



NEXTGEN PREFORMS

Tailored Fiber Placement Technology
(TFP)

FIBER INPUT



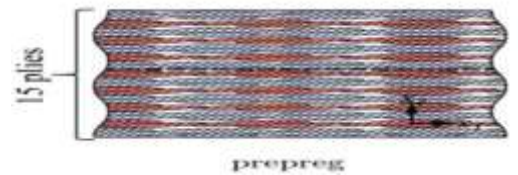
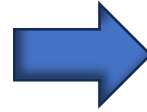
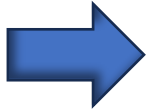
WOVEN/NCF/PREPREG



KIT CUT



MOLDED PART



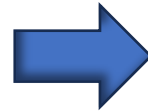
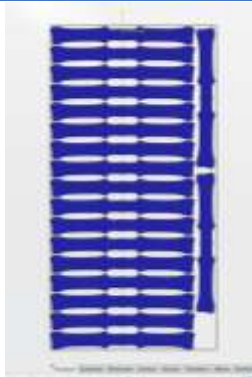
PART GEOMETRY



NEAR NET PREFORM DESIGN



MOLDED PART



Preform Production



PART GEOMETRY $\Rightarrow$ NEAR NET PREFORM DESIGN $\Rightarrow$ MOLDED PART



1 RAW MATERIAL



2 PREFORM PRODUCTION



3 NET SHAPE TFP PREFORM

ADDITIVE MANUFACTURING

- REDUCED MATERIAL WASTE
- INCREASED PART QUALITY
- REDUCED CUT LABOR
- IMPROVED PART PERFORMANCE

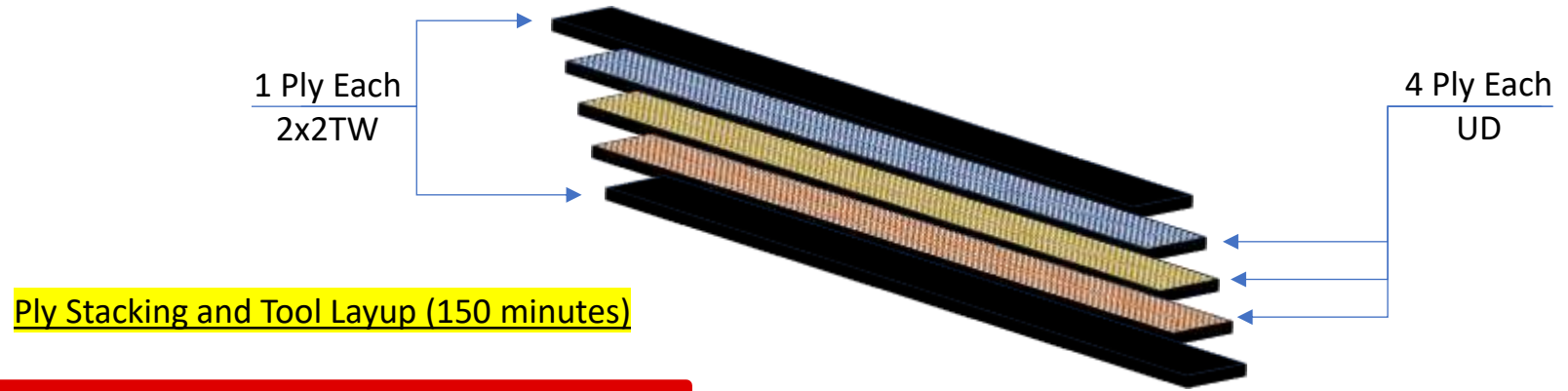
Our Winning Ways



Ply Cutting (1 hr)



Waste (20%)



Tool Layup (26 min)

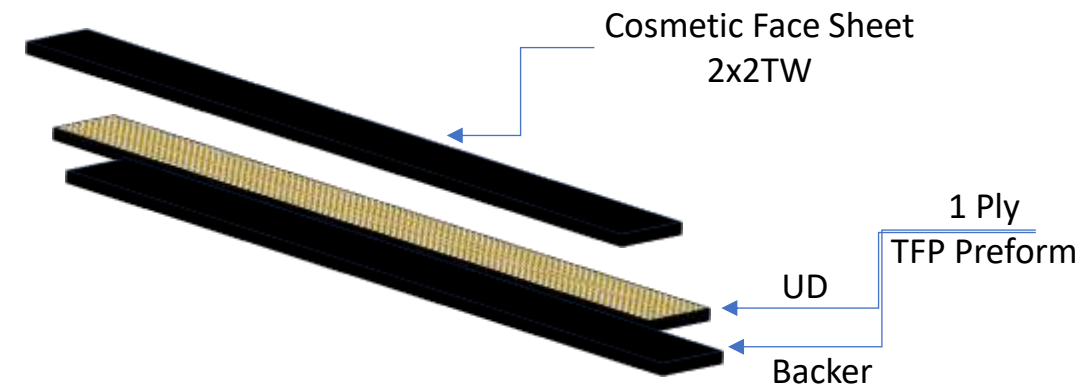
TFP Preform Method



Ply Cutting (10 min)



