

GE Aviation



# Aerostructures Facility Overview

This document provides information on the capabilities and facilities at the GE Aviation aerostructures business at Hamble, in the UK, including its history and experience in the design and manufacture of civil and military structures and assemblies on various aerospace platforms





# Aerostructures Vision Statement

The trusted and competitive global aerostructures partner of choice, offering high-value solutions for design, development and production requirements of the aviation industry, today and tomorrow

## Introduction

GE Aviation, an operating unit of General Electric Company, is a leading producer of jet engines and integrated systems for civil and military aircraft, and aero- derivative engines for marine applications.

Technological excellence, supported by continuing substantial investments in research and development, has been the foundation of growth and helps to ensure quality products for customers.

GE's Aviation business recorded revenues of \$20 billion in 2012.

Headquartered in Cincinnati, Ohio (USA), the Aviation business employs more than 40,000 people and operates manufacturing, overhaul and repair facilities worldwide.



## The Hamble Facility

GE Aviation's aerostructures business, headquartered in Hamble, U.K., is a leading supplier of major aircraft structures in hi-tech composites, metallic and acrylics.

Its specialties include design and manufacture of wing leading and trailing edge assemblies, flight control surfaces, fairings, nacelles, in-flight refueling systems, and role equipment. This business also supplies integrated canopy and windscreen systems, and undertakes repairs and upgrades of both civil and military aircraft structures.

The following provides a review of programs that represent the design, development and production capabilities of GE Aviation's aerostructures business.



# Aerostructures

## Design and manufacture of major structures and precision components.

### Fixed and Moveable Wing Structures

GE manufactures the Mid Fixed Trailing Edge Details on the A380. With design responsibility, Hamble made the necessary investments to prepare and support its production on the basis of a long-term contract. The production activity involves machined metallic elements, with some assembly. Each shipset is composed of approximately 400 deliverable items. In production since 2003, more than 150 shipsets have been built.

GE are also risk sharing partners to Airbus on the A350XWB, designing and manufacturing the Wing Fixed Trailing Edge components. This involves 3,000 deliverable components that include structural composite panels and complex machined metallic assemblies, (ribs, brackets, spreader plates, support structure, jacking points), upper and lower panels, gear beam fittings and panel support structure.

This is the largest production contract awarded in GE Aviation, Hamble's 77-year history, In addition to increasing the scope of GE Aviation, Hamble's own technical capabilities in developing new tool sets, materials and technologies, the company involved a global design team that included GE Aviation Engineering resources in Poland and India.

The A350 XWB complex five-axis metallic details are manufactured at Hamble and also sourced from key contributing manufacturing houses located in U.S., Canada and the U.K, using GE's global sub-tier supply chain.

In addition to the above Hamble has supplied Wing Leading Edge kits for A300\A310, Trailing Edge structures for A340-500\600 and the Wing Fixed Leading Edge structural ribs and associated sub-structures for the Boeing 737. It also manufactures the Trailing Edge Details for the A400M and Flap Hinge Fairings and Wing Trailing Edge Panels on the C-17.

Other Aerostructures products include Leading Edge Strakelets and Gap Covers for the 787 Jetliner, and Fillet Fairings and Seal Plates for the A320.

The 787 components are produced with a mix of composite and metallic elements. Hamble provided design assist to Spirit AeroSystems for component design.

The A320 products involve high rate production composite components for the A320 Family of single-aisle aircraft. The seal plates are of a monolithic carbon configuration, while the fillet fairing is of a Kevlar panel design.



A350 Composite Panel and Rib

Initially built in Hamble to validate the production process, the manufacturing of both components was transferred to GE Aviation's facility in Suzhou, China. This demonstrates Hamble's ability to place production work in low-cost zones of the world in meeting its customers' requirements. The Suzhou facility has confirmed its capabilities, with a track record of timely deliveries and excellent quality for both the fillet fairings and seal plates.

### Canopies, Windscreens, Pylons, Refuelling Probes and Fuel Tanks

GE provides an integrated fully framed cockpit windscreen and canopy systems for the Hawk and T-45 Goshawk trainer aircraft. These products are manufactured using stretched and cast acrylic materials for transparency with the canopy frame being principally of metallic construction. Final assembly and integration – including fitting of the miniature detonating cord for crew escape, along with production acceptance testing – is carried out at the GE, Hamble facility. In sustained production, more than 1,000 aircraft sets have been produced for the Hawk-family aircraft.

Unique technologies are employed in the processing and manufacture of the complete canopy system which includes the transparencies, structure, and subsystems integration and test. GE Aviation, Hamble also supports overhaul and maintenance of the complete Hawk/Goshawk canopy system for all fleets around the world.

In addition to the Tornado and Eurofighter Typhoon Refuelling Probes Hamble also deliver to Airbus, the A400M In-flight Refuelling Probe. Initial rate production is underway following the A400M's successful qualification and Hamble is responsible for the refuelling probe's design, manufacture and qualification – which includes full scale static, vibration and lightning strike testing. In addition to the metallic probe, the company also manufactures the surrounding carbon composite fairings of both monolithic and sandwich construction.



