The Future of Aircraft Connectivity

The boom in aircraft connectivity is not only changing how we fly, but also how parts are designed and finished.

Today we are embarking upon an era of smaller, high bandwidth satellite communication capability that was inconceivable just a few short years ago. This enhanced connectivity means more than just in-flight movies, social media postings, and email capability while in flight. The economic potential for these innovations has attracted some of the industry's leading companies, including Honeywell with their Connected Aircraft offerings, SpaceX's Small Satellite Mega-Constellation, One Web's Non-Geostationary Satellite Orbit Network and Airborne Wireless Network's Low Earth Orbit Communications.

"The rise in connectivity and resulting increase in communication devices presents a unique set of challenges to a product finishing supplier"

High bandwidth satellites are enabling new capabilities, such as displaying real-time weather updates to allow airlines to make real-time routing decisions, collecting detailed information necessary to support reduced aircraft separations and the use of GPS based approaches that save time and money while ensuring safety. Additionally, these systems provide continuous tracking in oceanic airspace outside of radar coverage and allow airlines and operators to capture data about the health of avionics and other critical systems while in-flight to provide better maintenance scheduling and health trend monitoring of their aircraft fleets.

This new-found capability is revolutionising the passenger experience, improving fleet management, increasing flight safety, optimising flight operations and increasing asset utilisation through enhanced aircraft turnaround times and costs. However, to make this new-found capability function, the industry needs new satellites, new on-board aircraft systems, and new ground-based stations that are all connected in a single, high-bandwidth network. So, just how does all of that happen?

UNIQUE CHALLENGES

The Connected Aircraft revolution has resulted in a rapid increase in demand for product finishing services that enhance the surface characteristics of communication components and devices. To satisfy this requirement, Valence Surface Technologies (Valence) has leveraged its existing product finishing expertise to develop a range of plating, anodising and paint processes tailored to the specific requirements of the broader communication market.

The rise in connectivity and resulting increase in communication devices presents a unique set of challenges to a product finishing supplier:

Operating Environment – Communication devices are exposed to extreme working environments that can change throughout the life of the device. For example, an antennae housing that is installed on a commercial airliner to provide Wi-Fi connectivity is exposed to thermal cycling and fluctuating stresses. A satellite waveguide that allows a ground-based maintenance crew to monitor the operation of an engine in flight encounters high-frequency vibrations on launch, and is subsequently exposed to radiation and thermal cycling in the vacuum of space. Whatever the operating environment, surface characteristics of the part cannot be undermined, and in specific applications, the surface finish needs to perform for the life of the aircraft or a satellite.

Design Complexity – As more components on the aircraft become nodes of communication, designers must try to reduce the overall size of communication devices. This has increased part complexity, and dimensional tolerances have become more stringent. Surface finishes therefore need to both enhance the surface characteristics of the part and maintain very tight dimensional tolerances.

Part Specific Properties – The surface characteristics of a part or a sub-assembly directly influence the operating performance of an installed communication device. Many communication devices combine multiple sub-assemblies, all of which must be optimised for a specific application or working environment. For example, a Wi-Fi antenna will be comprised of internal components that rotate at a precise frequency and external components that act as an interface to the airframe of the aircraft. In this example, a range of surface properties is needed to ensure the antennae will operate as required. The internal components require specific electrical properties and enhanced wear resistance to prevent the rotating surfaces from failing, whereas the external components would require improved corrosion and impact resistance.

VALENCE INVESTS IN CONNECTIVITY

To overcome these challenges, Valence has worked closely with a range of customers to improve process consistency and further optimise the surface properties of various communication devices that are an integral part of the connected aircraft.

A key part manufacturer recently asked Valence if it could help to reduce the premature wear of Wi-Fi antennae components that rotate at a high frequency. In response, Valence developed new tooling techniques that improve the concentricity and flatness of parts during anodising. Combined with an automated anodisation process that increases the uniformity of anodised surfaces and wear resistance of the device, the enhanced surface characteristics of the parts extend the life of the antennae.

In another example, Valence was asked to develop a selective plating process to

2Ku WiFi Antenna

improve the operating performance of satellite waveguides. Plating is used to enhance the conductivity of the surface of the waveguide, and due to the complex geometry of the part, the current supplier was unable to control the plating process efficiently. Valence uses digital masking to create repeatable masking templates, and has developed part-specific electrodes to improve consistency in the plating process.

Due to significant business growth derived from its unique capabilities, Valence announced in April 2018 that it is investing in a 10,000-sq. foot facility expansion at its site in Garden Grove, California. The additional space will act as a centre of excellence for digital masking technologies and provide floor space to add state-of-the-art phosphoric anodising and bond primer capabilities, further enhancing Valence's complete solution offering for space, satellite and overall connected aircraft markets.

The phosphoric anodising and bond primer processes are used extensively in satellite applications to improve the emissivity characteristics of RF components. They also enhance the bonding and corrosion characteristics of metal-composite interfaces, which are common in commercial and military aerospace applications. The line will be installed and fully operational in Q3 2018, providing a full-service solution for Valence's international aerospace, satellite, and defence customers, confirming Valence's vital role in the connected aircraft industry.

ABOUT VALENCE

Valence Surface Technologies is the world's largest independent provider of Aerospace product finishing services. With 11 locations, 700,000+ sq. feet of manufacturing space, and over 2,500 unique industry approvals, Valence processes more than 16 million parts per year. In addition to being Nadcap and AS9100 accredited, all Valence sites provide specialised metal processing and finishing services to a diversified set of fast-growing commercial aerospace, defence, and space/satellite markets.