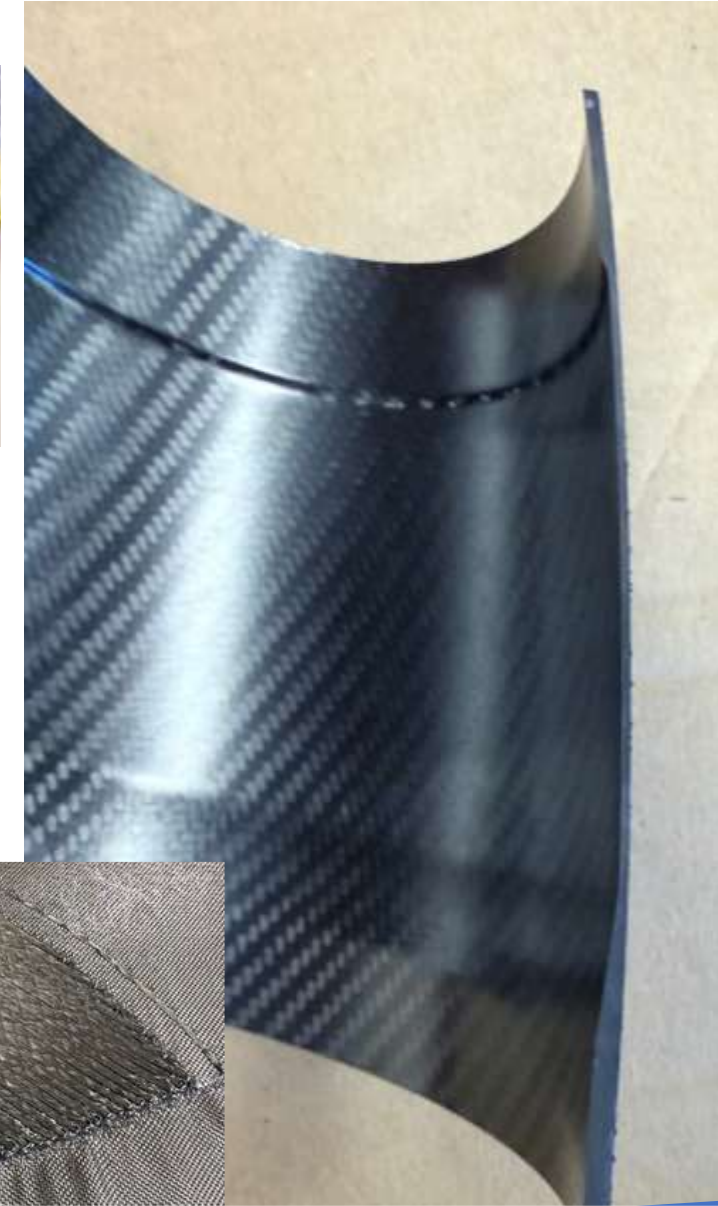
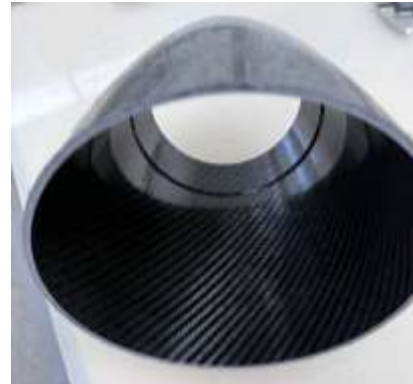
Waste (<1%)



- **Original Technology** – UD prepreg with 2x2 TW carbon prepreg skins
- **New Technology** – 2x2 TW prepreg skin with towpreg preform
- Advantages
 - **Significant layer/ply reduction** - 36 plys reduced to 2 face sheets and 2 preforms
 - **Reduced touch labor** – reduced kitting and layup from 2.5 hours to 26 minutes
 - **Reduced waste** - 20% to less than 1%
 - **Increased throughput** – 40% increase in production cell capacity



- **Original Technology** – Prepreg: 2x2 Twill (200gsm)/Epoxy
- **New Technology** – Towpreg Structural Fiber Placement
- Advantages
 - **Significant layer/ply reduction** - 25 plies reduced to 2 TSFP preforms
 - **Reduced touch labor** – reduced kitting and layup from 4.5 hours to 16 minutes
 - **Reduced waste** - 25% to no waste
 - **Increased throughput** – 2 parts per day to 10 parts per day



