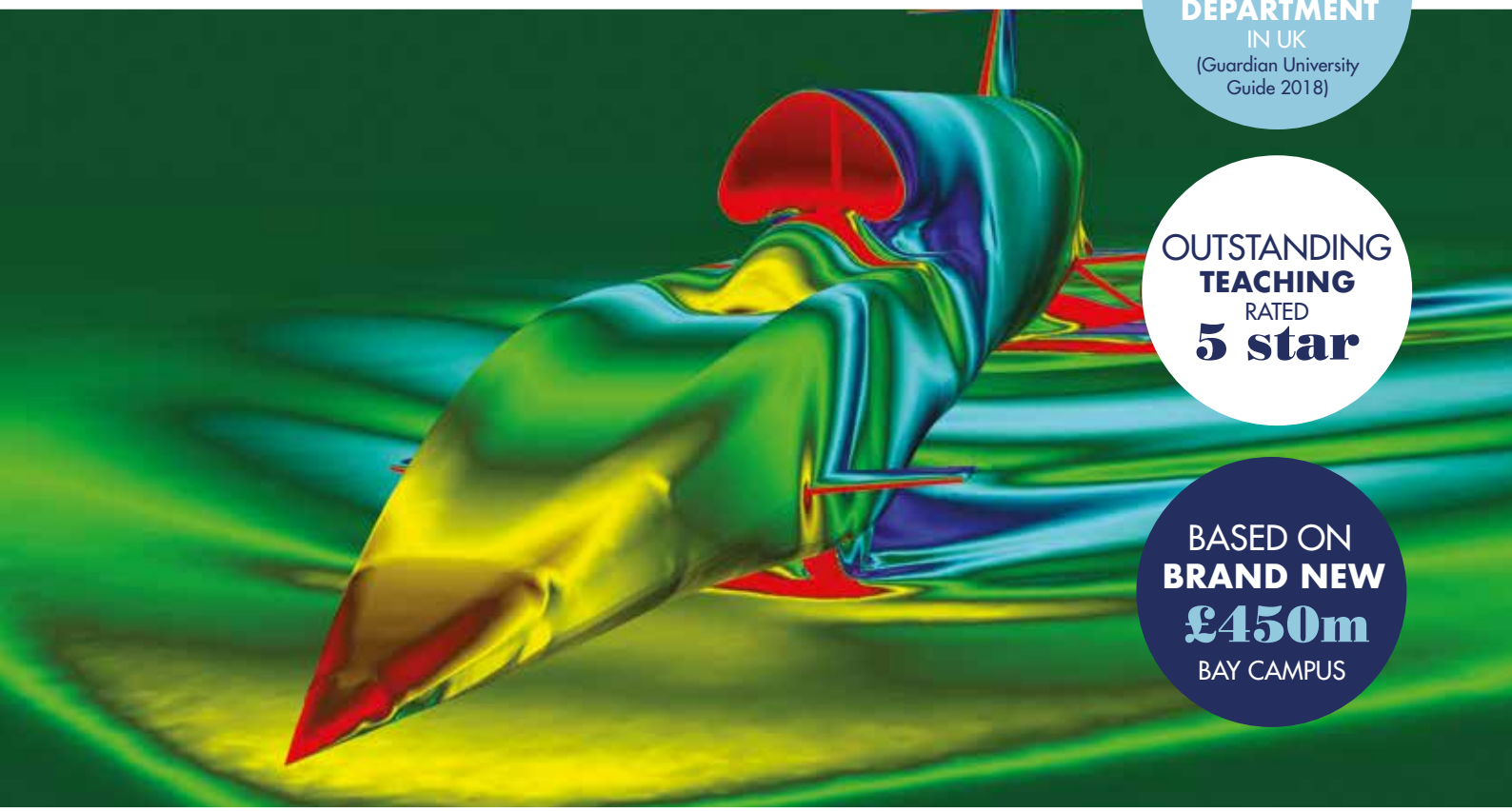

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Haulage on a big scale by Arthur Spriggs & Sons Ltd

As a family owned business formed in 1918, Arthur Spriggs & Sons has established itself as one of the leading haulage providers in the UK.

The ethos of the business is very much about investing in people and giving them the opportunity to be inspired about all aspects of business, especially allowing them to be creative and get excited about Technology and Engineering. This ethos aligns itself perfectly with the beliefs of the BLOODHOUND SSC project and it was this synergy that has seen the partnership flourish into our involvement today.

In 2009 Chris Spriggs, Director and Grandson of Arthur, was approached by Richard Noble to join the team by providing logistics support. After a brief meeting Arthur Spriggs made its first delivery of the then only Show Car to RAF Coningsby in Lincolnshire with the then old Mercedes Unit and Trailer combo.

Arthur Spriggs then continued for the next few years to provide logistics support with a dedicated logistics team lead by Chris Spriggs and ably assisted by Gary Wilton (better known as Minky) and John King (better known as Jock) who between them have taken the Show Cars to businesses, schools and universities the length and breadth of both the UK and Europe, inspiring young and old and showcasing everything that is truly unique and exciting about the BLOODHOUND SSC Project.

