

September 30, 2026



PRESENTED BY



Solving Aerospace Weight and Prototype Bottlenecks with Xycomp® Thermoplastic Composite Components

Presented by:
Seth Beckley & Travis Mease

Welcome!

Housekeeping Items:



Presentation will be
~30 minutes long with
time for Q&A
at the end



Submit your
questions via the chat
function



Handouts available



Polls included



Short survey
at the end

About our Speakers



Travis Mease

Travis Mease is **Greene Tweed's Thermoplastics Product Manager for Structural Composites**, specializing in chopped fiber applications. He leads product strategy development and technology roadmap execution, driving the expansion of thermoplastic composites into emerging markets.



Seth Beckley

Seth Beckley is a **Senior Composites Development Engineer** in Greene Tweed's Structural & Engineered Components group, focused primarily on aerospace composites. He is part of a cross-functional team working on new product and process development, manufacturing automation, and rapid prototyping.

Seth recently won a Greene Tweed Innovation Award for the rapid prototype tooling strategy, cutting standard lead times by 50%.



Agenda

1. Introduction to Greene Tweed

2. Xycomp® DLF™ Technology
Overview

3. Benefits and Aerospace
Applications

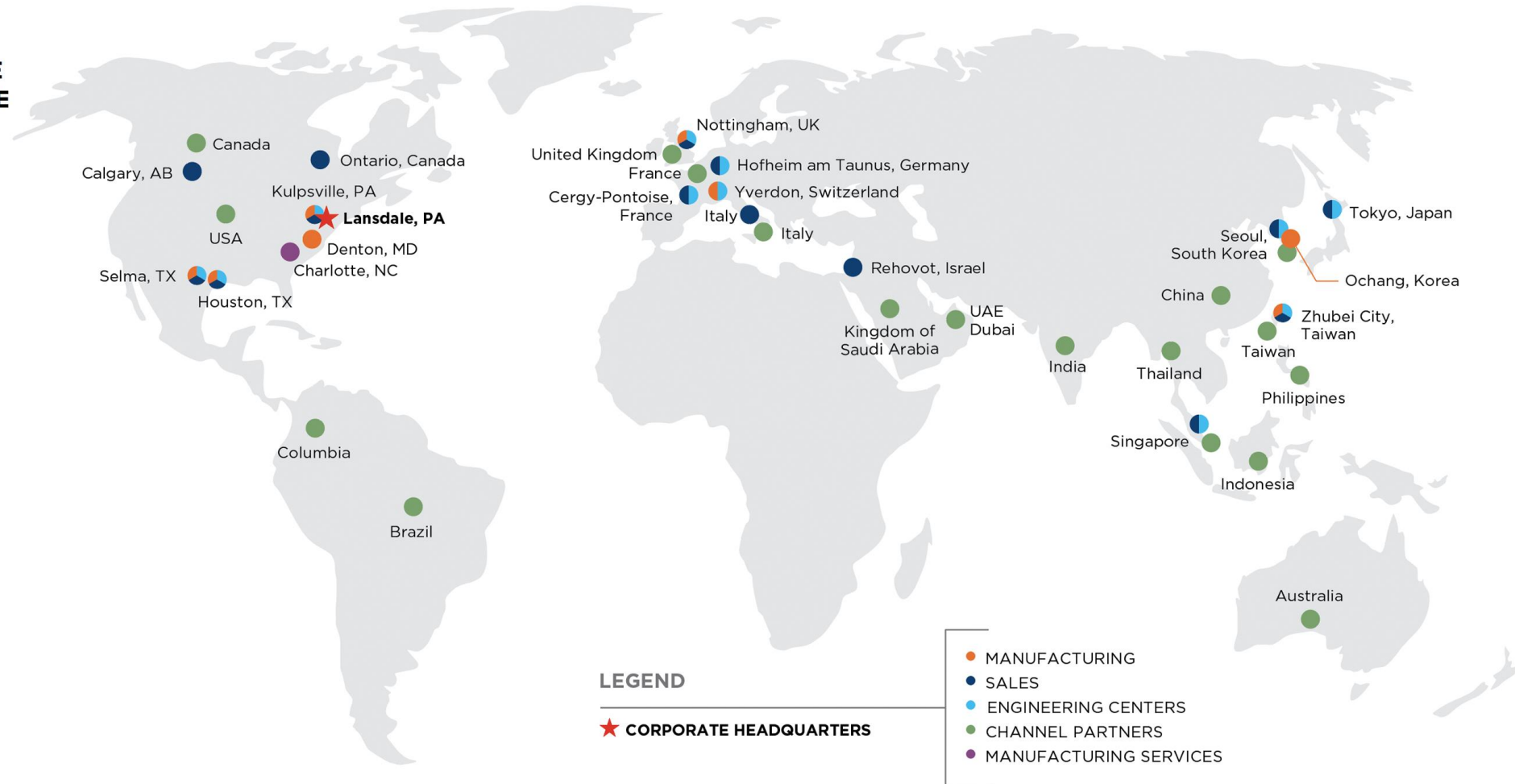
4. Why Rapid Prototyping?

