Introduction

• A forming cell is being developed for process development and manufacturing of small complex geometry composite parts to meet high volume requirements for the aerospace industry.

• The forming cell uses highly-aligned short fiber thermoset prepreg (called TuFF) with its unique ability to stretch in-plane similar to sheet metal.

• The primary objective of this project is to validate the manufacturing process, find the ideal pressure and temperature, and prove system reliability.

Manufacturing Process Verification

• A triangular rib has been selected as a model component to develop the forming process with an experimental plan to understand the interplay between process parameters.

• These Parameters include temperature, prepreg blank boundary conditions, forming pressure and rate, formed part quality (wrinkle-free formed geometry, good consolidation and cycle time).

• A custom metal frame is designed to hold the ‘material blank’ for triangular rib

• Metal clamps attached to springs are used to hold material in tension to facilitate forming

• Material Tension, clamping pressure and gripping mechanism are critical

Results and Discussion

• Tension testing on coupons is conducted to determine the effects of critical process parameters including material tension, loading rate and temperature/pressure to help determine parameters for forming cell

• Aluminum tabs were used in the grips for testing

• Debulking of material results in ‘homogenization’ of response and reduce variability

• Samples were debulked under vacuum prior to testing for comparison with non debulk samples

Conclusions and Future Work

• Material stretch starts with loads in excess of 10 lbf/ply based on load-displacement data

• Debulking the material results in higher tension loads, and can help reduce variability

• Tests with varying loading rates to access material response

• Repeat testing with added springs to check any variation in response

• Failure mechanisms and blank gripping mechanism

• Preliminary trials are in progress to understand material stretch behavior as a function of force, temperature and rate, followed by blank forming trials to understand the influence of boundary conditions on stretch forming.

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• Thomas Cender, Alex Vanarelli, Kyle Morris