GE has considerable experience in the manufacture of fuel tanks. Programmes include Harrier Fuel Tanks and Hawk Centreline Fuel Tanks and the Global Express XRS Fuel Tank.

Qualified for supersonic flight, the Eurofighter 1,000-liter capacity fuel tank and its integrated pylon has three separate compartments, containing gauge probes, proportioner, and fully-immersed electric pumps and more than 1,000 tanks have so far been produced.

GE Aviation, Hamble is responsible for the Typhoon fuel tank's design, full-scale qualification and manufacture. The tanks are primarily of metallic construction, with composite fairings, and are designed to be accommodated on three Typhoon stores stations (two on the wing, and one on centre fuselage). The services provided by GE Aviation, Hamble include OEM, along with test, repair and overhaul.

GE has manufactured Pylons for many years and currently supplies Boeing with Wing and Fuselage Pylons for its P-8 Maritime Patrol Aircraft. Hamble has managed this design-to-specification package which also included both static and vibration full-scale testing. The pylons are of all-metallic construction, with five-axis machined components. GE Aviation, Hamble also integrates the initial-fit wiring harnesses and pneumatic pipes. The pylons subsequently are fitted out with LRUs (Line Replaceable Units) by Boeing, with the weapons station control units are produced by GE Aviation at its Grand Rapids, Michigan operation.





Dash 8 Engine Nacelle



Airbus machined items

### Nacelles

GE Aviation, Hamble builds the complete engine nacelle assembly for the Dash 8 Q400 regional jetliner, which is a hybrid of metallic and composite items. It is produced and fully equipped at the Hamble facility, involving some 40,000 line items, and delivered to Bombardier as a complete unit.

The company also oversees an extensive supply chain for the various components produced and supplied by other companies. GE Aviation, Hamble also assembles and integrates the engine mount unit in the nacelle, which is supplied by Bombardier.



Centreline Fuel Tank



Canopy Assembly



# Manufacturing Facilities

The following gives a brief overview of the main facilities at GE Aviation, Hamble. Further details on any specific aspects of the site's facilities can be provided on request, or arrangements can be made for a site visit\tour which fully demonstrates all of GE Aviation's capabilities.

## Tooling

GE Aviation has considerable experience in the design of all forms of tooling, ranging from large aerostructure assembly jigs, through to sheet metal press tools. Whilst the majority of tool manufacture is now sub-contracted, the design function is retained in-house and supported with turning, milling, cylindrical and grinding equipment.

In addition, there is a temperature controlled jig boring section and cutter and form grinding facilities, using state of the art CNC equipment, supported by an extensive Standards Room.

## Sub-assembly and Main Assembly Areas

The main assembly has a working floor area in excess of 4500sqm. This area has a working height of 12 metres and has overhead crane facilities with up to 5-ton lifting capacity. As is typical throughout all the sub-assembly and assembly areas, compressed air and electrical services are extensively provided. In addition, two mezzanine floors extend the whole assembly capacity by a further 2500sqm.

## Press and Fabrication

The sheet metal and detail shops offer extensive capabilities in the production of light alloy, stainless steel and titanium components. Capabilities include the precision manufacture of press blanks in aluminium alloys, titanium and steel using Pullmax and Trumpf punch routing facilities. The area also houses ASEA fluid forming, stretch forming and extrusion capabilities.

## Machining

Significant investment in capital equipment over the years has enhanced the machining capability, which includes a number of 4 and 5 axis high speed machining centres, various 5-axis vertical machining centres, router/skin profilers, and CNC machining Centres.

There are pallet loading facilities to all key machining centres, as well as DNC links via CATIA and CADD5, with Valysis Verification for configuration and feedback. There are co-ordinate measuring machines and SPC (statistical process control) stations throughout the facility.

## Transparencies

GE Aviation's transparency business is a premier manufacturer and supplier of military aircraft canopies and windscreens, and has the capability to design, manufacture and deliver complete canopy assemblies in frame, encompassing full release actuation mechanisms. It also provides a full repair and overhaul facility for its manufactured items, supported by both design and R&D for future product development.



One of the Makino Machining Cells



## Composites

GE Aviation's composites department has a long tradition in composite manufacture and has continued to enlarge the size and scope of its facilities to meet the diverse needs of the aerospace, and automotive, industries.

The main aerospace facility is equipped to handle large components and structures in carbon, glass and aramid fibre, both a monolithic and honeycomb sandwich assemblies, produced by both vacuum oven curing and autoclave techniques.

It has produced composite assemblies for a wide range of civil and military programs, structures include various nacelles, flap track fairings, fin fairings and wing leading edges. In addition to components made in 125°C and 175°C cure epoxy, the department has, for many years, manufactured components using Bismaleimide (BMI) resins for very high temperature applications, in particular the design and manufacture of large Flap Hinge Fairings for the Boeing C-17 Globemaster III aircraft.

The company has also developed a particular expertise in the manufacture of structural composite panels using pre-preg processed 'out-of-autoclave'.

The technology was originally exploited for the manufacture of high performance automotive structures but is now being applied to the latest aircraft programmes. Monolithic and honeycomb core panels can now be fabricated & cured by a simpler vacuum bag / oven process with performance comparable to conventional autoclaved cured components.

