SMART TOOLING

SMART TOOL CAUL
CASE STUDY
PYLON FAIRING WITH TIGHT RADII

Using a Smart Tool Caul to eliminate bridging and pinching in tight corners by replacing laying up in a female cavity mold with laying up on a rigid, male Smart Tool that becomes elastic during cure to achieve full laminate compaction.

PROBLEM
Fabricate a pylon fairing with a tight radii while preventing bridging and pinching during layup

OPPORTUNITY
Create a solution using a male Smart Tool Caul to eliminate laying up in the female cavity mold

SOLUTION
A rigid Smart Tool Caul that becomes elastic during cure was combined with an OML cure mold, material was laid up directly on the Smart Tool Caul, closed into the cure mold, autoclave cured, and demolded

THE PROBLEM
The trailing edge pylon fairing was a double contour 8 ply epoxy/carbon fiber laminate with epoxy/copper mesh and epoxy/fiberglass surface plies. It contained a radius along the entire part length that was not constant, changing from .40" to .12" (10.2mm to 3mm).

The pylon fairing came with inherited aluminum female tooling for hand layup and a vacuum bag autoclave cure. Carbon laminate had to be layed up into complex radii in the female cavity that created difficulties achieving proper ply consolidation and void prevention. The lay-up was a labor intensive process taking 6 hours to complete. A 50% scrap rate occurred from program start due to inter-ply delamination.

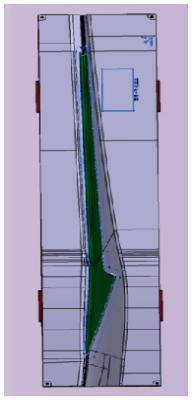
SMART TOOLING PROCESS
A Smart Tool Caul was first vacuum assisted resin transfer molded (VARTM) off a female carbon fiber Smart Tool master mold, allowing layup to be done over a rigid male Smart Tool Caul, instead of inside the female mold cavity.

Once the layup was complete (in reverse pattern order) on the stiff male Smart Tool Caul, it was dropped directly into the aluminum female mold. No transfer of the layup was necessary. Barrier ply release film was used to cover the Smart Tool Caul to ease the release from the cured laminate.

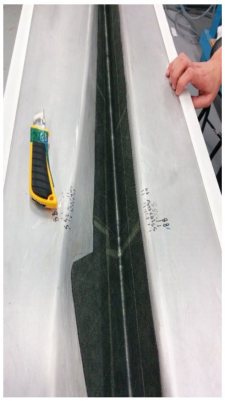
During cure, the Smart Tool Caul became elastic and was pressurized to translate the force to the laminate and into the radii, sufficiently compacting and consolidating the laminate.

After de-molding, the Smart Caul was reformed under a vacuum bag at 250°F (121°C) in the Smart Tool master mold.

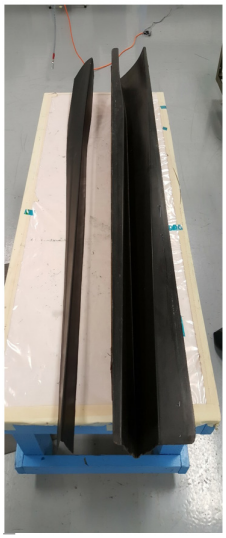
RESULTS
The Smart Tool Caul tooling solution significantly reduced scrap rate from 50% to 3% and reduced labor hours from 6 to 2. The Smart Tool Caul tooling solution also significantly reduced radius thickness and increased overall ply consolidation by 36%, resulting in the desired part nominal thickness and eliminated the inter-ply delamination problem.



Female mold cavity CAD showing part



Previous layup method into female cavity



Demolded Smart Tool Caul & composite part

How Smart Tool Caul fitsinto female mold