



Complex Structural Thermoplastic Window Frame Geometry through innovative use of Braided Materials

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Progress beyond



Complex Structural Thermoplastic Window Frame Geometry through innovative use of Braided Materials

Contents:

- 1.Choosing Materials
- 2.Material Format compared to other formats and competitors
- 3.Virtual Simulation for Window Frame
- 4.Processing and Practical Application



“ Providing maximum performance from minimal material usage while retaining processability ”

Aerospace Performance Materials

Using aerospace grade Thermoplastic family PAEK's of PEKK and PEEK



Superior Properties & Performance

- High Temp Structural Properties
- Excellent Toughness
- Unequaled Fire Smoke & Toxicity
- Infinite Room Temperature Storage Life
- Good Environmental Resistance



Cost Efficient Fabrication/Assembly



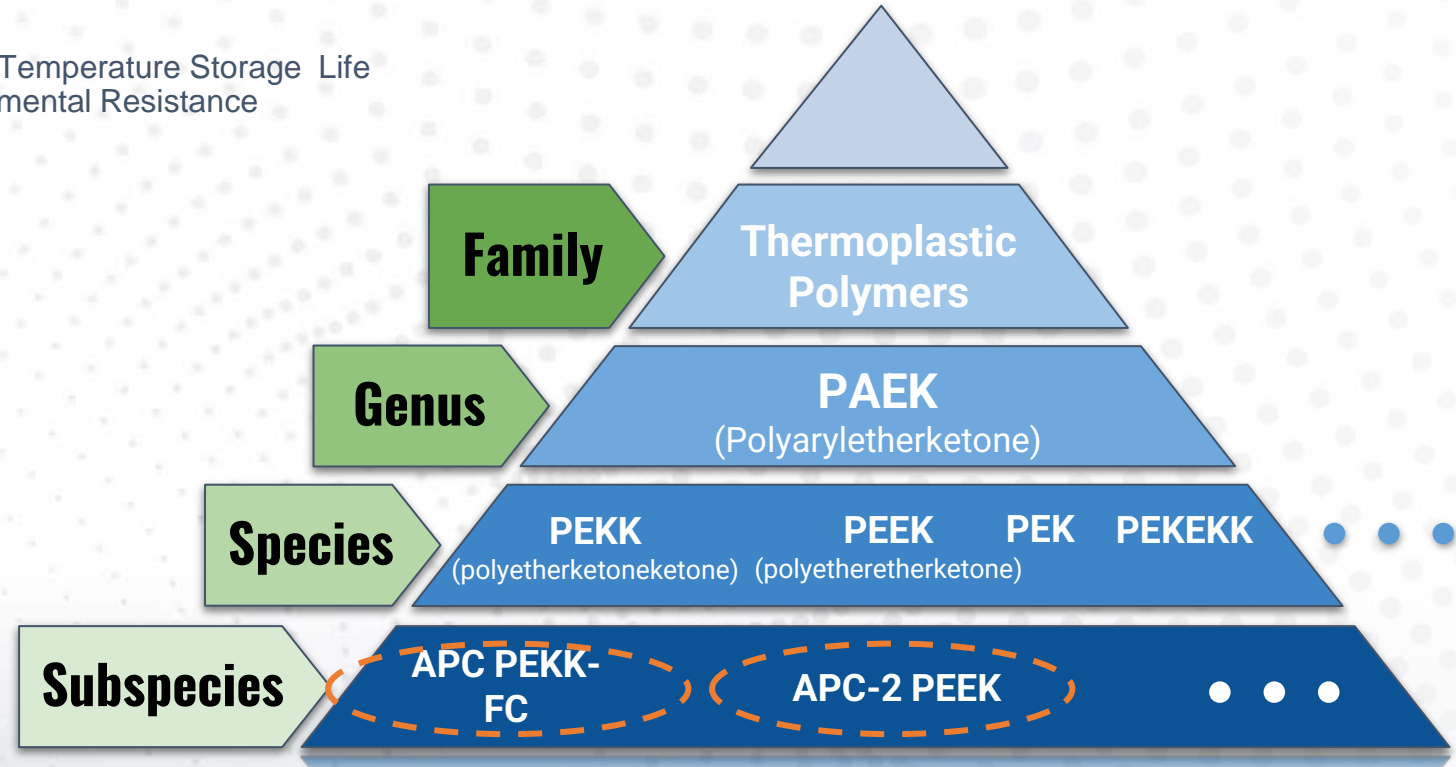
- Automated Tape Placement
- High Speed AFP & In-Situ
- Roll forming / Continuous Compression Molding
- Press Molding/Stamping
- Welding



