

Additive Manufacturing

How additive manufacturing helped launch SpaceX



SpaceX is by far the most exciting company of the 21st century. No other company claims to have such lofty goals, like giving internet access to the entire planet or colonising Mars. SpaceX, however, has a track record of proving they can achieve the impossible... from being the first private company to launch an orbital rocket to being the first organisation in history to land a huge, first-stage rocket upright on a barge in the middle of the ocean. This article will focus on how SpaceX's additive manufacturing adoption is being used to push the boundaries of what's possible in manufacturing through cutting-edge technologies.

How does SpaceX use additive manufacturing?

SpaceX have been using Additive manufacturing increasingly in their production in order to optimise their processes and produce parts that aren't possible with conventional manufacturing methods.

SpaceX is a champion of vertical integration; this means that they bring in raw material at one end of the factory and a fully manufactured rocket comes out the other end. Additive manufacturing allows the implementation of this philosophy, for example a typical cast part

needs to be designed in CAD, a complex mould then needs to be manufactured, a test casting is done at the foundry and if necessary, any alterations to the mould must be made before manufacturing can commence in earnest. Additive manufacturing eliminates this entire process as the design and manufacture of a complex metal part can be done in the SpaceX factory without having to outsource to other suppliers. This reduces cost, safeguards intellectual property, allows for stricter quality control and reduces lead times.

SpaceX has been continuously evaluating the benefits of AM and perfecting the techniques required to develop and manufacture flight hardware. With innovation and efficiency at the core of SpaceX, it's no wonder they've been one of the first companies in the sector to embrace additive manufacturing as a major part of their production.

What technology does SpaceX use?

SpaceX makes use of direct metal laser sintering (DMLS). This type of AM works by laying down thin layers of metal powder in a heated chamber. A laser then traces out the 2D cross section of the part. The laser brings the temperature of the powder above its melting point and the metal melts. The next layer is then added on top and the process is repeated, thus sintering each layer to the previous one. SpaceX prints also run through cooling cycles.

SpaceX additive manufacturing projects

SuperDraco Engine Chamber

The SuperDraco rockets are designed primarily as an emergency launch escape rocket in the unlikely event the first stage of the rocket fails explosively. These rockets need to accelerate the crew capsule with an incredible thrust of 120,000 pounds in order to safely escape the blast. The engine chamber of the SuperDraco was Additive manufactured out of Inconel; a superalloy used in the aerospace industry for high-stress parts. This component was put through a variety of tests such as multiple starts, high temperature and extended firing durations to name a few. These tests proved that the engine chamber was ready for use on a Dragon 2 capsule rated for human flight.

Main Oxidiser Valve Body

This valve body was successfully tested in one of the 9 Merlin 1D engines used on SpaceX's Falcon 9 in 2014. The component managed to withstand cryogenic temperatures at excessive pressures and high vibration. This component was also manufactured within 2 days, a record time when compared to the typical 2-month cycle of traditional mould making and casting. After various tests and qualifications this part was allowed to replace cast parts on all Falcon 9 flights.

These critical components are just the first step in a future dominated by additive manufacture,

due to SpaceX's willingness to adopt new technology. As long as it benefits the ultimate goal there will be more and more AM parts in SpaceX's inventory. As the technology matures the number of applications will begin to expand and any technological developments made by companies like SpaceX will trickle down into other industries. With the AM torch being carried by SpaceX the future of the technology looks bright.