5. Our Rapid Prototyping
Approach and Results

6. Case Studies

Global Presence with Local Support – 1,900 Employees Across 11 Countries

WHERE WE ARE



Greene Tweed's sealing solutions, connectors, structural and engineered components outperform and outlast the competition.



Landing gear seals are relied upon in more than 80% of commercial aircraft.



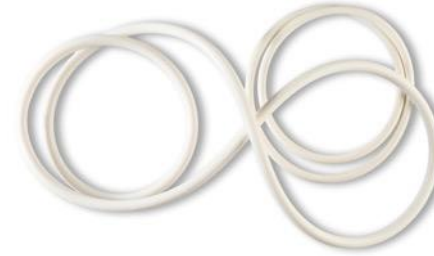
Elastomeric seals withstand 35,000+ pound per square inch (PSI) under 3 miles of ocean in deep water oil & gas wells.



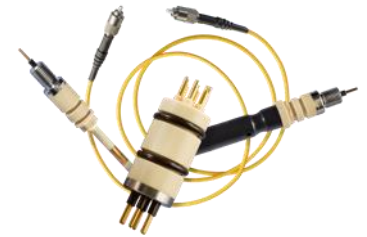
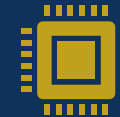
Composite wear parts increase pump, compressor and rotational equipment reliability and efficiency.



Custom-designed structural components reduce aircraft weight to improve fuel efficiency.



Chemraz® FFKM Seals enable the manufacture of chips that power next-generation mobile devices.



Electrical and fiber optic connectors reliably transmit signals in the harshest environments.



Structural and Engineered Components Vision

SEC to be the preferred supplier of value-proven thermoplastic composite product solutions in the market segments that we service today and tomorrow