Tremendous Weight & Cost Advantages

Through composite design, performance, and integrated structure applications

“Innovation around the PEKK & PEEK species of genus PAEK Thermoplastic **Braided Tape** vs **PAEK Fabric** form-
types”



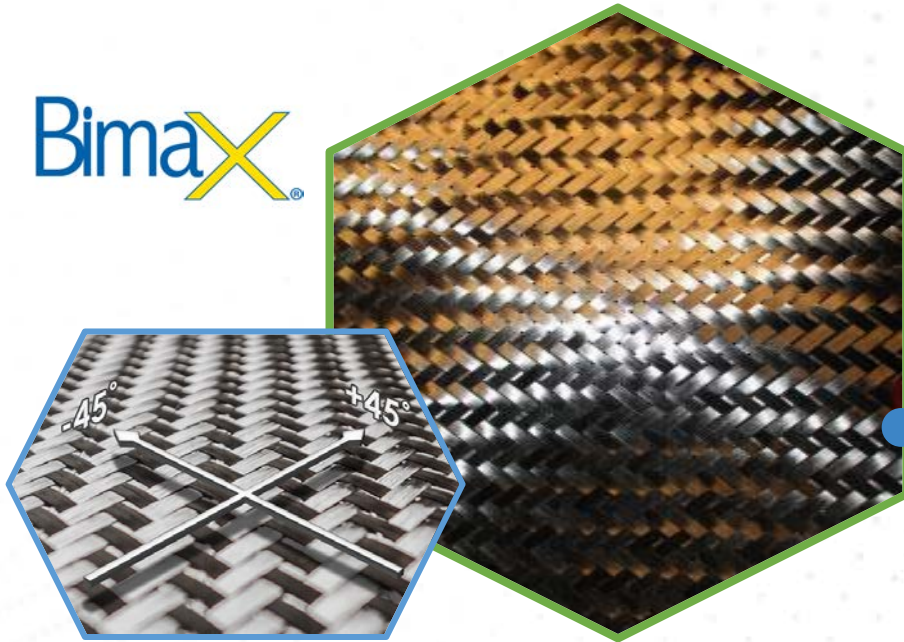
A&P State of the Art Machinery & Capabilities

- A&P has the **largest line of braiders** in the world.
- All machinery is designed and built in-house; capability to build **new braider in weeks**
- A&P's expertise enables the handling of slit tapes to create sleeveings, preforms, and fabrics up to **60+ inches**.



Slit Tape Braided Fabric Architectures

Bimax[®]

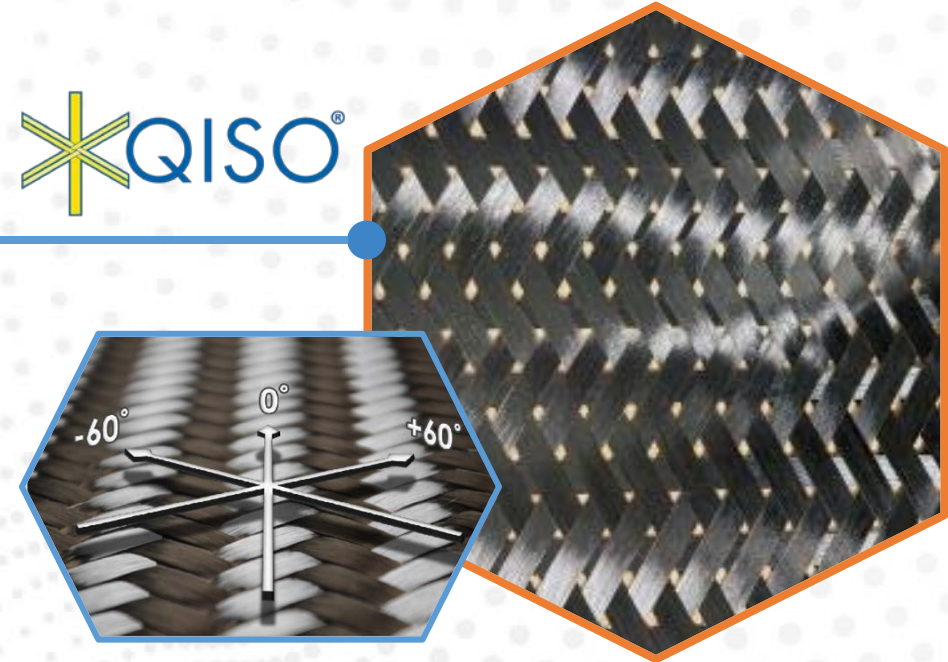


+/-45° fabric made with ¼" APC PEKK slit tape

Benefits of 45°

- +/-45° Bimax fabric provides **two orientations within one layer** – reduces number of plies from 8 layers of UD to 4 layers of +/-45° required for balance and symmetry
- Near Zero Waste due to A&P's ability to tailor the width
- Extreme Drapability Compared to UD Tape Laminate