As the demand on BLOODHOUND grew, Arthur Spriggs continued to invest in new equipment and purchased 2 brand new bespoke Articulated Mercedes Benz Units and Trailers to ensure both reliability and image were maintained. As well as these the introduction of new Moffett Forklifts, thanks to the support of HIAB and John Bailey in particular for their sponsorship, ensured that the dedicated logistics team could offer an efficient and safe means of loading and unloading the Show cars at the many events across the Country and Europe.

The Education programme which underpins the Project and is the driving force behind the BLOODHOUND SSC by 2014 was gathering real momentum. Arthur Spriggs opened up its doors to BLOODHOUND and created a space that would become the HQ for the BLOODHOUND Events and Education Teams at its site in Tewkesbury, Gloucestershire.

This facility allowed the Ambassadors to plan and coordinate events alongside the logistics team which improved efficiencies and ensured the team were capable of delivering first class events at venues such as the NEC, EXCEL Arena and The Goodwood Festival of Speed.

It was during this time that Chris Spriggs and his team began to talk with Richard Noble and develop the concept for the new trailer that would be capable of moving the Rocket Car to Newquay in 2017 and then onwards to South Africa for its World Land Speed Record attempt to exceed 1,000mph.

So we have made it to 2017 …. 9 years on and the dream is nearly realised after thousands of kilometres covered and hundreds of events visited and many, many friends made up to the present day we arrive at Newquay Cornwall for the testing of BLOODHOUND SSC as the Official Logistics Sponsors for the Project.

Both personally and as a business our company is fully committed to the success of the Project and the Education programme that BLOODHOUND delivers. As a business we have seen first-hand the positive difference BLOODHOUND makes and this is just the next stage of the journey. To everyone that has made it to Newquay or helped get us to this point and share in the experience we thank-you for your support and dedication.

On behalf of my team and everyone at Arthur Spriggs & Sons we hope you have a day to remember and continue in your support of The Project to South Africa where together we will make history.

Chris Spriggs
Director

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For 60 years The Lee Company has pioneered the design and development of miniature precision fluid control components for aerospace, Formula One racing cars, downhole oil tools and industrial gas turbines.

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Visit BLOODHOUND

The BLOODHOUND Project is about so much more than building a World Land Speed Record car. We also want to inspire the next generation to explore science, technology, engineering and mathematics. And we want to share our iconic research and development programme with a global audience – including schools, youth groups, clubs and businesses.

If you've enjoyed your experience at Newquay in 2017, there are many other ways in which you can interact with the Project. We regularly take our show Car and interactive activities to events in the UK and abroad, but did you know you can visit the BLOODHOUND Technical Centre (BTC) at Avonmouth, near Bristol, where we are building the Car? Or we can come to visit you.

Here are some of the ways you can engage with BLOODHOUND and be inspired!

To find out more, please email visit.us@bloodhoundssc.com

School visits

The BLOODHOUND Team loves having schools come to visit the BLOODHOUND Technical Centre. But we know that's a bit far for some schools, so we can also arrange for our Ambassadors to visit you, tell the BLOODHOUND story and run hands-on activities.

Our educational activities and workshops are designed to have links to the National Curriculum, and provide a once-in-a-lifetime opportunity to inspire budding scientists and engineers.

If you want to visit us at the Technical Centre, we offer a variety of options, suitable for students from Key Stage 1 to degree level. We are also happy to welcome children's clubs, foreign language groups and home educating families. Our events are appropriate for all ability groups, including those with special and/or additional needs.

Packages available include full and half day visits on:

- Desert living
- Design and build an air-powered Rocket Car
- Design and build a foam block Rocket Car
- Balloon cars
- 3D printing
- Tour and explore the BLOODHOUND Technical Centre

Alternatively, we can come to your school and run one of our three inspiring packages:

- Air-Powered Rocket Cars – up to 90 children can build and race air-powered rocket cars using K'Nex.
- Model Rocket Car Workshop – up to 100 children can build and race model rocket cars at up to 55mph.
- VEX Robotics Workshop – up to 90 children can program a VEX IQ robot to complete a BLOODHOUND challenge in a hands-on introduction to engineering and coding.

For more information about any of our educational activities, please email education@bloodhoundssc.com

Visit the BLOODHOUND Technical Centre

We welcome special interest groups, clubs, businesses and organisations of all kinds to see us building the ultimate jet- and rocket-powered car at the BLOODHOUND Technical Centre. We also host team-building events at what is one of the most unusual venues in the UK!

We can cater for:
- Club visits
- Conference room hire
- Team building days, including making and racing rocket cars
- Children's parties (see 'Have a BLOODHOUND Party')
- School trips (see 'School visits')

Every event includes a guided tour of the workshop and you'll hear all about the BLOODHOUND Project and how the Car is progressing. Ask our Team your burning questions about the Car and take photographs to show off to friends and family. You may even get the chance to test your skills in the BLOODHOUND driving experience!

Have a BLOODHOUND party!

A party at the BLOODHOUND Technical Centre is sure to have all the kids talking afterwards! Give your child a party they will never forget right next to where the BLOODHOUND Team is building a supersonic car – how cool is that?

