

# Airflow Testing of Ceramic Matrix Composites

## Original Objectives

- Reduce cycle time of application and removal.
- Develop a repeatable coverage method.
- Method must pass leak test for 30 seconds at 2.5 psi.
- Reduce cycle time by 50%.

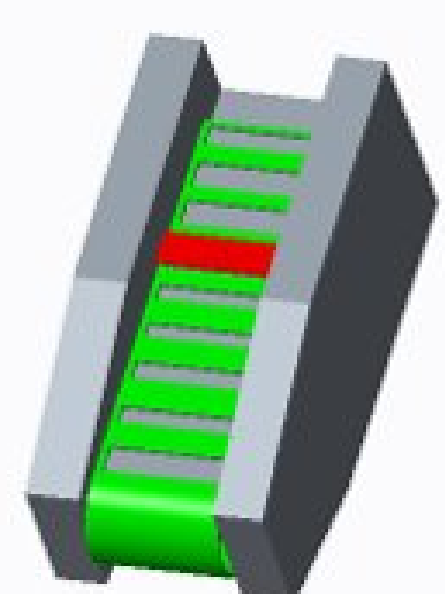
## Requirements

- Reduce cycle time of application and removal by 50%.
- Must be repeatable and reproducible
- Cost Effective
- No tooling interference
- Clean Removal
- No surface damage upon removal
- <15% retest rate
- Employ DMAIC establish an application process

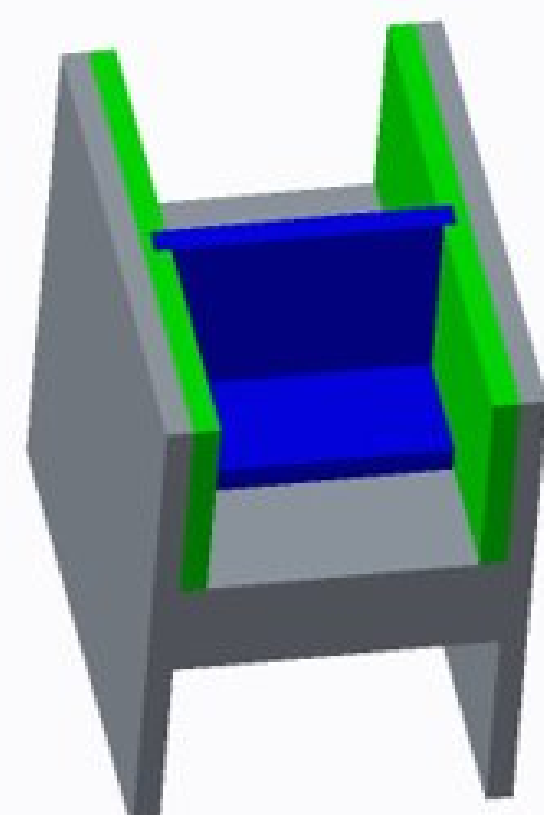
## Concepts

- A risk analysis was conducted to select the final design.
- Part Geometry proved too complex to design a machined fixture.
- No suitable materials could be found for a "peel and stick mold".