The composite department is housed in a modern well equipped facility and includes CNC cutting of pre-preg kits, large temperature and humidity controlled clean-rooms, vacuum curing ovens, five autoclaves (largest 3.65m diameter x 9.14m length), 5-axis CNC machines, co-ordinate measuring machines, Non-destructive Testing facilities and a paint shop.



Composite Wing Panel

## Composites Expansion

**GE Aviation is creating a 9,000-square-meter composites production facility at Hamble as part of a \$50 million-plus investment at the site over five years to support the production of composite wing components.**

The new composites facility is based on a sustainable building concept that includes a 2,000-square-meter clean room, two autoclaves, four large curing ovens for out-of-autoclave composites production, five-axis machine tools, non-destructive testing facilities, along with offices for administrative and engineering personnel

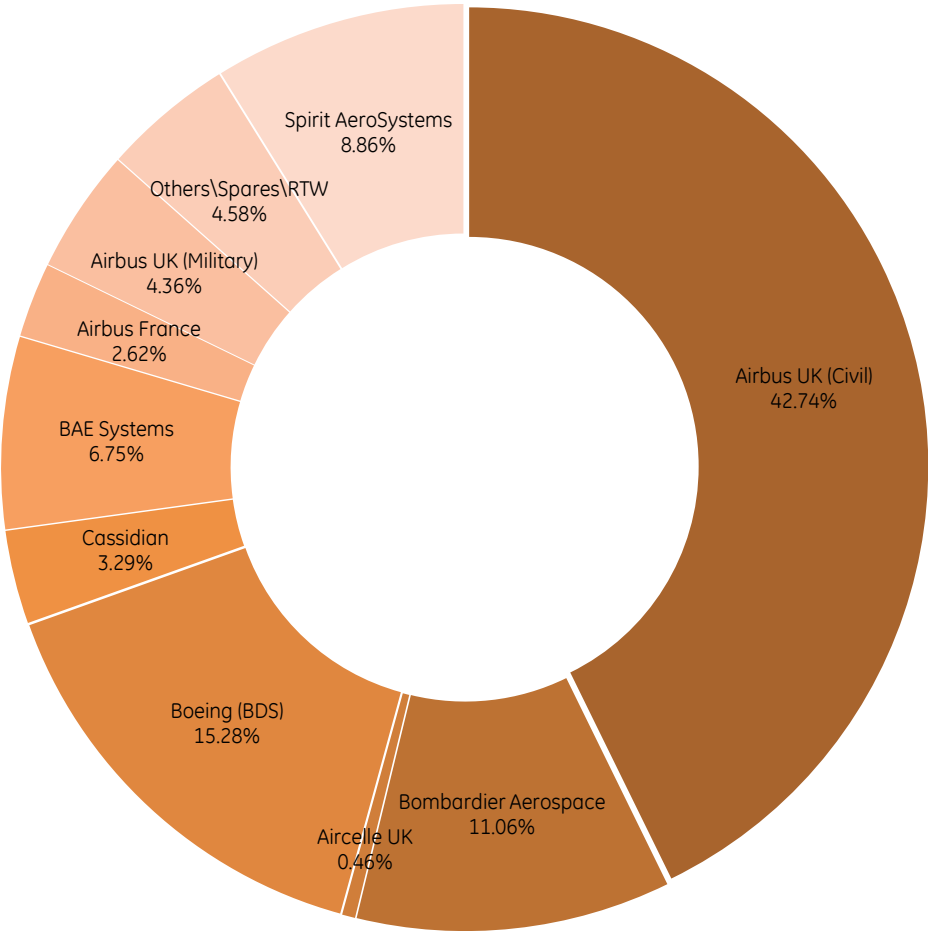


Illustration of new Composite facility



# Sales Distribution

Customers and percentage sales forecast for 2014



# Quality

Quality is one of the basic operating principles of our company, driving us to provide products to our Customers that meet or exceed their requirements for performance, delivery and value

Each of us is directly responsible for knowing our Customers’ requirements, both internal and external. We will, individually and collectively, demonstrate compliance to those requirements by continually striving to improve our processes, reduce waste and provide our Customers with reliable, defect free products.

It is GE Aviation’s Quality policy is to:

- provide customers with world-class products and services and obtain customer satisfaction through the application of appropriate quality discipline and tools;
- maintain quality as a fundamental value in our business;
- establish an environment that focuses leaders and employees on quality improvement of processes, products, and services, and
- commit to comply with requirements and continually improve the effectiveness of the quality management system.





[www.geaviation.com](http://www.geaviation.com)

## A little bit of Hamble's History.....

The Hamble Site celebrated 75 years of aircraft manufacture during 2011.

In 1936 British Marine built the factory to manufacture flying boats, and over the years Hamble has been involved with the vast majority of major aircraft programs.

Hamble is proud of its heritage and the long association with the aerospace industry on the South Coast and its worldwide customers.....  
**a site to be proud of for its past, its present and its willingness to shape itself to the opportunities of the future.**



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Imagination at work