Our children's parties are suitable for girls and boys aged 4 to 16 years, and include:
- Dedicated party hosts.
- Presentation and activity – choose from a range of activities including K'Nex, balloon cars and rocket car workshops.
- Private party room
- E-invites which can be edited and sent out to your guests.

You can find more details about our children's parties on the BLOODHOUND website or email visit.us@bloodhoundssc.com

Book a BLOODHOUND speaker

We can help you to make your corporate, car club or institution event truly special by sending along a member of the BLOODHOUND Team to give a presentation and speak to your members/guests.

Choose your speaker from four key members of our team and your attendees will enjoy an unforgettable occasion:

•Richard Noble, BLOODHOUND Project Director and former holder of the World Land Speed Record – Richard specialises in developing high risk ventures, including Thrust 2 and Thrust SSC, and can share how he set about this unique achievement. His drive, determination and passion are guaranteed to inspire and enthuse any audience you put in front of him!

•Andy Green, Driver and current holder of the World Land Speed Record – Fighter pilot and Royal Air Force Wing Commander, Andy is the self-proclaimed fastest mathematician in the world. As the only person to have driven a car at supersonic speeds, the insights Andy shares in his presentation are truly unique! (You can find out more about Andy in the profile elsewhere in this programme.)

•Mark Chapman, Chief Design Engineer – Mark has been part of the BLOODHOUND project since its inception and before that he worked on many high profile aerospace projects. In 2015 he was invested in the Semta Engineering Hall of Fame. Mark's technical knowledge of the Car is second to none – what he doesn't know about BLOODHOUND isn't worth knowing. (You can read more about Mark in the profile elsewhere in this programme.)

•Tony Parraman, Head of Sponsor Liaison – Part of the team since it went public in 2008, Tony has worked in several areas of the Project, including Education, Events and now Sponsorship, which gives him a unique overview of the Project and its aims. As a former engineer and teacher, Tony knows all about the effect BLOODHOUND has on the companies and students that get involved.

If you'd like to know more about booking a speaker, please email: speaking@bloodhoundssc.com

Events

We take our show car and hands-on activities to events around the UK and abroad. These are just some of the events we've attended – sign up for our newsletter and keep an eye on our website for details of where to find us.

•Goodwood Festival of Speed
•Farnborough International Airshow
•New Scientist Live
•Royal International Air Tattoo
•Cosford Airshow
•Cheltenham Science Festival
•World Expo in Kazakhstan

We can also attend company corporate events and join with you as part of a company stand, as we have done at events such as the Caravan Show, MACH (manufacturing industry show) and FIREX International.

For more information about our events activities, please email events@bloodhoundssc.com

BLOODHOUND is a once-in-a-lifetime client for this UK event specialist

Not many exhibitors do over 150 events a year and can claim to be inspiring the next generation of engineers, but then, not everyone has a 1,000mph car to show off!

Producing and managing displays for that many events is a major challenge for BLOODHOUND'S Event Team and is only made possible by the support of their expert sponsors.

We interviewed Oliver Bell, Creative Director at Cambridgeshire-based exhibition specialists, Bell Stone Associates to find out how they got involved.

BH: When did you first become aware of BLOODHOUND?
OB: It was at the Gadget Show back in 2010. We were just finishing a slick techno stand for a big Corporate and I saw behind us a lone exhibitor setting out a trestle table with bunting and a rather well used pop-up. What caught my eye though was the 800Bhp race engine they had with the caption, 'This is our fuel pump'. I think I was hooked right there.

BH: Apart from naked race engines posing as fuel pumps, what still gets you going about the LSR project?
OB: Although I'm a designer rather than an engineer, I'm fascinated by the challenge of making things. And they don't come much more challenging than a 1,000mph car.

BH: How challenging would you say your involvement has been over the last seven years?
OB: It's quite an ask to put together an event kit that will survive the rigours of being rebuilt and reconfigured literally hundreds of times. "Oh and it needs to be simple enough to be installed by anybody", they said. That was just for starters!

BH: So, an adult's Lego kit in effect?
OB: Yes, but you need to imagine a Lego kit big enough to fill a pavilion at the Farnborough Air Show or Goodwood Festival of Speed.

BH: I know you also support the BH Events Team at the bigger shows; any that stand out in your memory?
OB: The first we did at Farnborough in Spring 2010 was memorable for the general stress levels it produced!

It was the roll out of the Show Car and I think we were still adding new elements to the pavilion layout the day build up began.

I would say though, when the actual car was presented to the world at Canary Wharf in September 2015 it was great to be part of the Team that helped it happen. It didn't hurt either that our stuff was seen by millions on the global media networks!

BH: Haven't Bell Stone had a few unusual requests too from BLOODHOUND?
OB: One of the best was to design and build several full scale modular Cars for their Education Roadshow. We decided to go one better and sliced it down the middle to reveal the inner workings. We also built in four large TV screens and four touchscreen information points. It then had to be packaged to fit into a trailer less than one-third the length of the real car. It took a lot of experimentation and creative thinking but the end result was a great success. So much so, the DIT ordered one for their Business is Great campaign and have since taken it all over the world.