Membrane Mold



Slotted Fixture

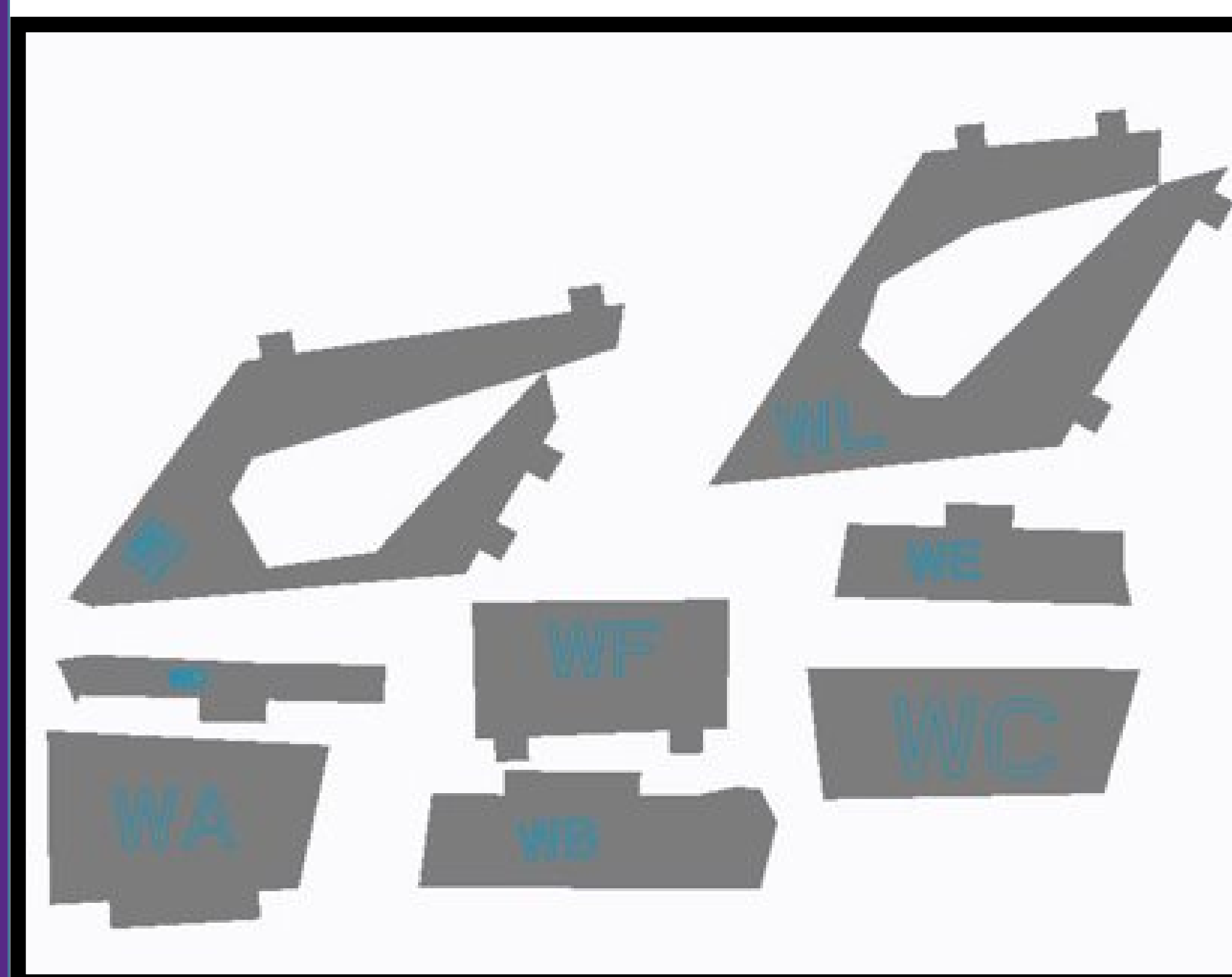


## Problem Statement

Airflow testing of certain Ceramic Matrix Composites (CMC) components requires masking or blocking off multi-circuit holes which requires a significant amount of set-up time for each circuit tested, causing unacceptable cycle times and delays in shipping of products. Accurately testing these circuits is of vital importance as these cooling holes supply the necessary cooling for components in the hottest part of the engine that operate at temperatures greater than 500°F, above the melting point of super alloy metals. To ensure sufficient airflow is present, every components cooling hole sections must be 100% tested.

## Final Design/Results \*

- Final Design was a tabbed 3311 aluminum HVAC tape cut to fit each individual circuit.
- Tape able to with withstand 5 psi for 3 minutes on WCU test apparatus.
- WCU Testing passed initial parameter with a 90% pass rate with GE testing proving promising before COVID quarantine.
- Manufacturing method of the tape circuits would be using a Circuit cutting machine.
- Tape circuits in combination with the Circuit makes this a simple, cheap and repeatable process which were the team's primary goals.



## Modified Objectives\*

- Final testing at GE had to be stopped
- Modifications to design were made from data gathered during the testing that had been completed at GE prior to COVID-19
- Extra communication with GE was necessary to discuss how to turn in the final design
- The team operated well in the new environment by staying in touch over Zoom calls and text message
- In the end the original objectives were going to be met, but the final testing was not done to prove it
- The overall impact of COVID-19 included not allowing testing of the finalized design

## Summary

- 3M 3311 tape was found to pass testing parameters.
- Tape was cut into templates of the circuit shape.
- Tabs were added to improve processes time.

## Team & Acknowledgements

- Team 8: GE Airflow
- Sponsor: GE Aviation
- Team Members-  
Bachelors of Science in Engineering, concentration in mechanical
  - Daniel Parmesano and Hannah Chapell
- Bachelors of Science in Engineering Technology
  - Bryce Myers and Brian Foster
- Mentor-Dr. Ritenour

\* On March 16, 2020 classes and labs were closed to students due to the COVID-19 Pandemic. Without access to fabrication and testing equipment, Objectives and Deliverables were modified accordingly.