QISO[®]

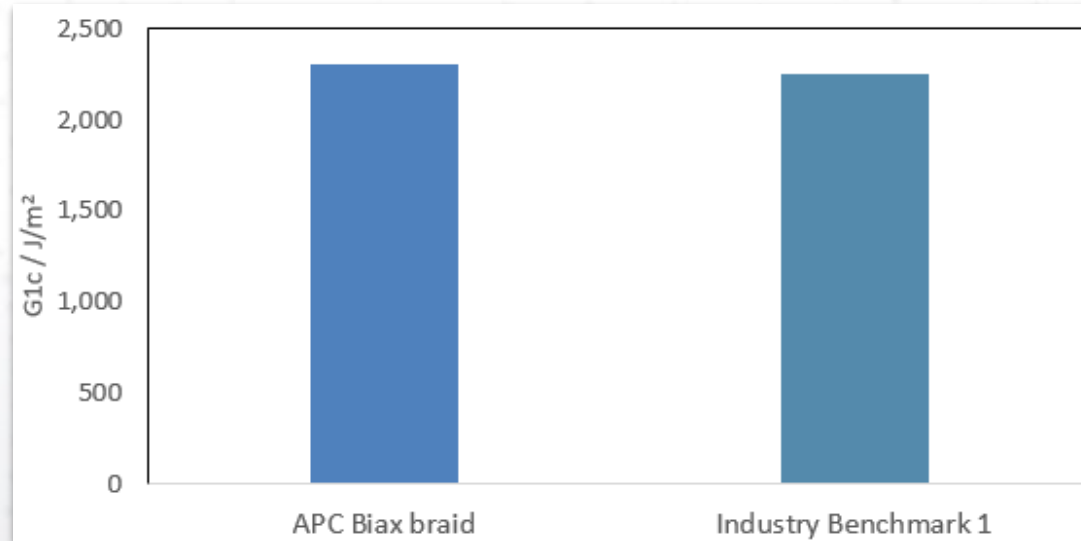
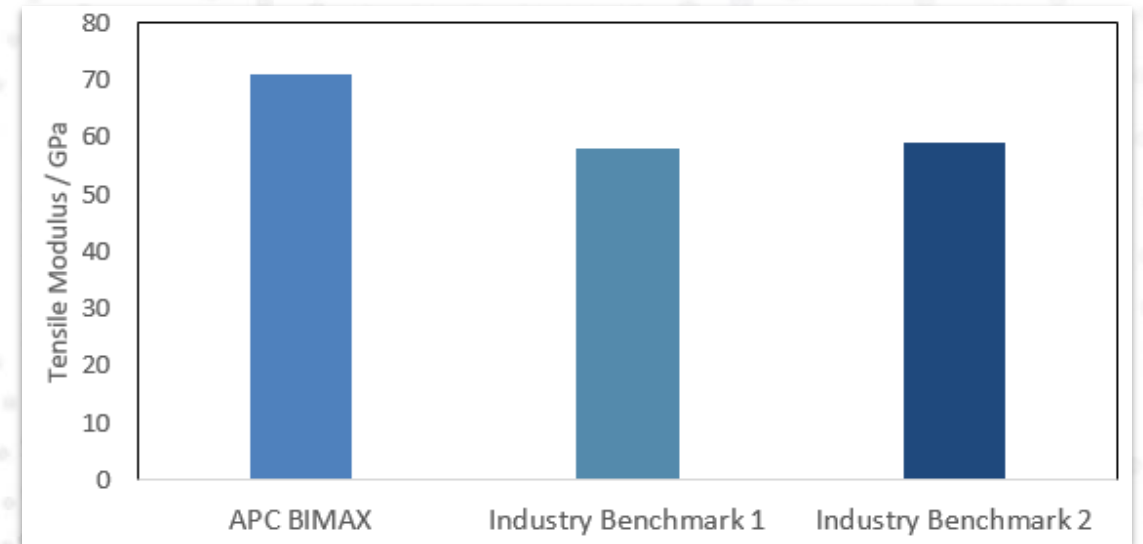
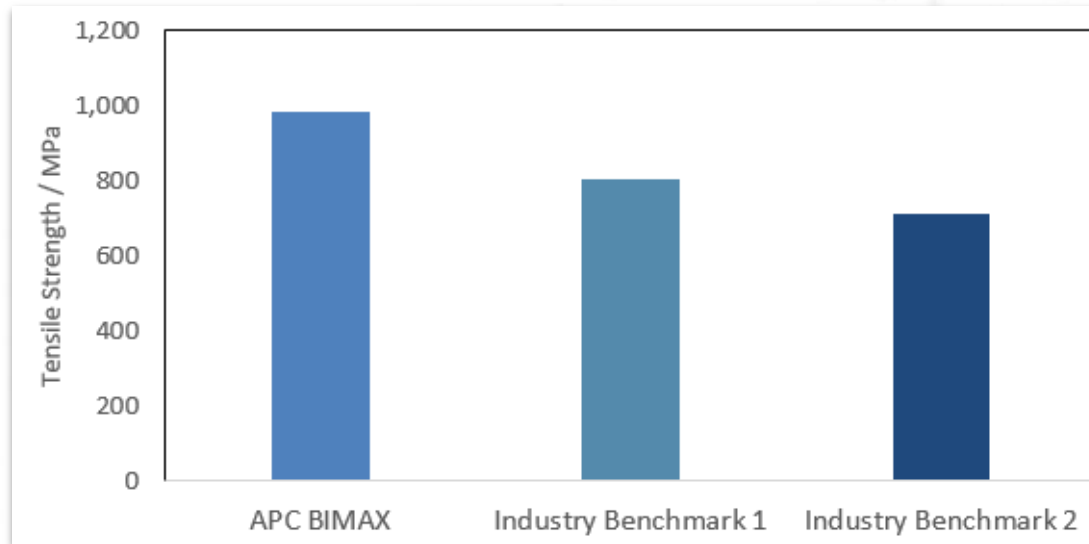