BH: What does the future hold for Bell Stone and BLOODHOUND?
OB: Lots more challenges, a World Land Speed Record and lots of fun along the way I imagine.
www.bellstone.co.uk

Picturing BLOODHOUND

By Stefan Marjoram, BLOODHOUND Film-maker, Photographer and Artist

I used to have a lovely job as a Creative Director at the Aardman studios in Bristol (where they make Wallace and Gromit). I got paid to draw silly characters and discuss how they should move and what colour they should be. At weekends I'd satisfy my passion for drawing and photographing cars by visiting events at hill-climbs and circuits. Then Richard Noble and the BLOODHOUND team moved into the building next door, about to begin constructing the Car....

I offered my services as an artist and photographer, thinking I could do some lunchtime sketching and sell a few prints to raise money for the Project. "That would be lovely," said Richard, "But what we really need is a film-maker. Can you do that?" My mind raced...

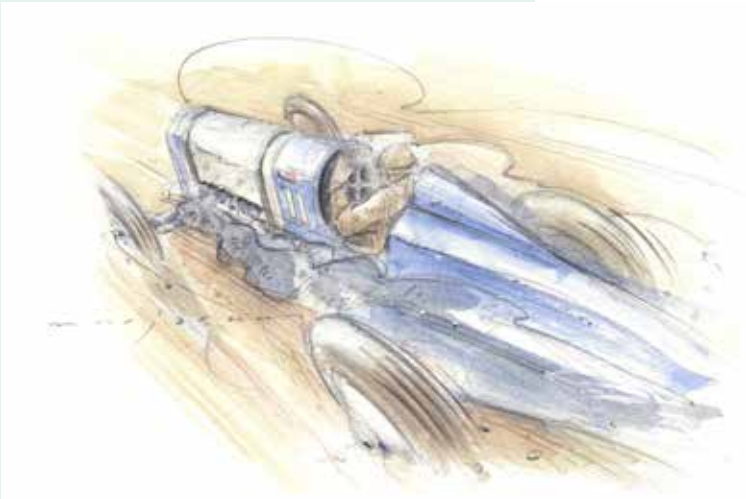
I really like cars. Cartoons are films – live action can't be much different. This opportunity will never come up again. It'll only be a year or two and then I can come back and draw funny characters again…

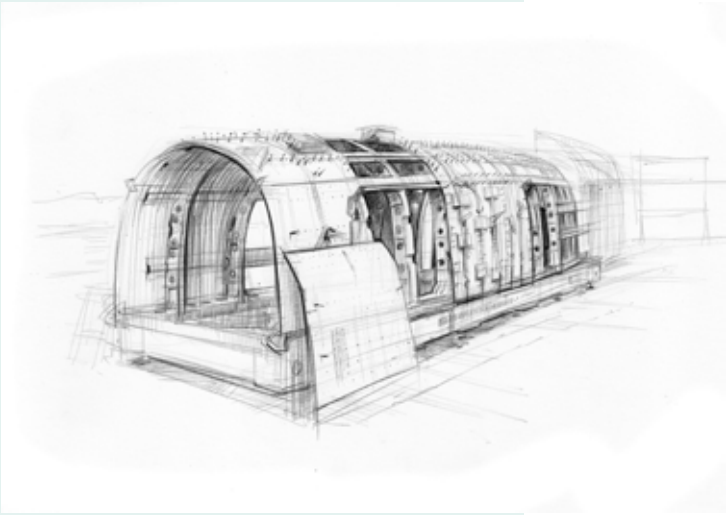
"Yes, I can do that!"

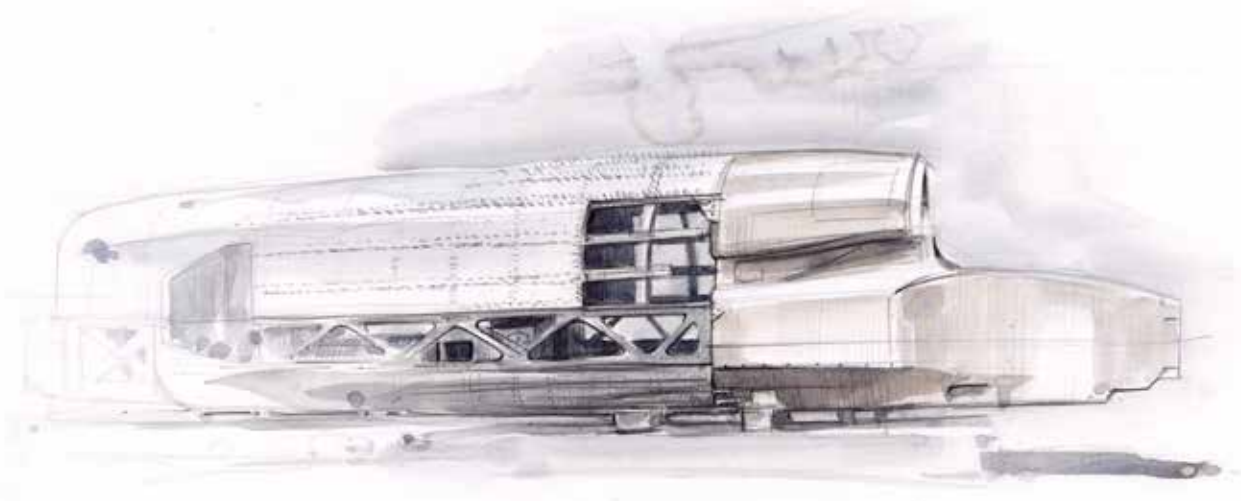
I've been involved in the Project for 7 years now – slightly longer than I had anticipated, but I wouldn't have missed it for the world. Witnessing a project like this first-hand is an amazing privilege. Obvious highlights are the milestones like seeing the first part being machined, the incredible wheels being forged in a 3,700 ton press and, perhaps most spectacular of all, seeing the Car reach full reheat in last week's tie-down test.

