

DEVELOPMENT OF THE GULFSTREAM G650 INDUCTION WELDED THERMOPLASTIC ELEVATORS AND RUDDER

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ABSTRACT

After a thermoset graphite/epoxy rudder developed by Lockheed-Georgia (1984, Gulfstream III /IV) and a second generation hybrid thermoset/thermoplastic design developed by Fokker Aerostructures (1998, Gulfstream G350/450/500/550), a third generation **fully thermoplastic** composite elevators and rudder have now been developed by Fokker for the new Gulfstream G650. Significant cost (20%) and weight (10%) savings relative to the earlier designs have been realized.

The design encompasses a double curved multi rib torsion box with skins, beams and ribs and removable leading and trailing edges. The parts are all manufactured of Carbon/PPS. The joints in the torsion box are **induction welded**. The detail parts, which are up to 6 meters (20 ft) long, are loaded into an assembly mould which applies pressure to the joints. No additional joining materials are added. A robot with an induction coil then welds the parts, by applying an electromagnetic field at the weld area. This induces an alternating current into the carbon fabric and due to joule heating the thermoplastic matrix melts and the parts are fused together. The process is highly automated and significantly reduces assembly cost.

An extensive certification program is underway with coupon, element, detail and subcomponent tests. Full-scale component tests will be used to demonstrate ultimate strength after fatigue exposure including the effect of inflicted damage. The Gulfstream G650, the fastest civil aircraft on the market with a maximum operating Mach number of 0.925, completed its first flight tests in November and December 2009. Entry into service is planned for early 2012.