0°, +/-60° fabric made with ¼" APC-2 PEEK slit tape

Opportunity to optimize with 0°, +/-60°

- 0°, +/-60° QISO fabric provides **balance & symmetry within one layer** enabling user to design to minimum thickness (lightweighting)
- Near Zero Waste due to A&P's ability to tailor the width
- High Level of Drape

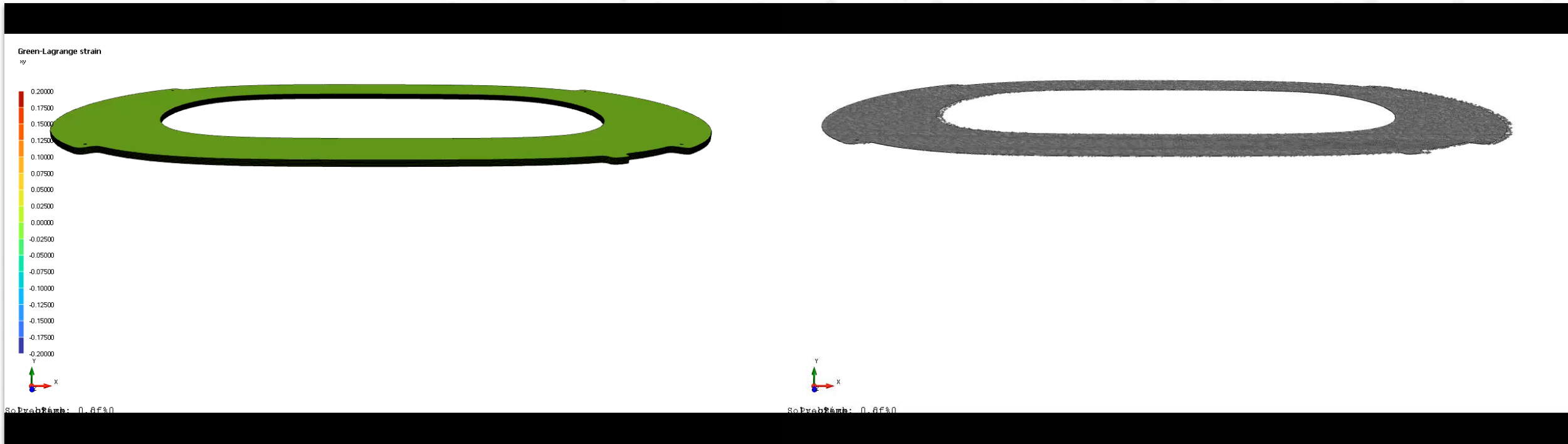
Mechanical Properties Comparison



- Meets or exceeds fabric alternatives
- Outstanding toughness

“Aromatic Polymer Composite (APC) PAEK process provide a resin-rich surface and improved melt flow to provide superior 'slip-plane' movement between plies needed for rapid and complex forming.”