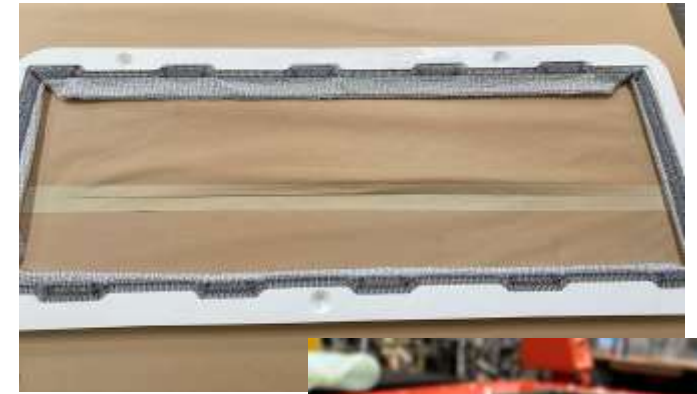
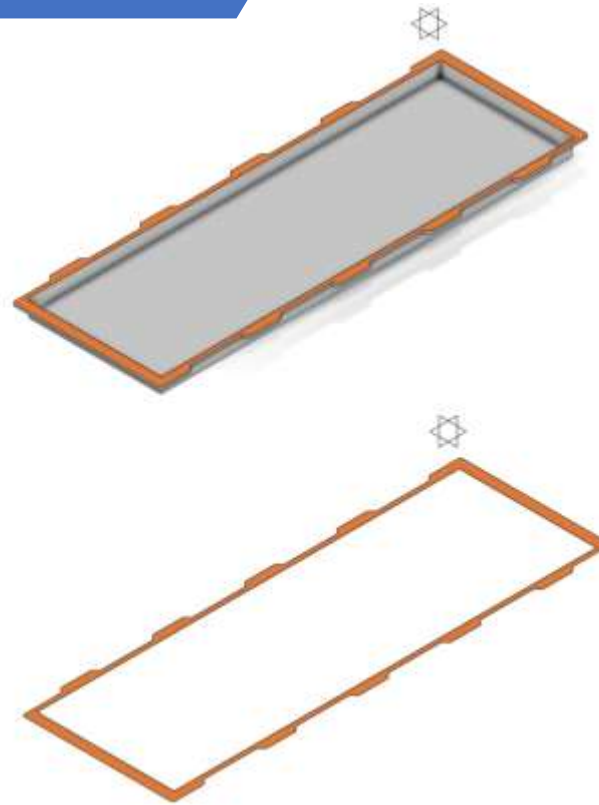
Rocket Mounting Hoop

- **Original Technology** – Stacked 24 oz NCF FG
- **New Technology** – FG TFP Hoops
- Advantages
 - **Significant layer/ply reduction** - 35 plies reduced to 5 preforms
 - **Reduced touch labor** – reduced kitting and layup from 20 hours to 1.5 hours
 - **Reduced waste** - 18% to no waste
 - **Increased throughput** – 150% increase in production cell capacity

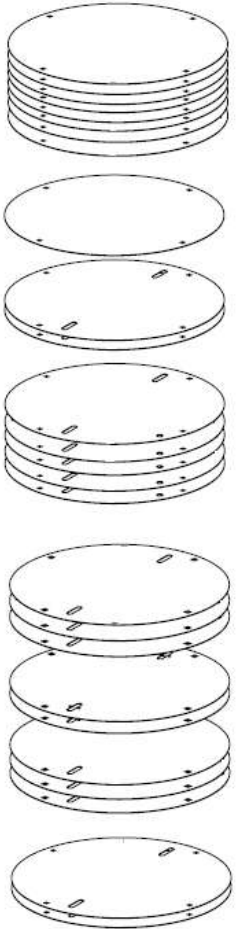


Flanged Battery Box

- **Original Technology** – RTM with FG NCF with post machining
- **New Technology** – Infusion using net shape FG TFP flange insert
- Advantages
 - **Significant post machining reduction** – no post machining resin flange to final shape.
 - **Reduced waste** - 12% to less than 1%
 - **Increased throughput** – No post machining of flange except for hole drill



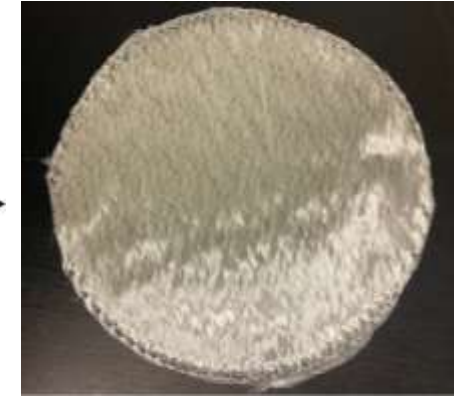
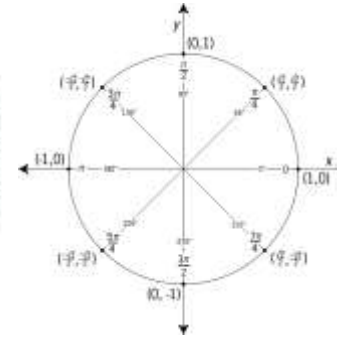
Manway Lid



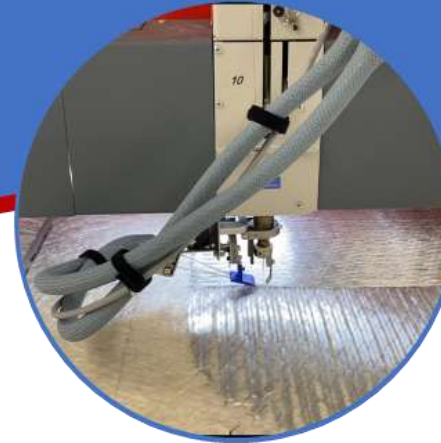
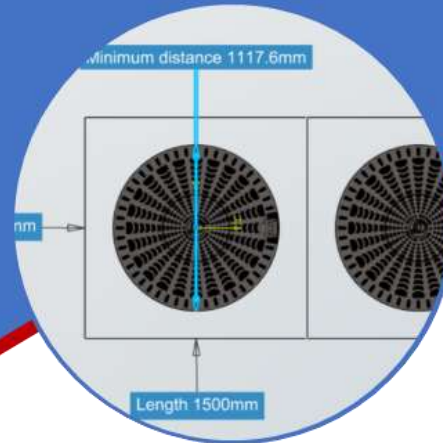
Project: Infrastructure

