

Production Technology of Large-Scale Composite Wings for Commercial Aircraft



787 Division, Commercial Aviation & Transportation Systems

A composite wing structure was selected for the Boeing 787, and this was a first for a commercial aircraft. MHI developed production technology for large-scale composite wings. This article describes an outline of the technical problems and their solutions.

1. Outline of the composite wing

Figure 1 shows an outline of the 787 composite wing box structures. It consists of a span 30m x chord 6m box assembly, and its main structures are made of CFRP. The inside of the wing box is utilized as a fuel tank. **Figure 2** shows a scale comparison of composite wings. The 787 wing box is much larger than the F-2 fighter wing box and the Boeing 777 vertical fin.

The technical difficulties of 787 composite wings are as follows:

- (a) Much larger than existing composite components
- (b) Big punch loads due to engine and landing gear
- (c) Sharpened outer mold line for superior aerodynamic performance
- (d) Fuel leak tight requirement because of the use of the inside of the wing as a fuel tank

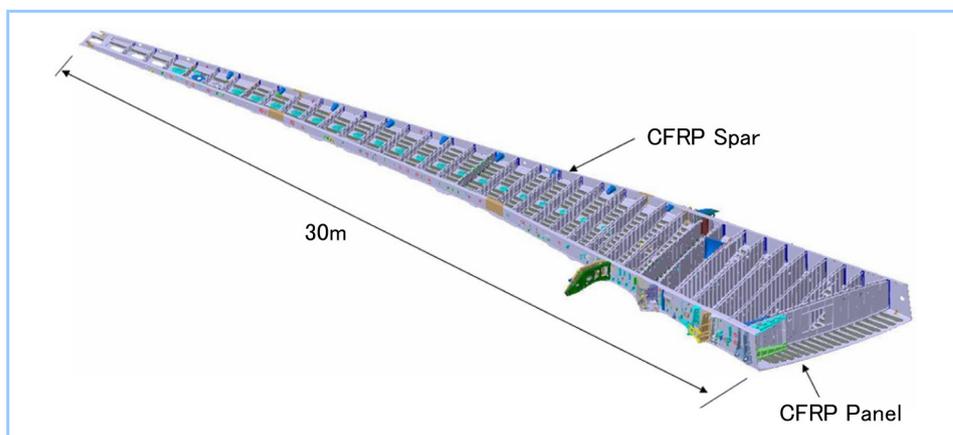


Figure 1 Outline of 787 composite wing box structures

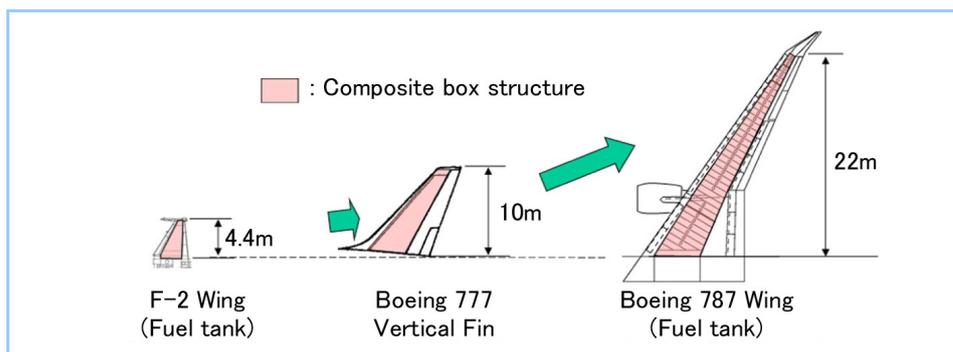


Figure 2 Scale comparisons of composite wings

2. Composite panel fabrication process

- (1) Prepregs (laminated sheets of epoxy or other kinds of resin strengthened with carbon or other fibers) are laid down on the cure table with wing panel geometry using CTLM (Contour Tape Laying Machine) (Figure 3).
- (2) The laid-down prepregs go into the autoclave with the table to cure the resin at the specified pressure and heat (Figure 4).
- (3) After curing in the autoclave, the periphery is trimmed with the parts geometry. The panel is completed after the final inspection.

The key point of the fabrication process is to reduce traditional manual processes and to make them automatic, due to the large scale of the products.

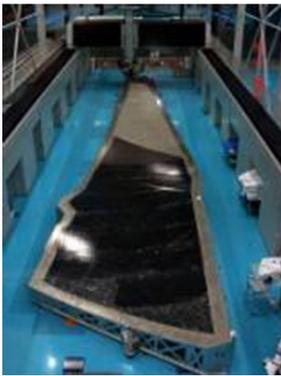


Figure 3 CTLM



Figure 4 Massive autoclave

3. Composite wing assembly process

Figure 5 shows the assembly process of 787 wings.

- (a) First, the spars and ribs are settled for framing.
- (b) After framing, the upper and lower skin panels are installed to complete the structure.

The main tasks in the assembly process are the huge quantities of drilling and fastening. It is necessary to improve productivity in the future. Next, tubing, wiring and equipping are completed on the wing box at MHI, and the wing is then connected to the fuselage, and the control surfaces and the wingtip are installed by the Boeing Company.

Furthermore, as the wing is used as a fuel tank, proper conductivity and insulation are provided to ensure lightning protection to prevent ignition.

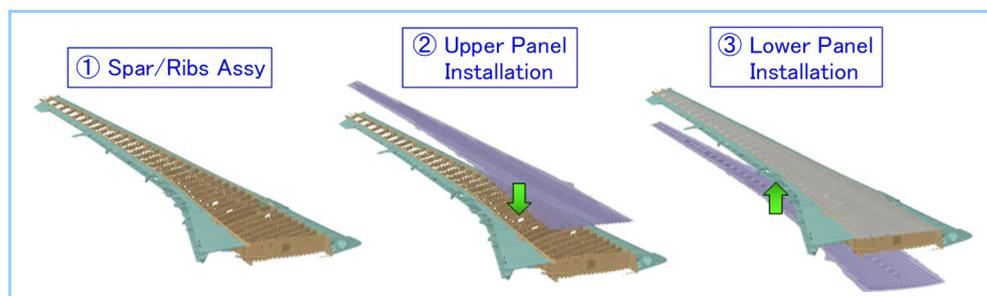


Figure 5 787 wing box assembly process

787 composite wings are now in production. MHI needs to improve the production efficiency for sustainable production.