Forming Simulation:

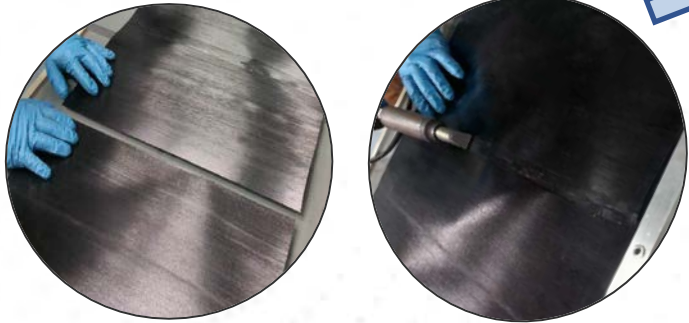


Green-Lagrange Strain Plot

Fiber Direction Plot

Production steps...

Hand Layup

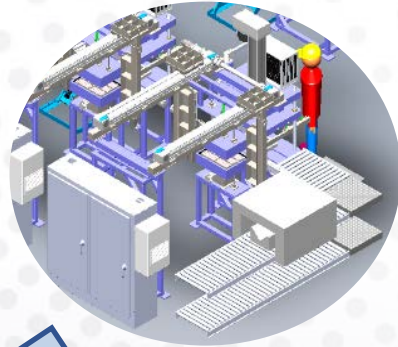