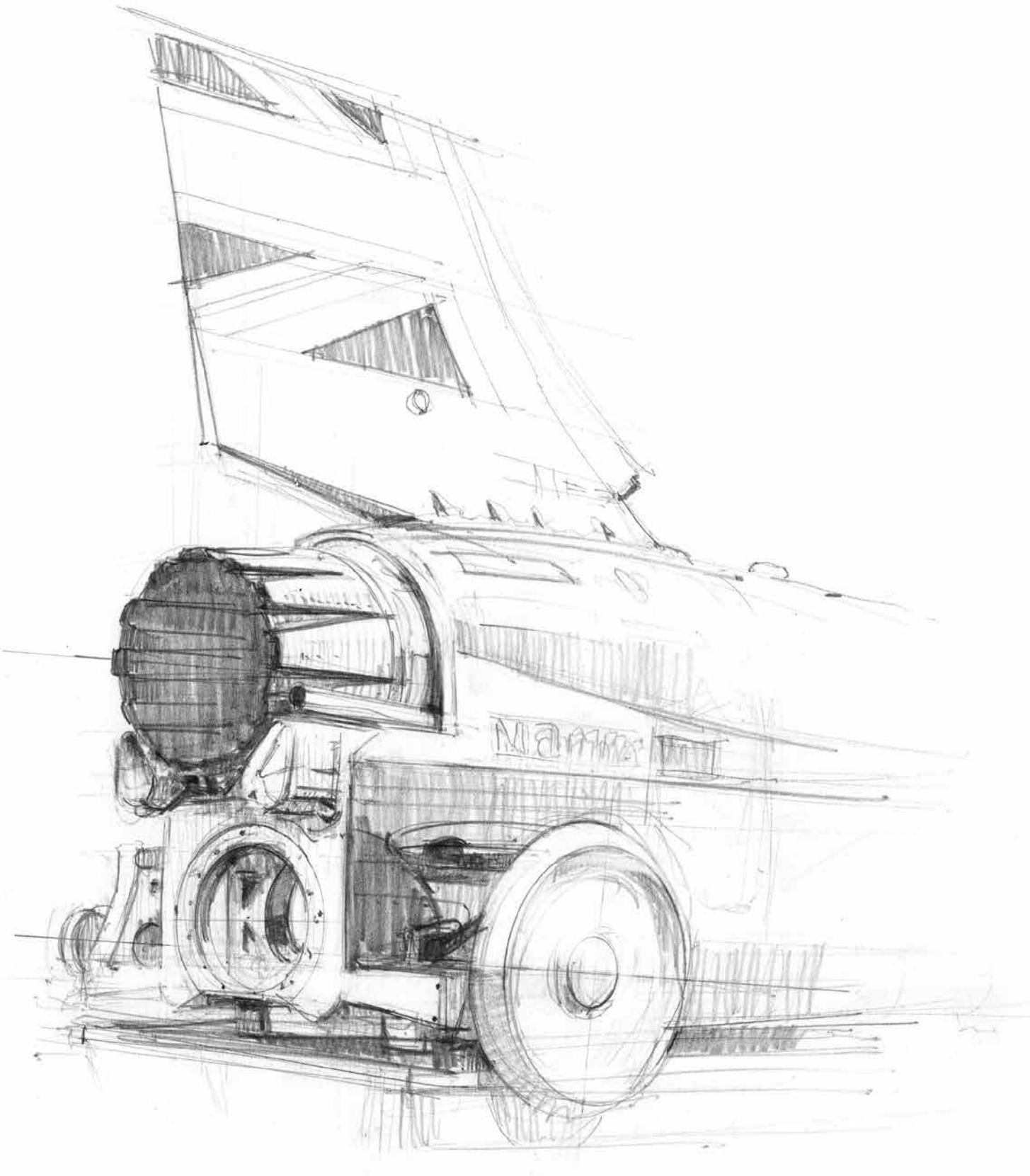
Alongside these I've seen the amazing work of the Education Team – I've rarely seen children as excited as when they've been given the chance to play with rocket cars and I'm sure these fun sessions will have been the starting point for many of tomorrow's engineers.