Part: Utility Lid

- Current NCF Ply Count: 23
 - Ply Count with Preform: 6
- Time Savings: 4.5 hrs/part
- Waste Savings: 35%
- No NCF kitting required
- Quality/Strength increase



Infrastructure Covers



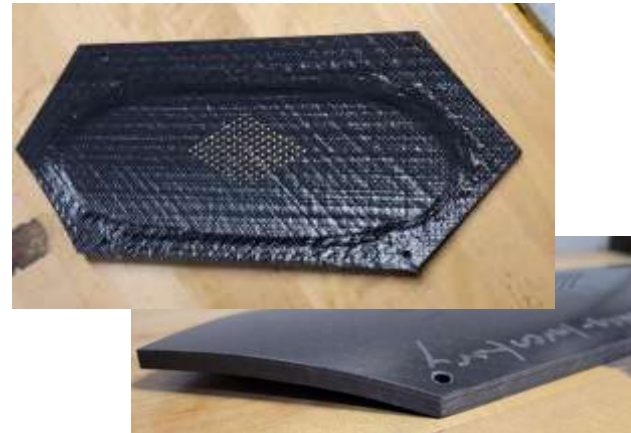
Other Applications - Carbon



Cane Arm
Nylon/Carbon



Wing Skin
Epoxy/Carbon



Empennage Access Cover
