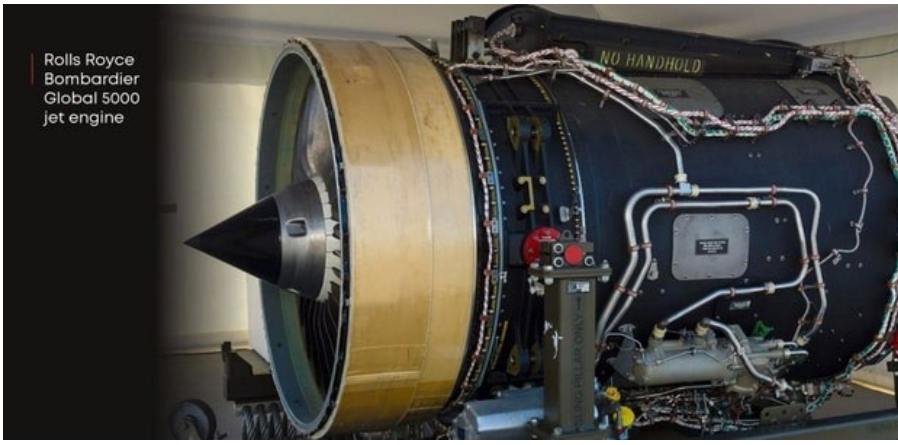
How Rolls Royce is embracing additive manufacturing in its aircraft engines



Rolls Royce describes itself as a technology company committed to providing clean, safe and competitive power solutions. One of its core drivers apart from electrification is digitalisation. This includes amongst many other things, additive manufacturing (AM). Rolls Royce has been a literal powerhouse in the aerospace industry with its jet engines – Airbus and Boeing both being long-standing Rolls Royce clients. It can be safely said that Rolls Royce is at the top of the list when it comes to jet engine design and manufacture. This blog post will describe how they are making use of additive manufacturing to push the horizons of what is possible.

Advantages of additive manufacturing for jet engines

Some key advantages of additive manufacturing in jet engine manufacturing settings are listed below.

- **Make lightweight aerospace components** – Aerospace parts are designed to save weight and reduce the flight to weight ratio. Incorporating topological optimisation further reduces the weight. Often these optimisations lead to very organic and complex shapes; shapes that are only possible to manufacture additively.
- **Faster production cycles** – When compared to mass-produced car parts, additive manufacturing is very slow. But for aerospace parts that often require multiple manufacturing processes which often include casting, AM is much faster.
- **Design of complex parts** – The aerospace industry is often on the forefront of technological progress, as such there are always new methods of optimisation being developed to gain a competitive advantage. More often than not these theoretically optimal designs are highly complex in geometry with hidden cavities and are not very practical to manufacture using traditional machines. Metal AM is ideal for these types of parts.

What technology does Rolls Royce use?

Rolls Royce makes use of additive layer manufacturing (ALM), specifically, Rolls Royce has used electron beam melting technology (EBM). This technology is different from selective laser sintering, or

selective laser melting, as it uses a focused electron beam to heat the powder past melting point and fuse subsequent layers to each other. It must be noted that EBM can only be used on a select list of materials like titanium alloys and cobalt chrome alloys. EBM produces very high-density parts – up to 99.9% – which are ideal for aerospace applications.

Rolls Royce additive manufacturing projects

Advance3 Demonstrator Engine

This demonstrator engine has a large proportion of its components manufactured with additive technologies. It is designed from the ground up to be energy efficient and environmentally friendly, and accomplishes this by improving fuel efficiency by 25% thus reducing its overall impact on the environment. This engine is not a production engine but rather a demonstrator for new techniques and technologies designed to be implemented in the UltraFan engine being developed by Rolls Royce.

Trent XWB Turbofan Jet Engine

According to Rolls Royce, this was the most powerful jet engine ever built. The model is not new but it was upgraded and modified with a range of new components and technologies; one of these new components was an advanced aerofoil within the engine's front bearing housing that was manufactured using ALM. This titanium aerofoil was one of the largest ever additive manufactured components incorporated into a jet engine and helped increase the engine's thrust output from 84000 lbs to 97000 lbs. This engine was tested on an Airbus A350 XWB and replaced one of the four typical engines used. Despite this part not being in a production model of the engine this is a very big step for additive manufacturing in general.

Directed energy deposition

This is an advanced form of additive manufacturing that allows damaged components to be repaired by building up any material that was lost when it was initially damaged. Rolls Royce uses this technology along with traditional subtractive manufacturing to repair a component and machine it back down to the required surface finish.

In conclusion

The aerospace industry has always been one of the most aggressive technology drivers and often adopts what many would consider bleeding edge technology. Additive manufacturing allows incredible design flexibility as engineers are not limited by current manufacturing technologies. With competition like General Electric, which also has an extensive additive manufacturing programme, Rolls Royce has to keep pushing the forefront of technology to out-innovate the competition and as it stands they are achieving this with flying colours.