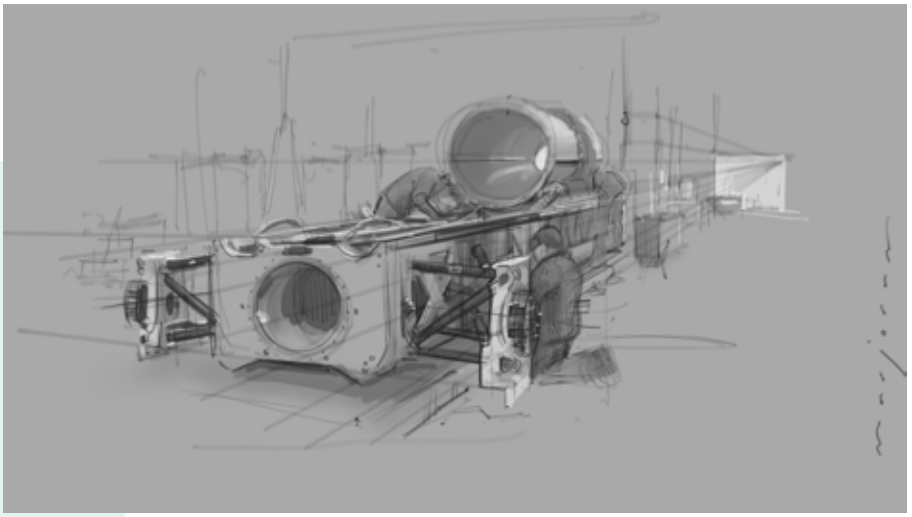
Perhaps most of all I've enjoyed being in the workshop, watching the highly skilled engineers put the Car together. They have a fascinating array of backgrounds, in motorsport, aerospace, even as a jet-pack designer! My role as film-maker allows me to ask lots of annoying questions and they've all been extremely patient in answering them, and enduring the embarrassment of being asked to appear on film.