Epoxy/Carbon Prepreg

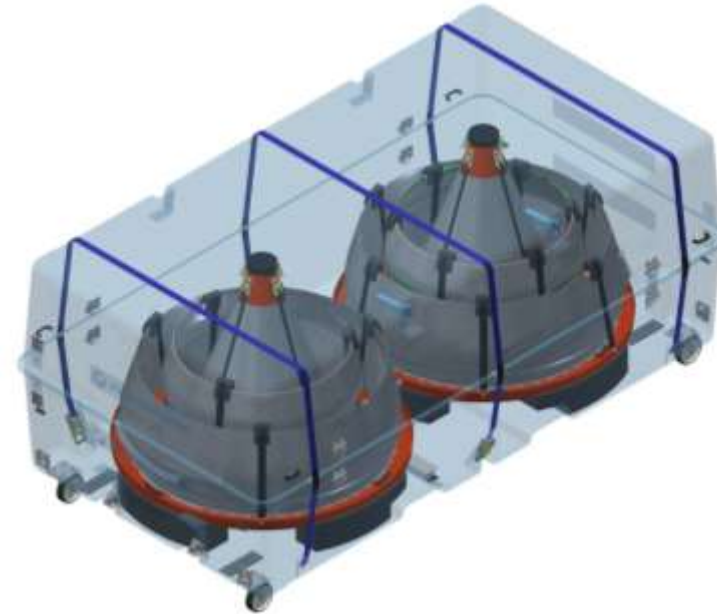


Hat Section
Epoxy/Carbon

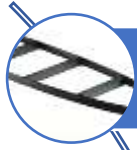
Other Applications - Fiberglass



U-Bracket
Fiberglass/Vinyl Ester



Cone
Fiberglass/Vinyl Ester



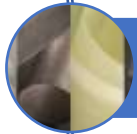
Selective Material Placement



Thickness Variation



Curvilinear Fiber Path