CCM



Blank
Pre-Trim

Stamp
Forming



Trim

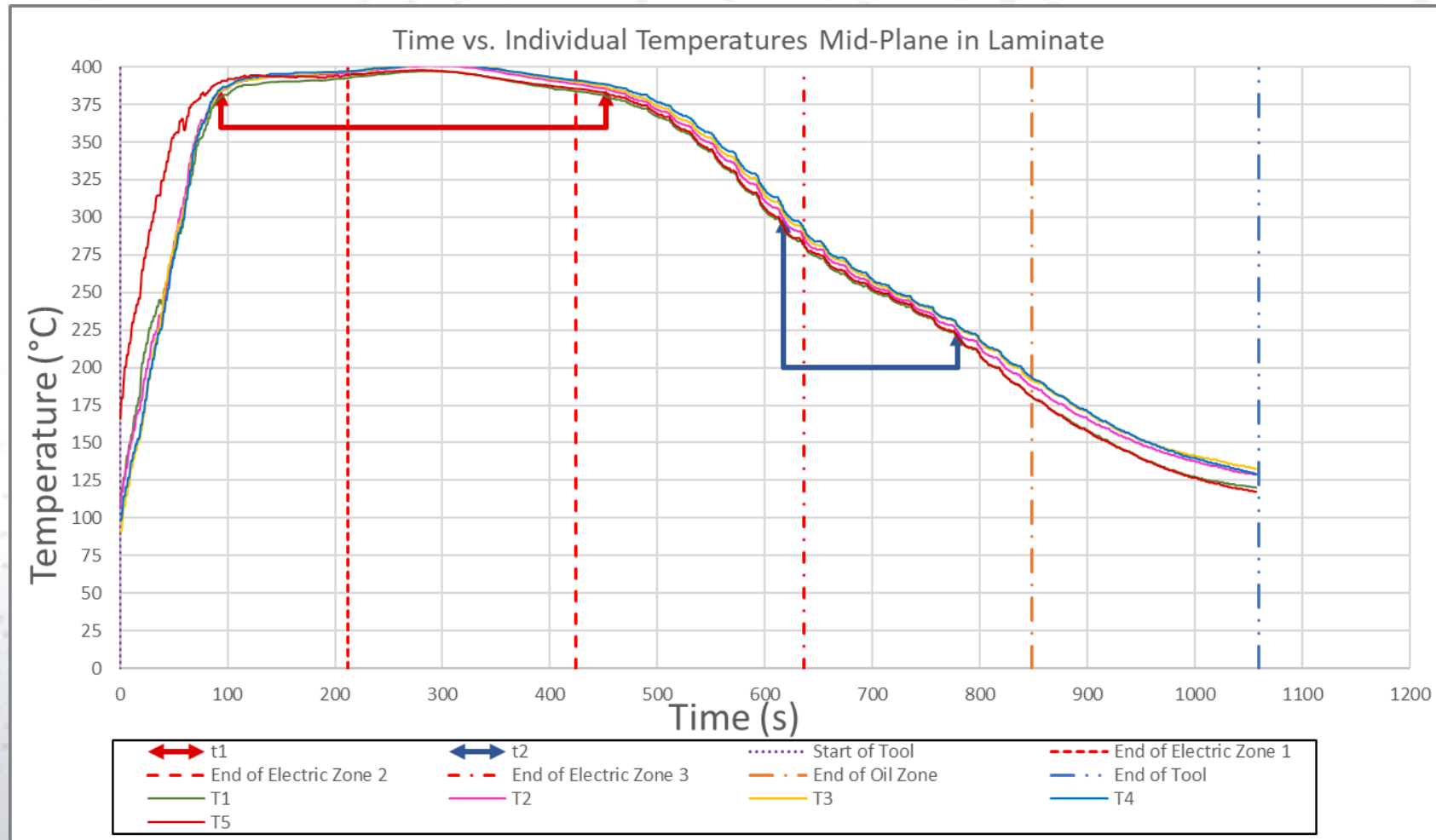


NDI



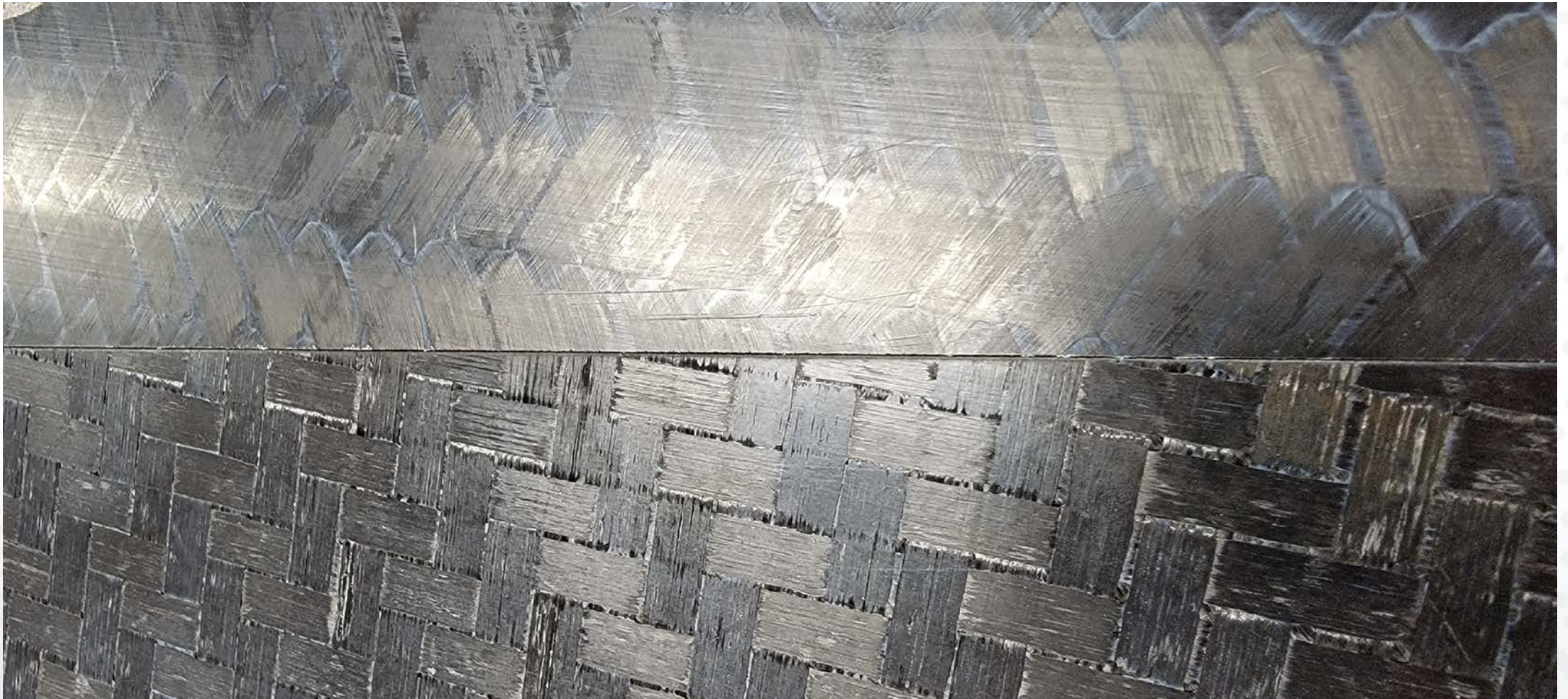
Production steps...