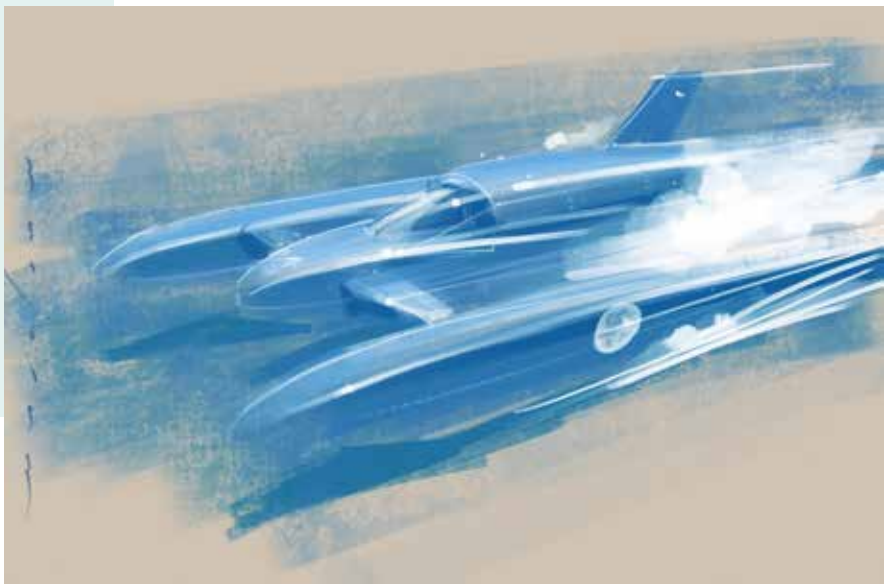


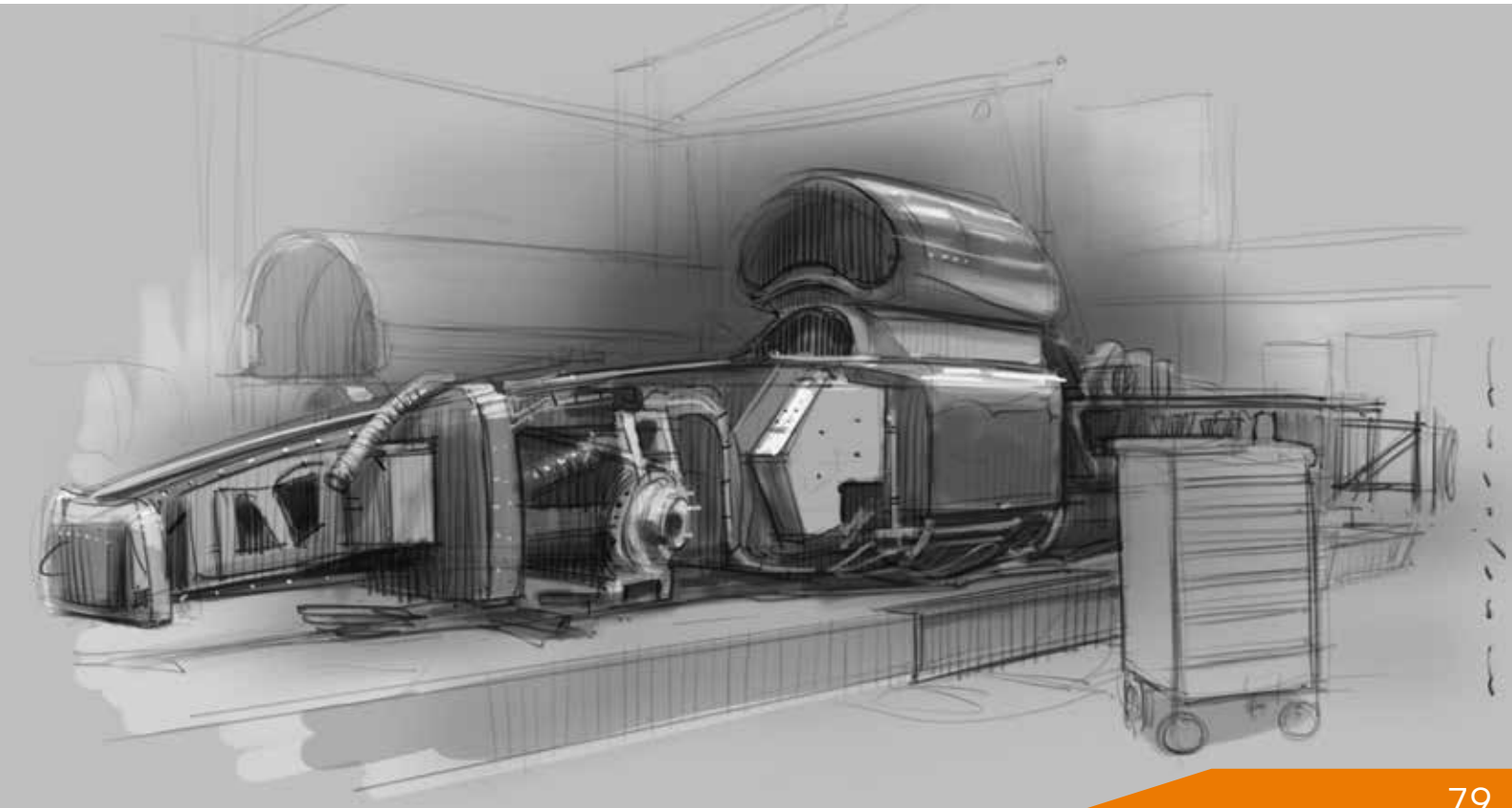




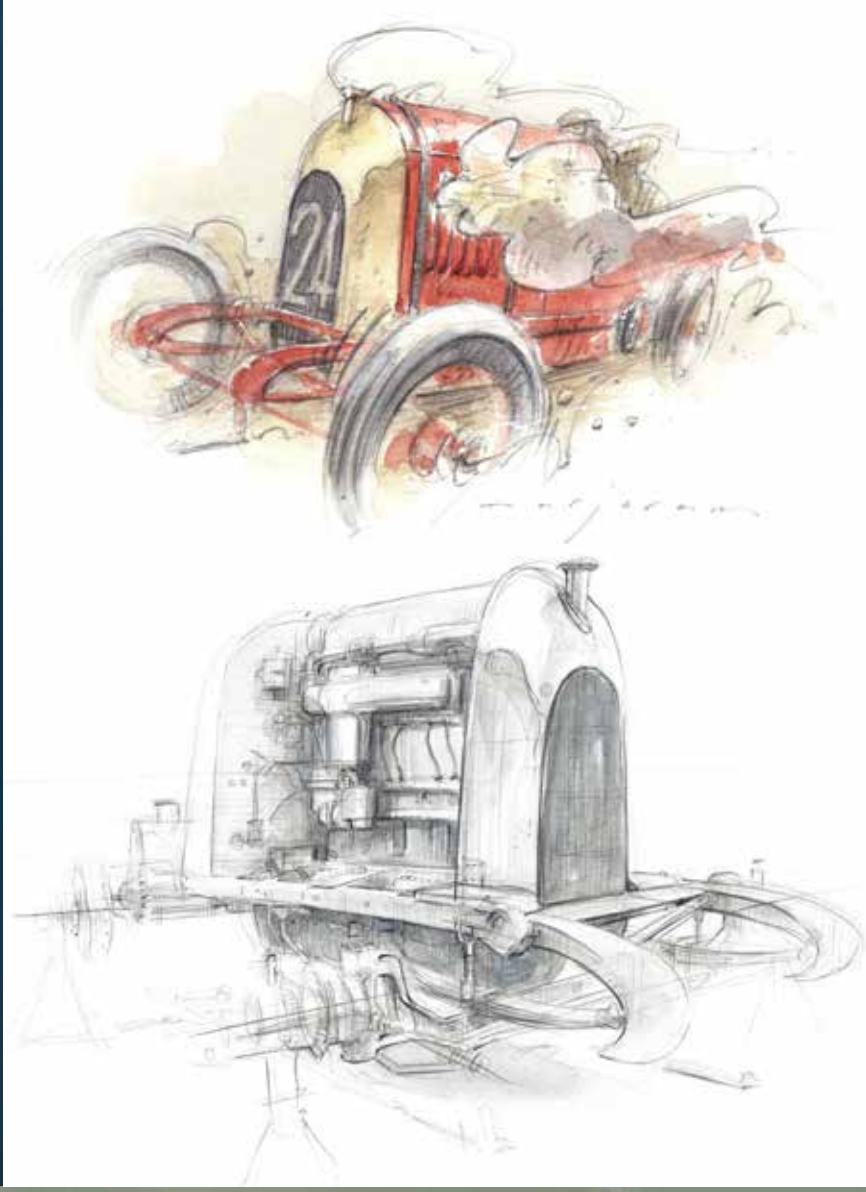
Writing, filming and editing the films (and shooting stills!) keeps me pretty busy, but I have managed to find the occasional quiet moment to sit and sketch in the workshop. Drawing something for an hour or so is very rewarding. You look at the object in minute detail and begin to understand how it is put together. Whenever I'm sketching, someone will invariably come and look over my shoulder and say how they used to love drawing. It's never too late to start again – and who knows where it might lead!