Freedom of Material Input Selection



Fiber Stitch Density

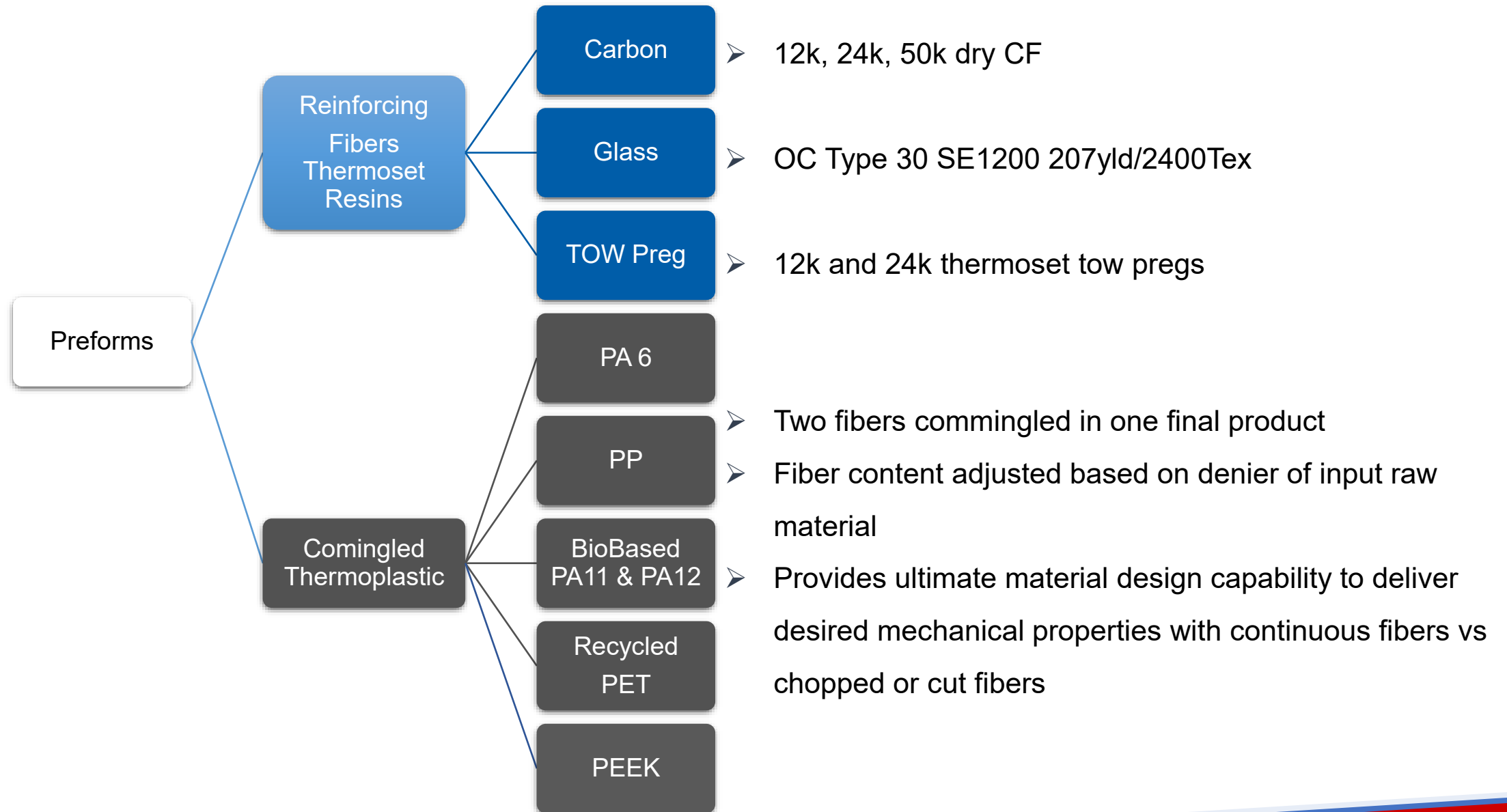


Human Legible Features

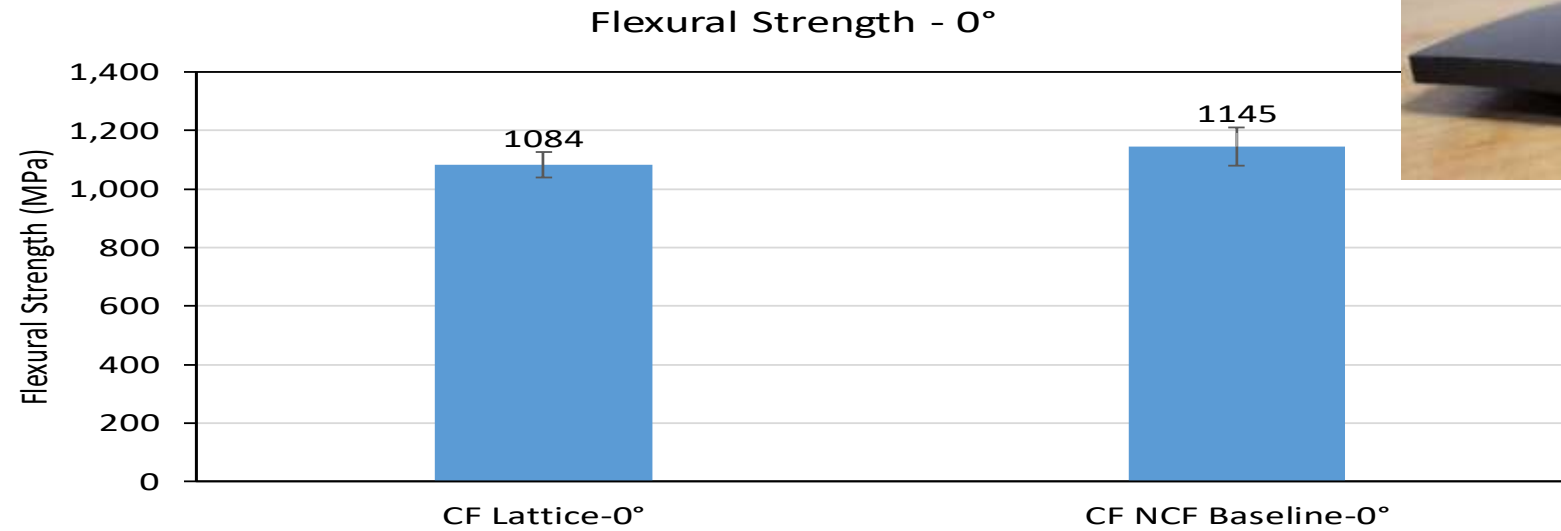


Value Added Carrier Designs

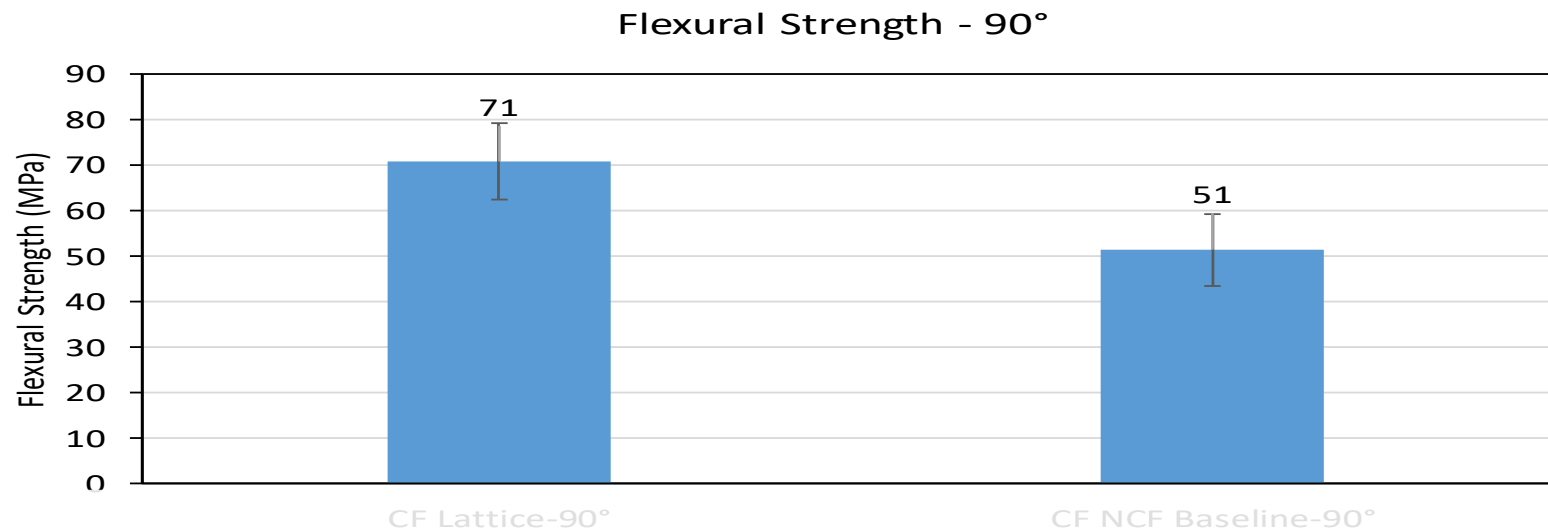
TFP Preform Inputs



Flexural Strength: TFP vs NCF



TFP is at or better in Flex Strength vs. NCF in the 0° and 90° measurements

