

EAP

ADVANCED CARBON FIBRE COMPOSITE STRUCTURE



**A JOINT AERITALIA, BRITISH AEROSPACE
DEVELOPMENT PROGRAMME**

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EAP Wing – The Technology

One of the main technological objectives for the EAP has been to use advanced structural materials in order to increase structural and manufacturing efficiency.

To this end, the wing torsion box has been designed to be made from carbon fibre composites using co-bonding techniques to eliminate the use of mechanical fasteners on the lower skin to sub-structure.

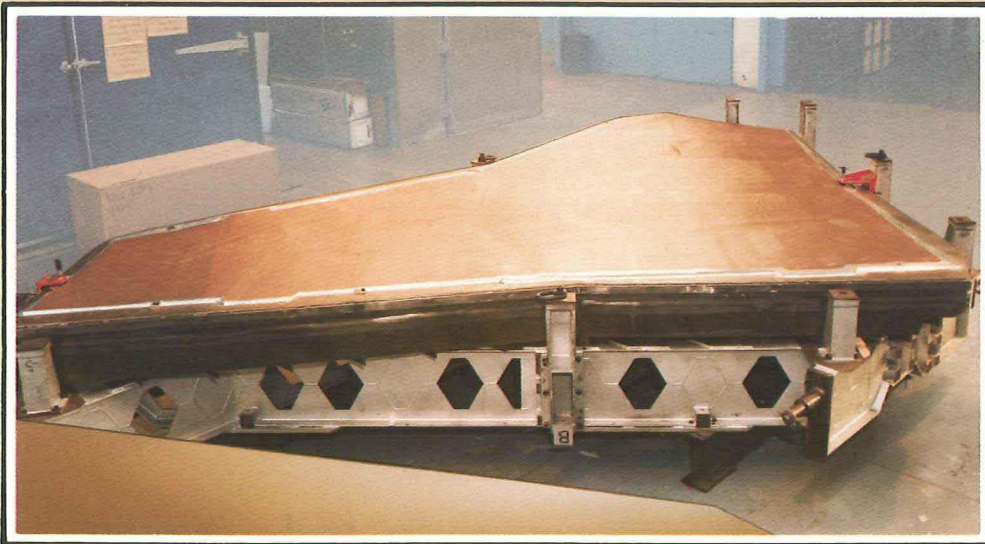
This has been successfully achieved and the two flight wings are currently in the process of being equipped, with assembly due for completion by the middle of the year. This, to our knowledge, is the first primary CFC bonded wing structure which will be flown.

Apart from sharing the design work, BAe Warton and AIT have collaborated in the necessary manufacturing development work to establish tooling and manufacturing methods to produce an assembly by simultaneously forming and curing all the intermediate spars of the multi-spar construction at the same time as bonding them to the pre-cured lower skin, using the upper skin as a tooling aid. Not only has this eliminated the need to provide mechanical fasteners in the lower skin but it has produced an accurate fit of the spars to the upper skin thereby dispensing with the need for shimming and simplifying the attachment. Structural tests have demonstrated the quality and strength of the flight wings.

Ciba-Geigy pre-preg has been used for the EAP wings with their BSL914 system containing both Toray and Courtaulds fibres.

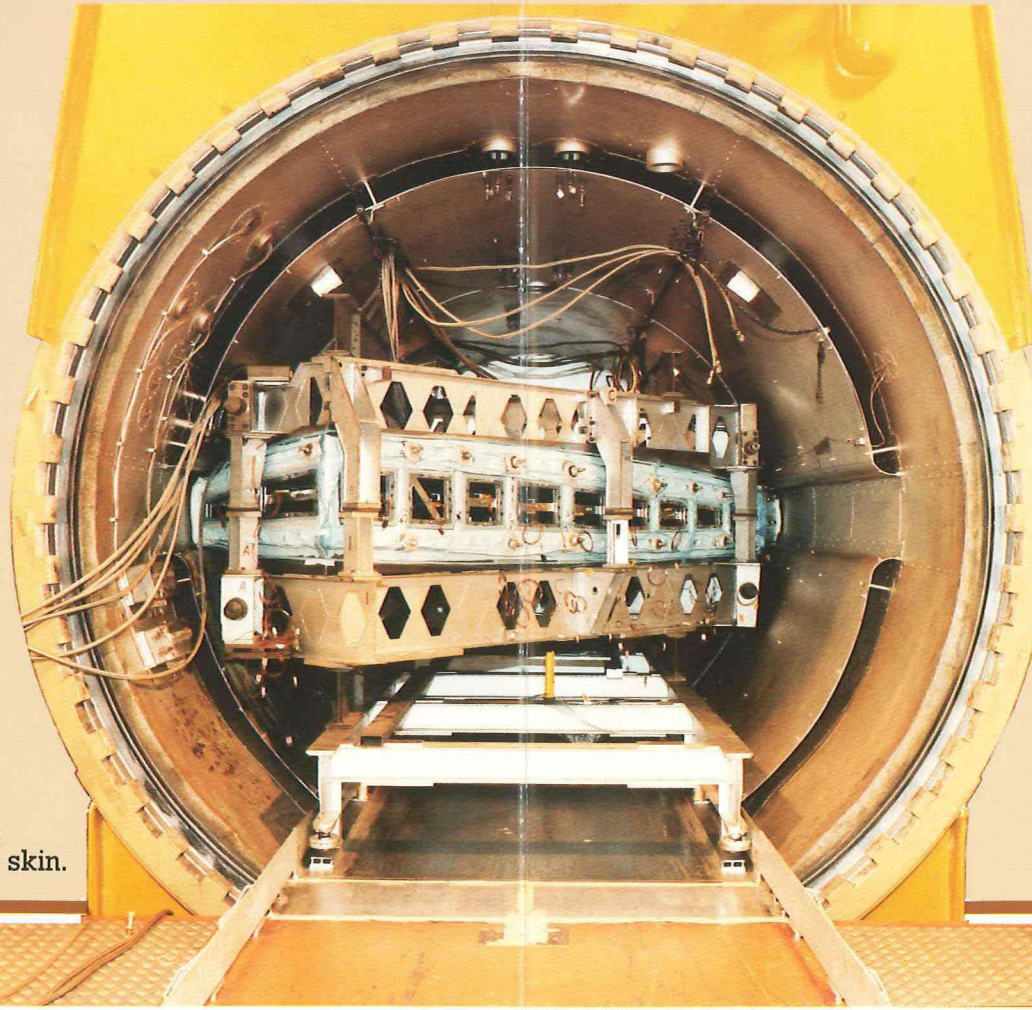
The build of the CFC wing for EAP has demonstrated one of the major objectives of this programme.