CCM Temperature vs. Time



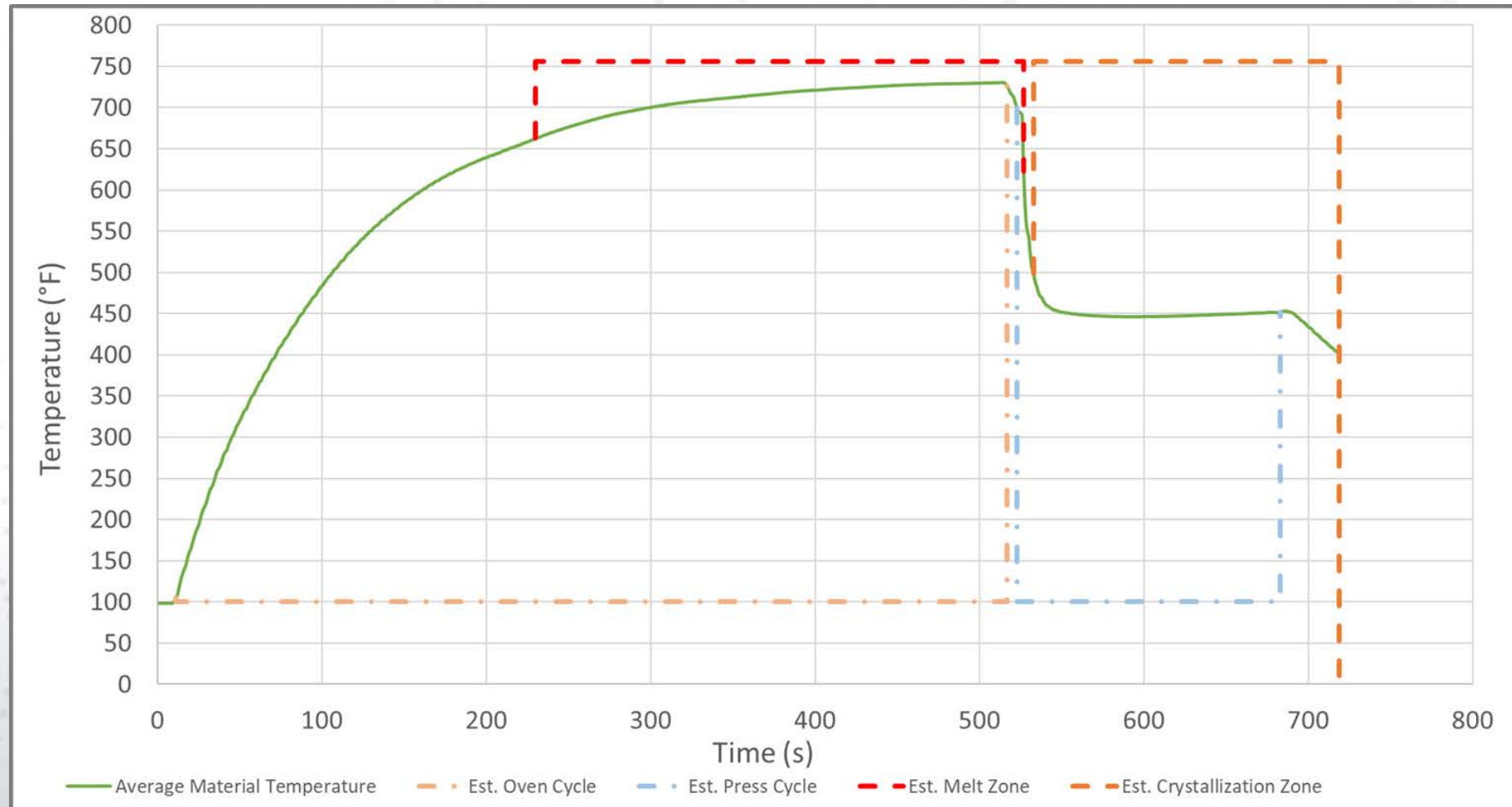
Production steps...

CCM QISO vs. VBO BIMAX

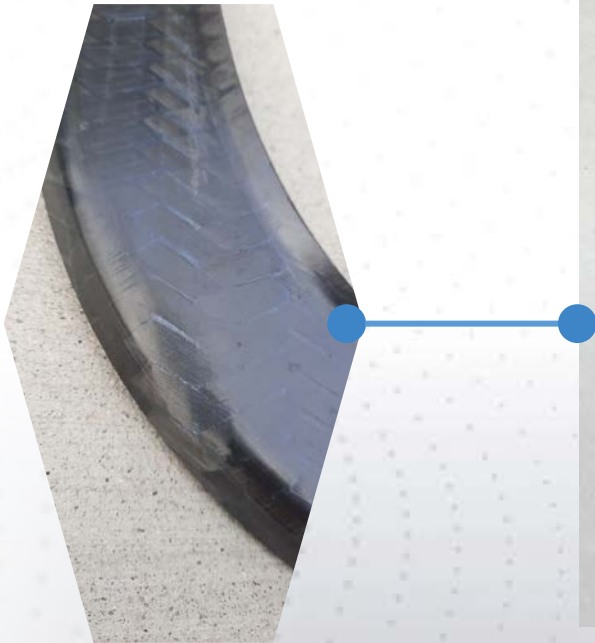


Production steps...