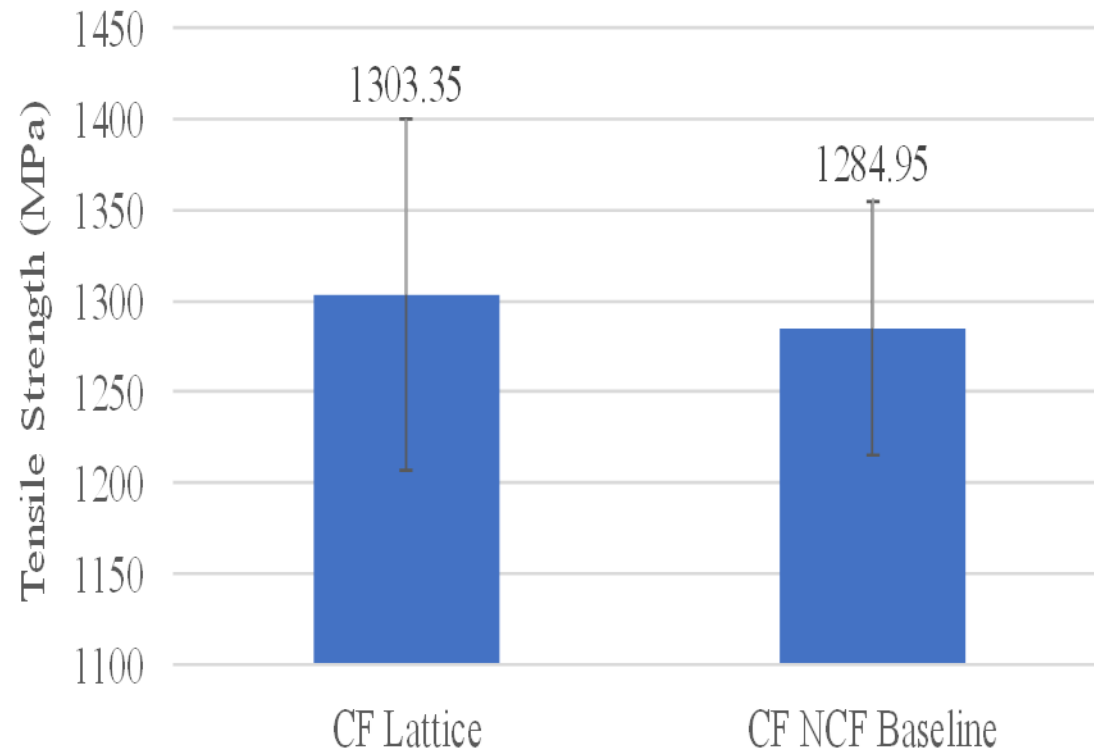


Tensile Strength and Modulus: TFP vs NCF

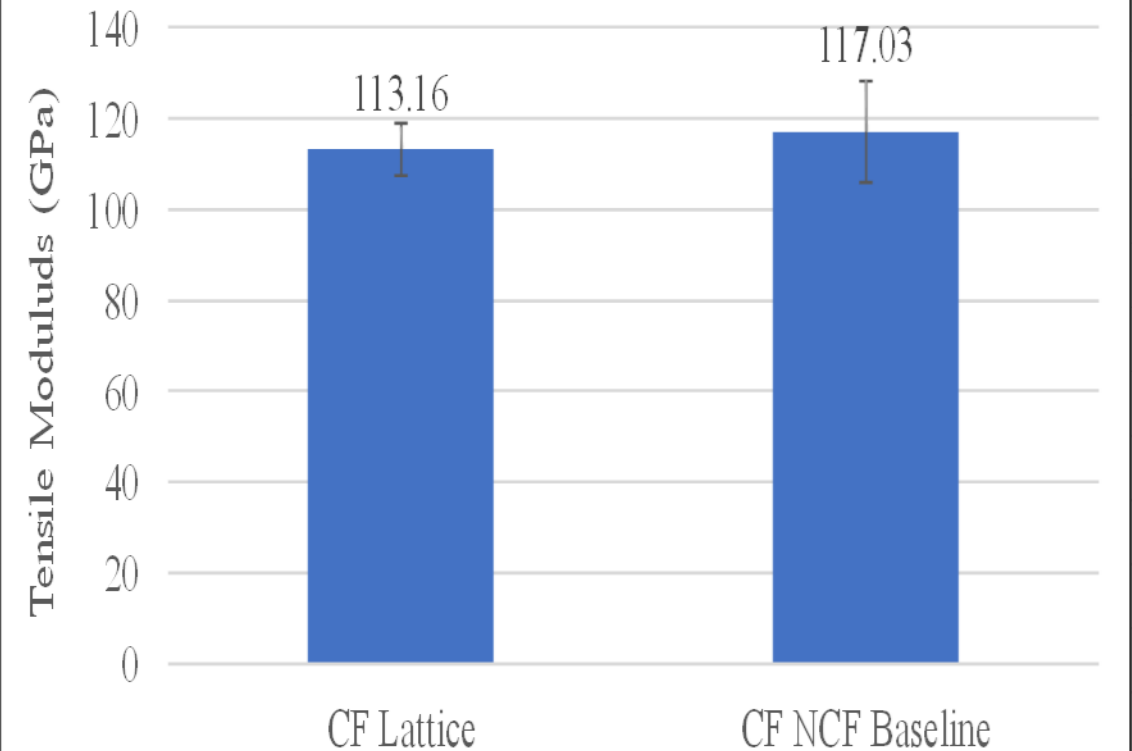


TFP exhibited
similar Tensile
Strength and
Modulus vs. NCF

Tensile Strength



Tensile Modulus



Continuous curved reinforcing fiber vs. drilled hole results in significant tensile strength retention vs. drilled hole performance

