



Autosport Case Study 12/2011

Company: Bloodhound Project

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The targets for the advanced [Bloodhound SSC project](#) are a simple yet astonishing, to set a new land speed record and if possible to achieve an amazing 1000mph. To accomplish these incredible goals, the F.I.A procedures dictate that Bloodhound must complete two runs in opposite directions within one hour, with the average speed of the two runs regarded as the speed achieved. At 15 deg. Centigrade, typical of the temperatures experience while record breaking, the sonic velocity is 761.2 mph. If Bloodhound achieves its ambitious 1000mph target, the car will have exceeded speeds of 1.3 times the speed of sound.

Few, if any of the enduring world record attempts capture the public's imagination in the way that the motorsport land speed record does. Even to the most casual observer, the combination of the most up to date technology and the bravery of a driver, triumphing over the fundamental elements of distance and time, seems to embody humankind's indomitable spirit and relentless pursuit of progress.

The tradition began as a battle between different types of propulsion. First electricity and then steam struggled for supremacy, after that came the era of the internal combustion engine. This was superseded by its much more powerful aeronautical counterpart, that too, was consigned to the pages of history by today's turbojet and rocket engines. It was this advanced technology that propelled, Thrust SSC, driven by Andy Green, to a remarkable 763.035 mph on October 15th 1997, resulting in Green becoming the first man to exceed the speed of sound at ground level. Andy Green remains the only man to have traveled at supersonic speed in a land based vehicle.

In the continuing, inspiring spirit of the tradition, the ambitious new target for the Bloodhound SSC is an amazing 1,000 mph, this objective represents an increase on the current mark of 31%. To achieve this challenging goal, the project team have chosen a jet and hybrid rocket propulsion combination. The rocket will deliver the raw power required, without the drag that results from an air intake. Although, the disadvantage of the use of a rocket is that it is an on/off device. By using rocket power alone, the team would have great difficulty hitting and holding the selected Mach velocity that would allow the team's aerodynamicists to gain their important data. Also, at these extreme speeds, Mach numbers need to be raised in small, incremental steps. To accomplish the all important control over power, the impressive Eurojet EJ200 is used. Compared to its impressive power output, the advanced Typhoon engine is incredibly small and light, and by throttling the jet, full control over the output of the combination of rocket and jet is accomplished.

Located in the middle of the Bloodhound SSC is an 800 bhp, Formula 1 race engine which acts as an APU, delivering hydraulic power for starting the EJ200 and for pumping the High Test Peroxide (HTP) through to the Falcon rocket. As with all other aspects of the ambitious project, the numbers associated with this pumping system are extremely impressive, it is designed to move a ton of HTP through to the rocket catalyst in just 22 seconds, at a pressure of 1200 psi.

The shape of the Bloodhound SSC is completely different to any vehicle that has preceded it. The cross-sectional area is minimised to reduce drag, whilst it features a supersonic intake and a smart suspension system that will enable the car to run smoothly over rough salt surfaces. As the rocket is positioned above the EJ200, raising the centre of gravity, for stability the rear wheels are located on outriggered struts. Previously this configuration was seen as a huge aerodynamic disadvantage, although today, running computational fluid dynamics (CFD) with multi-million elements, the team are able to compute the drag of the wheels and struts at Mach 1.4 and optimise the shape to negate the affects of drag.

The radical, technical nature of the Bloodhound SSC project has been made possible by the undoubted expertise of the team's engineers, and the considerable assistance and cooperation of both UK academia and industry. The high-precision requirements of the venture means that an absolute engineering prerequisite is the ability to undertake extremely accurate measurements at each stage of development and manufacture.

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Having carefully considered the alternative technologies, an advanced [Axiom too Coordinate Measuring Machine from Aberlink Innovative Metrology](#), was chosen as the high-precision workhorse of the project. Bloodhound SSC Engineer, Conor La Grue explained. “Now in constant use, our Aberlink CMM has proven to be very easy to use. Following a short learning curve, each of our technicians are now able to undertake extremely complex measuring routines and achieve very accurate results extremely quickly. In addition to the machine’s impressive hardware, Aberlink’s software is proving to be both comprehensive in its scope and very easy to use, a common operation being inputting data and checking against models.”

“As the mechanical failure of any of the constituent parts of the Bloodhound SSC could have severe consequences, we carry out meticulous dimensional checks on all components, keeping painstaking records of all of our measured data. The Axiom too CMM is making a significant contribution to our precise measurement and data capture efforts, and to the overall progress of the Bloodhound SSC project.”

Available in [manual](#) and [CNC](#) variants, the cost effective Axiom too is the best selling CMM from the largest UK owned Coordinate Measuring Machine manufacturer – Aberlink Innovative Metrology. The company’s popular Axiom too CMM can truly be described as the complete Inspection Centre; high measuring accuracies are achieved through the use of the latest metrology techniques and advanced in-house manufacturing methods. The Axiom too boasts an all aluminium bridge resulting in a very low thermal mass, rendering the machine ideal for use either in controlled environments or within less than perfect shop-floor conditions. Thanks to the Axiom too’s use of advanced materials, the machine’s reduced inertia results in class leading speed of operation. For increased accuracy air bearings of optimised stiffness are employed on all axes, whilst a granite Y Beam allows preloading of bridge bearings in both directions. Borrowed from the Aerospace industry, the CMM’s sturdy component support consists of an advanced granite/aluminium honeycomb construction, this technology, provides natural damping and further improves the machine’s thermal properties. Despite the Axiom too’s generous measuring volume 640x600x500 or 640x900x500, the machine’s compact design occupies a relatively small footprint, with the controller and all peripherals housed within the Axiom too’s workbench.

Equally rewarding when used by the novice or an experienced CMM operator, the easy to use Axiom too utilises [Aberlink’s famous, intuitive 3D software](#), ensuring greater user productivity and profitability. A welcome bi-product of any Aberlink CMM inspection routine is that a simultaneous picture of the measured component is created on the computer screen. Dimensions between the measured features, mirroring those that appear on the component drawing, are then picked off as required. In essence this ‘smart’ software represents an intelligent measuring system that is able to automatically recognise and define the various features being measured. Aberlink 3D is the easiest to use CMM software currently available, and a complete novice is usually able to perform relatively involved measurement routines after just 5 minutes training.



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