Stamp Form Temperature vs. Time



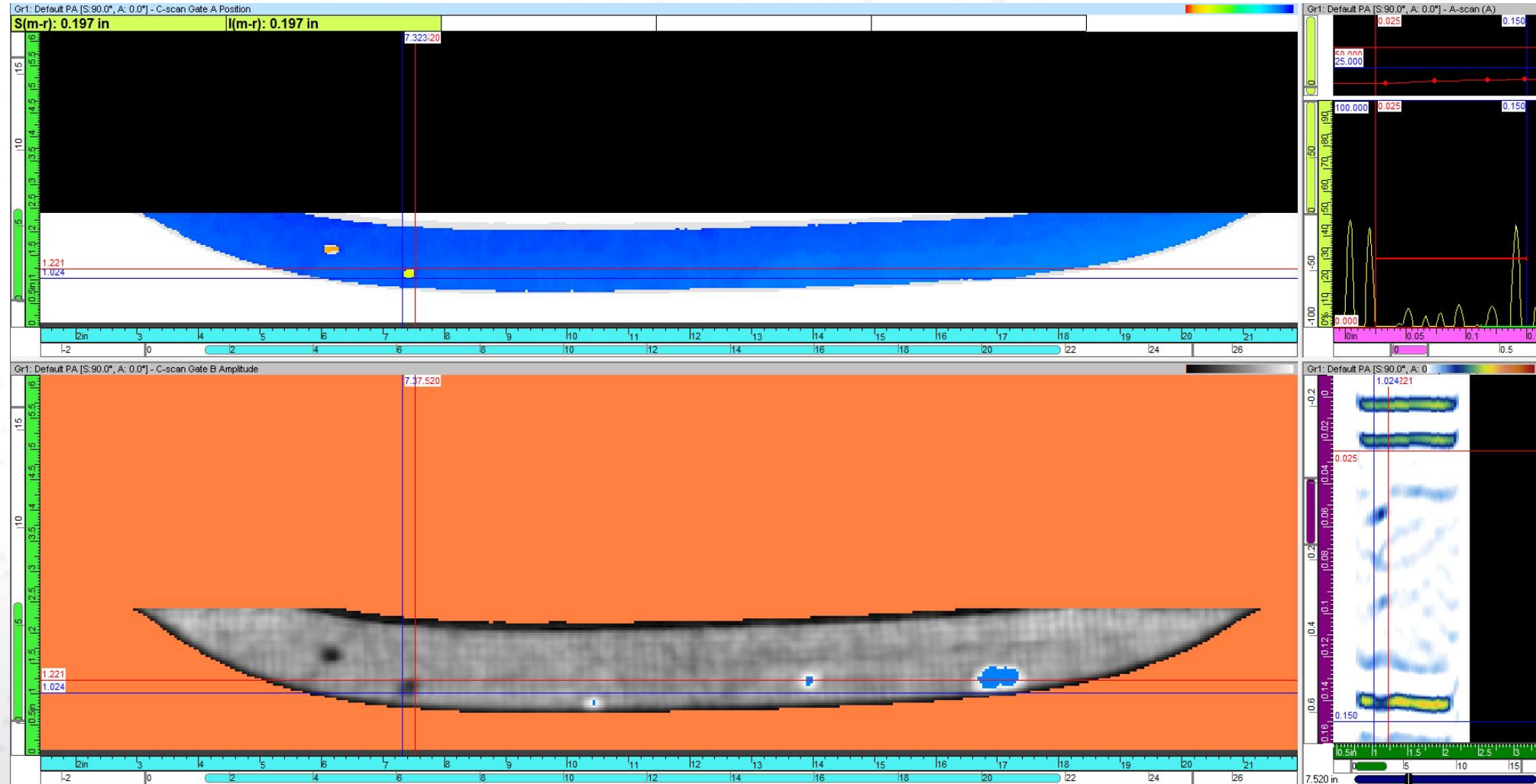
Production outcome...



Production outcome...



Production outcome...



Conclusions:

- The combination of material, format, and forming in this process enabled hot melt flow, VBO laminated processing, and rapid complex forming
- Material worked with industry standard forming conditions.
- Simulation software utilization for accurate forming results, predicted corners as potential challenge areas.
- Out-of-autoclave pre-consolidation still resulted in passing NDI results after stamp forming.

Presenter Contact Information

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Progress beyond

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