PRE-CURED LOWER WING SKIN ON CO-BONDING TOOL



1. The pre-cured lower wing skin is laid up on the co-bonding tool ready to accept the pre-formed un-cured spars. This done, the upper skin and tool are fitted and the assembly placed in an autoclave for the co-bonding process.

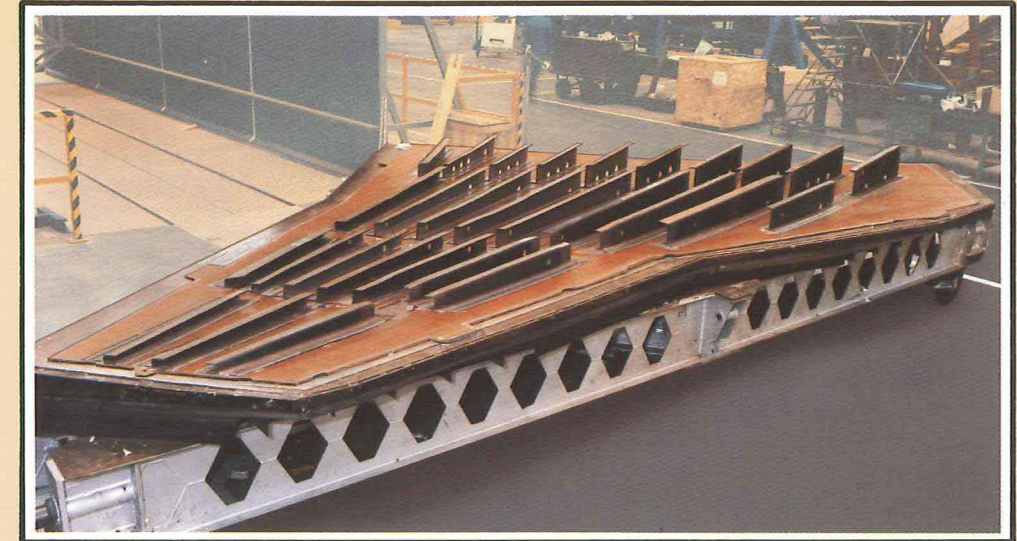
WING ASSEMBLY INSTALLED IN AUTOCLAVE



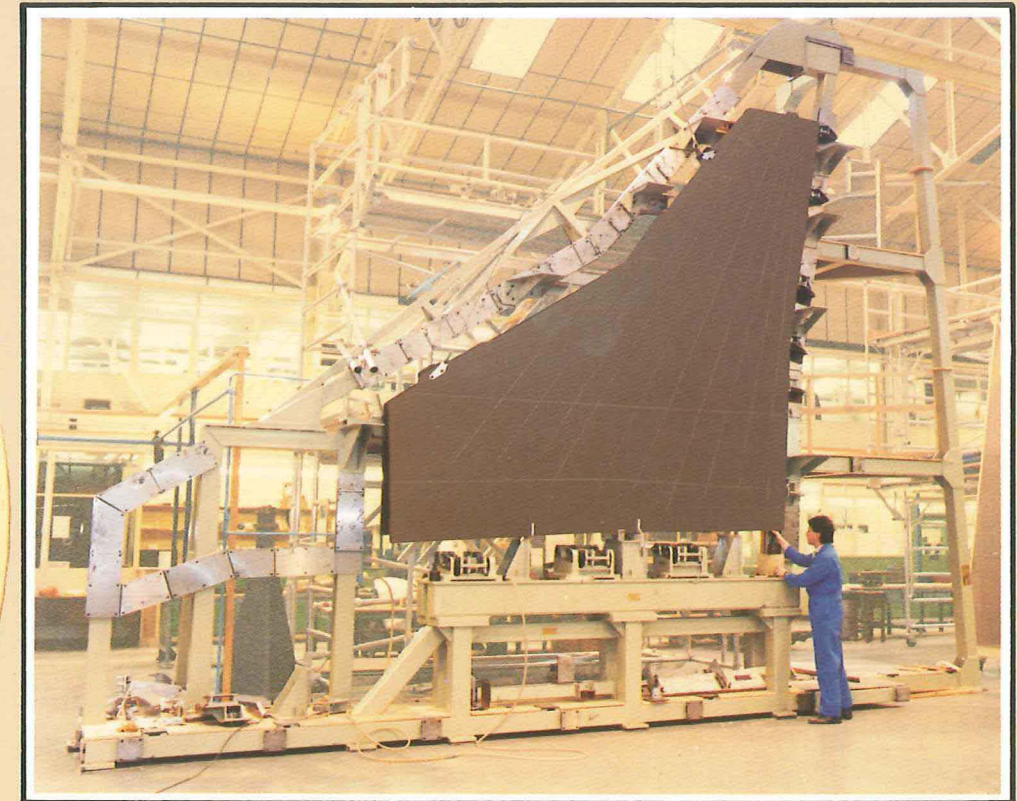
2. Installed in the Autoclave, the wing assembly undergoes a process which simultaneously cures the spars and bonds them to the lower skin.

CO-BONDED WING ASSEMBLY

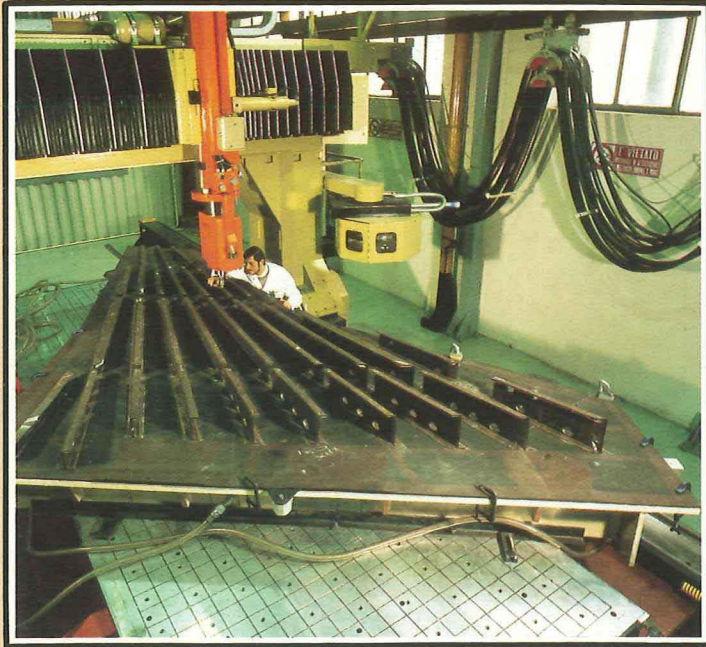
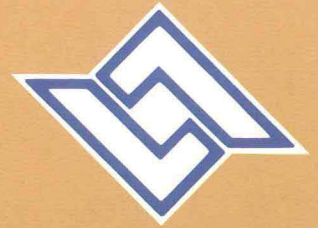
3. The curing cycle complete, the co-bonded assembly is made ready for non-destructive testing and raising into the main assembly jig for rib and peripheral spar assembly and equipment fitting.



ASSEMBLY OF TOP SKIN TO CO-BONDED WING



4. The co-bonded structure, having been erected in its assembly jig, is mated with the upper skin for initial fitting trials.



Aeritalia have attained high reliability and confidence in the design and manufacture of composite structures through participation in several civil and military programmes, commencing in the late 1970s. One of the most significant achievements is represented by the AMX carbon fibre fin, which is a one step co-cured multispar box.

The on-going EAP programme is a new challenging task for technology enhancement in this field and Aeritalia, (whose effort has been developed from the preliminary studies through the design, manufacturing and testing phases), is now producing two left-hand wings, one for the demonstrator and the other for qualification tests.

The illustration shows the co-bonded wing (lower skin panel with spars) being checked prior to assembly to the top skin.



BAe, with Warton as the lead Division has, since 1966 when its research into the potential of carbon fibre began, built up a wealth of expertise in the design and manufacture of carbon fibre composite structures.

R & D programmes include, amongst others, design and manufacture of a CFC wing and engine bay door for Jaguar and, in collaboration with MBB, a CFC taileron for Tornado.

Currently engaged in the design, test and assembly of a set of advanced composite wings for SAAB Scania of Sweden for their JAS 39 'GRIPEN' aircraft, BAe are also manufacturing the CFC rudder for Harrier II (which includes AV8B and GR Mk.5) and the co-cured carbon stabilator for the GR Mk.5. Detail manufacture and co-bonding of the EAP right-hand wing torsion box were undertaken at the Warton Division's Samlesbury site. A view of the Samlesbury clean room facility is shown in the illustration.