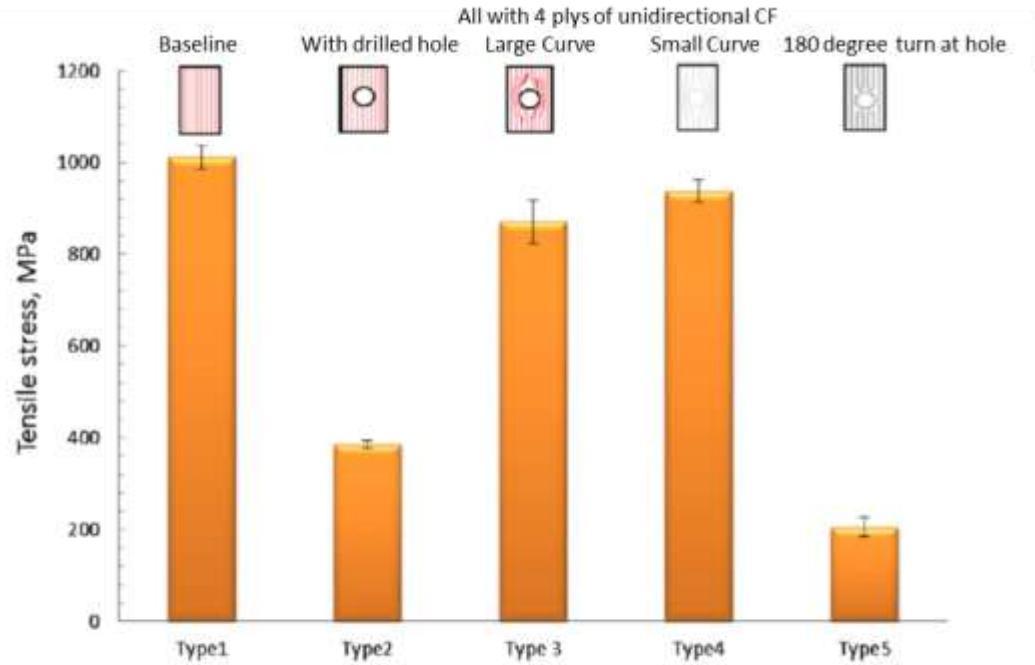


Fig. 10. Comparison of tensile strengths.

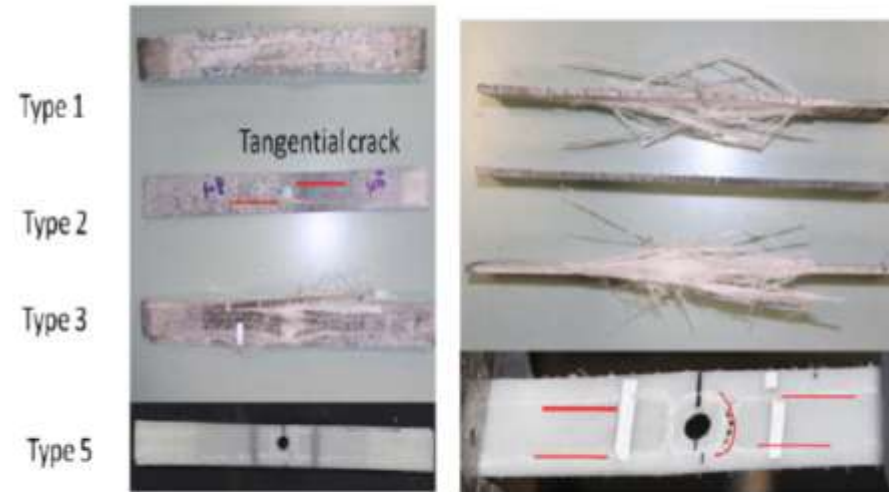
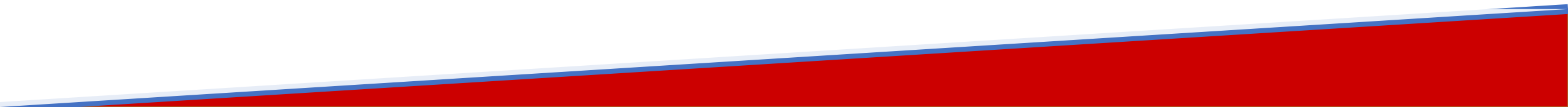


Fig. 12. Failure mode of composite specimens.





Path to Success



Approach

- Verify opportunities potential as a strategic target (lead qualification)
- **Execute NDA** (if necessary)

Interview

- Present TFP process and **educate customer on the value**
- **Project identification**, GAP analysis, and opportunity score generation

Demonstrate

- Develop **initial product samples** (4-6 weeks depending on material requirements)
- Provide **initial price comparison** (TFP vs Current)

Validate

- Test TFP product in process
- **Make Parts**

Negotiate

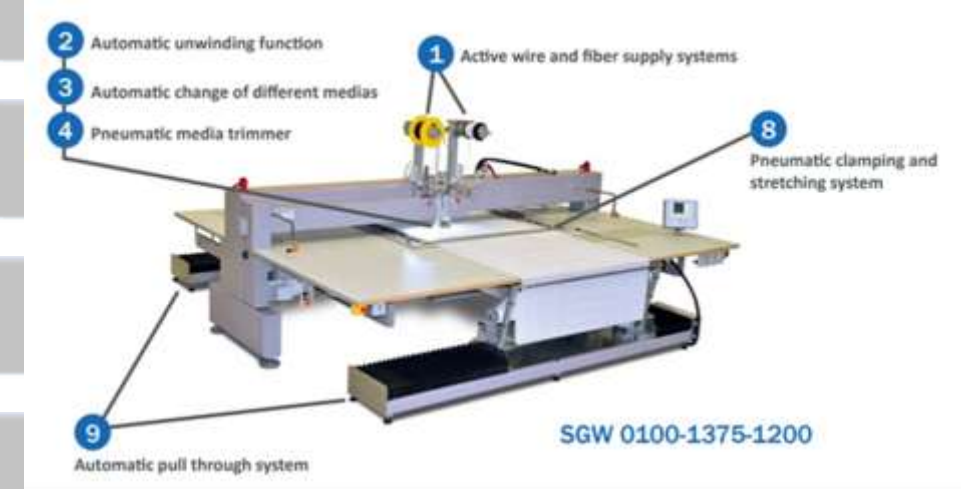
- Work together on feedback
- **Iterate** (if necessary)

Close

- Finalize product design
- Firm **Quotation** Review

Closed Won

- **Purchase Order**
- **Program Timeline and Forecast**



Thank you for interest in NextGen Preforms

Questions?

