

Demonstrator part: Air Brake Door Hinge

9 September 2014



End user

Bloodhound SSC (www.bloodhoundssc.com) is an extreme engineering project set on designing and building the world's fastest car ever. The goal is to smash the current land speed record of 763 mph and take it beyond the psychologically inspiring speed of 1000mph. The technical challenges demand the highest level of advanced engineering and mathematical analysis. There is a team of dedicated engineers whose aim is to inspire the next generation about science, technology, engineering and mathematics. Of the many challenges to be overcome the distribution of weight is a key factor for the vehicle's dynamic stability. Using LIGHT's Additively Manufactured parts, the project is planning to fulfil a role in helping the Bloodhound team achieve their goal. The parts chosen for LIGHT are the eight Hinges that critically open and hold the Air Brake Doors that are situated towards the rear of the Bloodhound vehicle. Stopping the car is arguably more difficult than accelerating the car in the first place. The doors are deployed at 800mph and are the only means of braking until the parachutes can be deployed at around 600mph.

Objective of the demonstrator part

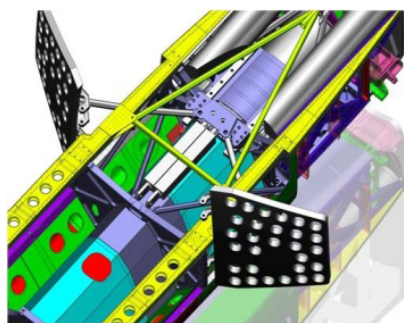
The Air Brake Door Hinges must be able to withstand 50kN of force transferred from the door itself. The Air Brake is critical to stopping the vehicle. During the 2 year programme many runs will take place therefore it must withstand cyclical loading.

Description of the demonstrator part

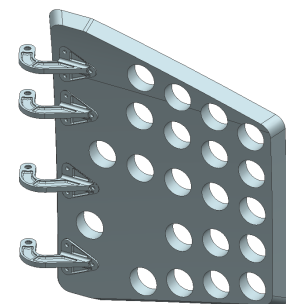
- The part shown is the Air Brake Door Hinge.
- Hinge overall dimensions: L 280mm H 120mm W 130mm (triangular flat plate).
- The pair of Air Brake Doors is held by 4 Hinges on each side.
- Stopping distance 5.5 miles or 8.8km.
- The Air Brakes must slow the vehicle from 800 to 200mph.
- Sub 200mph standard disc brakes aid the slow down.



Air Brake Door Hinge



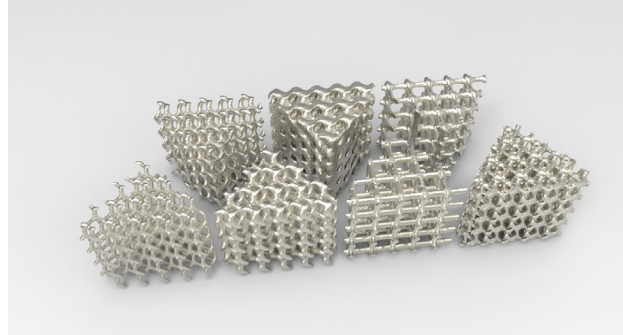
Air Brake Doors on Bloodhound SSC



Position Air Brake Door Hinges - 4 hinges

Description of the Research and Development approach to produce the final part

First of all Bloodhound is aiming to optimise the shape of the Hinge and replace some of the solid material by a lattice structure. This will reduce the weight of the component whilst still maintaining structural integrity. Each iteration of design changes must be stress checked and signed off as fit for purpose within the space envelope already defined by the mechanical design of the Air Brake Doors.



Different designs using different unit cells and volume fractions

Benefits for Bloodhound SSC

1. Reducing the mass of each hinge. Any mass saving is of course of great benefit when reaching for 1000mph.
2. As the air brakes are located towards the rear of the vehicle an additional benefit is moving the centre of gravity forward.

Project information

The LIGHT project (full title Inspiring New Design Freedoms and Light-Weight Solutions for Metal Additive Manufacturing) is funded by the UK's innovation agency, the Technology Strategy Board. Potential improvements in the economy and performance of Metal Additive Manufacture (MAM) components will be investigated by the use of specialised software. The LIGHT software tool, which will be developed throughout the project, allows the selective replacement of internal geometry by a lattice structure. Thus it is anticipated that the mass and material required to manufacture components will be reduced, whilst maintaining external geometry.

The LIGHT project is being undertaken by a consortium of seven organisations: Delcam Ltd, Bloodhound Programme Ltd, HiETA Technologies Ltd, CRDM/3DSystems Ltd, EOS Electro Optical Systems Ltd, Simpleware Ltd and Magna Parva Ltd. The project runs from the 1st of December 2013 until the 31st of May 2016.

The consortium selected three demonstrator parts:

- *Air Brake Door Hinge (end user Bloodhound SSC)*
- *Thrust Nozzle (end user HiETA Technologies Ltd)*
- *Thermal Protection System for Earth Re-Entry Capsule (end user Magna Parva Ltd)*

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