To view over 60 Cisco BHTV films look for BLOODHOUND SSC on YouTube. If you'd like to keep up to date with Stefan's motoring adventures you'll find him on Facebook and Instagram. His prints are available through his Etsy store at www.etsy.com/uk/shop/StefanMarjoram






STUTZ BLACK HAWK
FRANK LOCKHART 1926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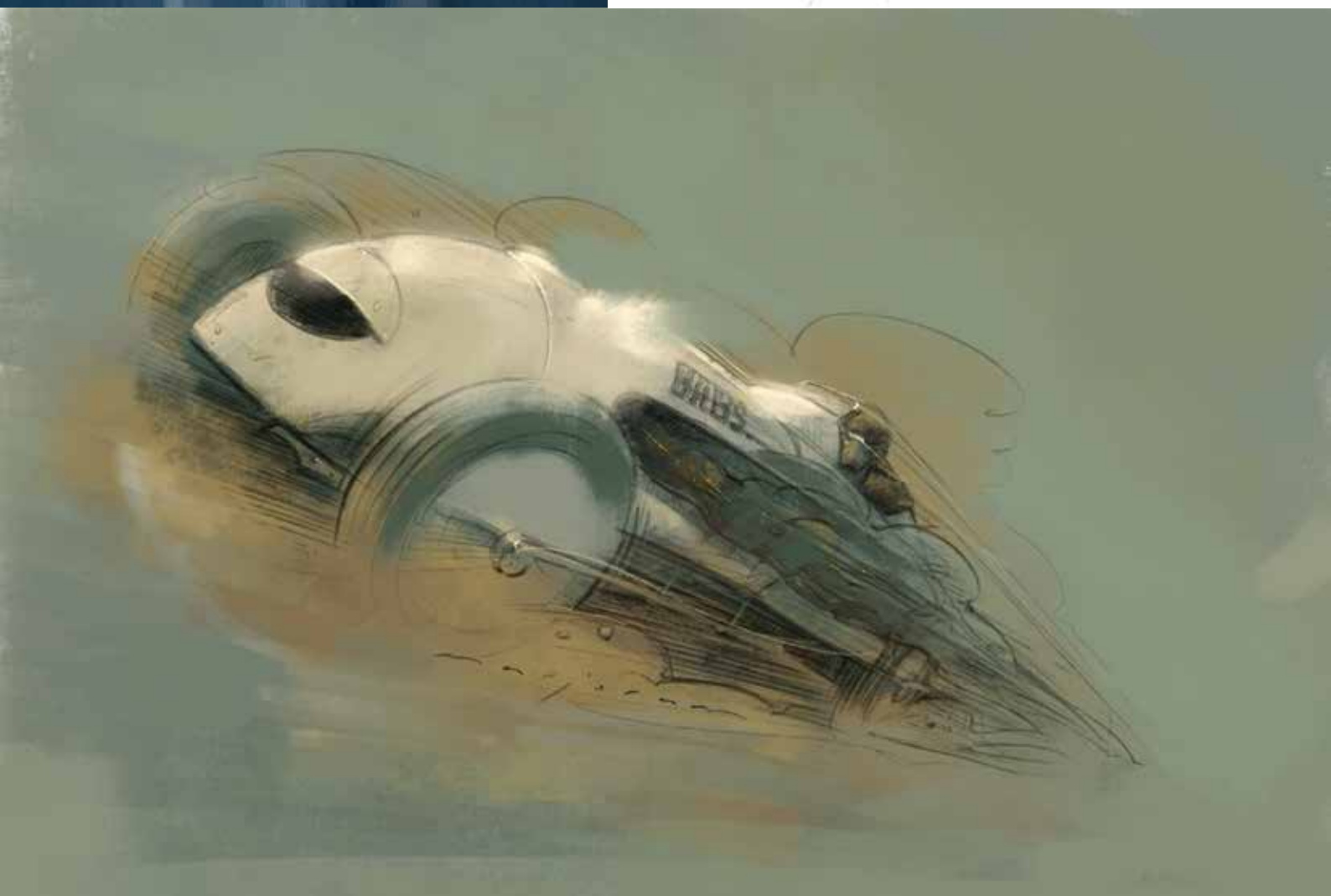

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