VISION

WR/AR® | ONX® | Arlon® | Orthtek® | Xycomp® DLF



METAL REPLACEMENTS

Engineered Components

Equipment & Process Efficiency | Wear/Abrasion/Chemical Resistance

Structural Components

Weight Reduction | Complex Shapes

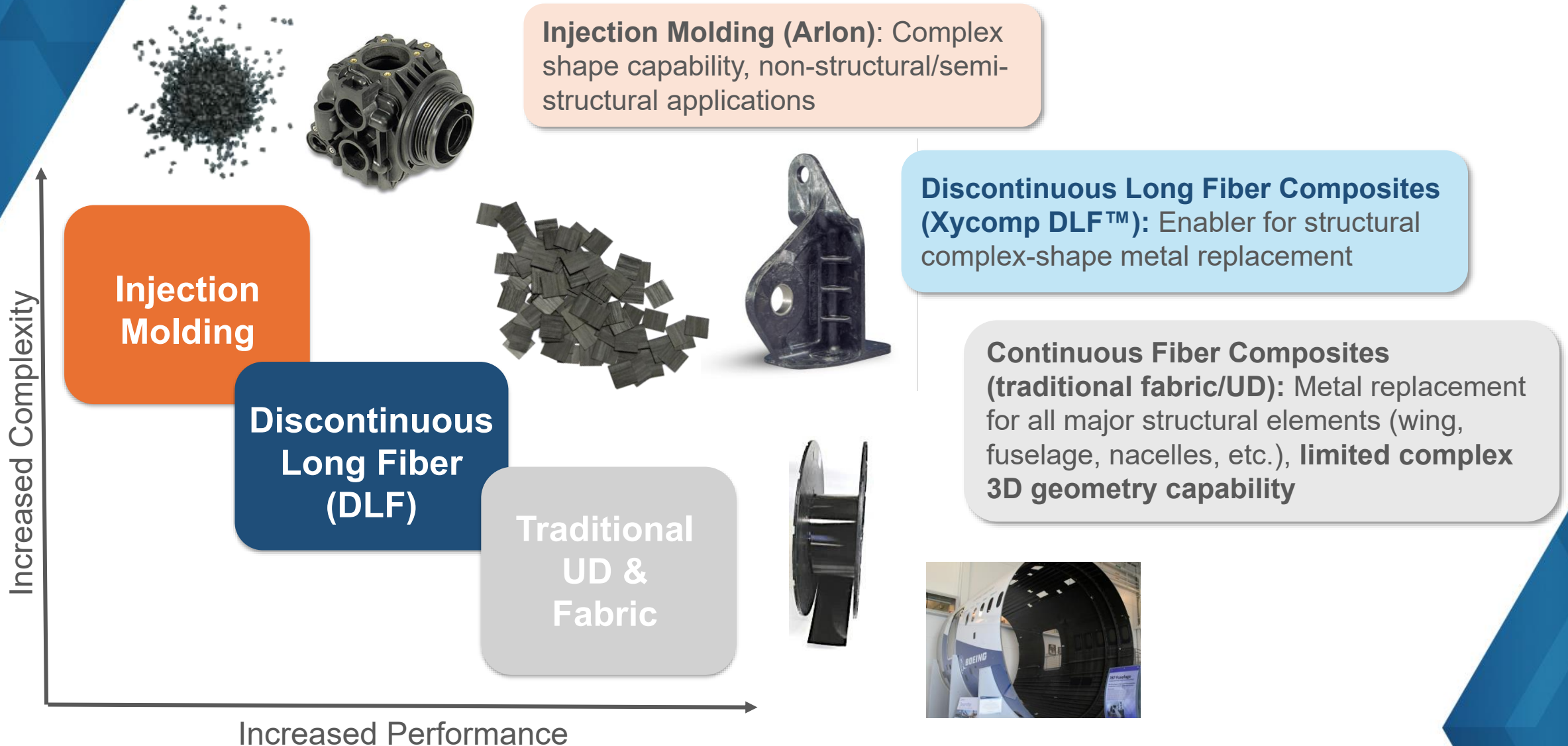
Poll Question:

When evaluating a new lightweight composite component, which factor is most important during prototyping?

- Rapid turnaround time
- Production-representative material properties
- Mechanical performance validation
- Weight reduction potential



Xycomp® DLF™ – Understanding the Basics



Xycomp® DLF™: Tape to Molded Part

- Aerospace-approved carbon fiber reinforced unidirectional prepreg tape “parent” material – PEEK, PEKK, PEI matrix
- Chopped by GT into random flake product form
 - Very high carbon fiber content (70% by weight)
 - Long fiber reinforcement (≥ 0.5 "/13mm in final molded parts)
 - Material certification/control at UD tape level
 - Resin content, fiber areal weight, lot/batch control
- Matched-die compression molded into finished parts
- Xycomp® carbon/nylon DLF™ available for non-aerospace applications



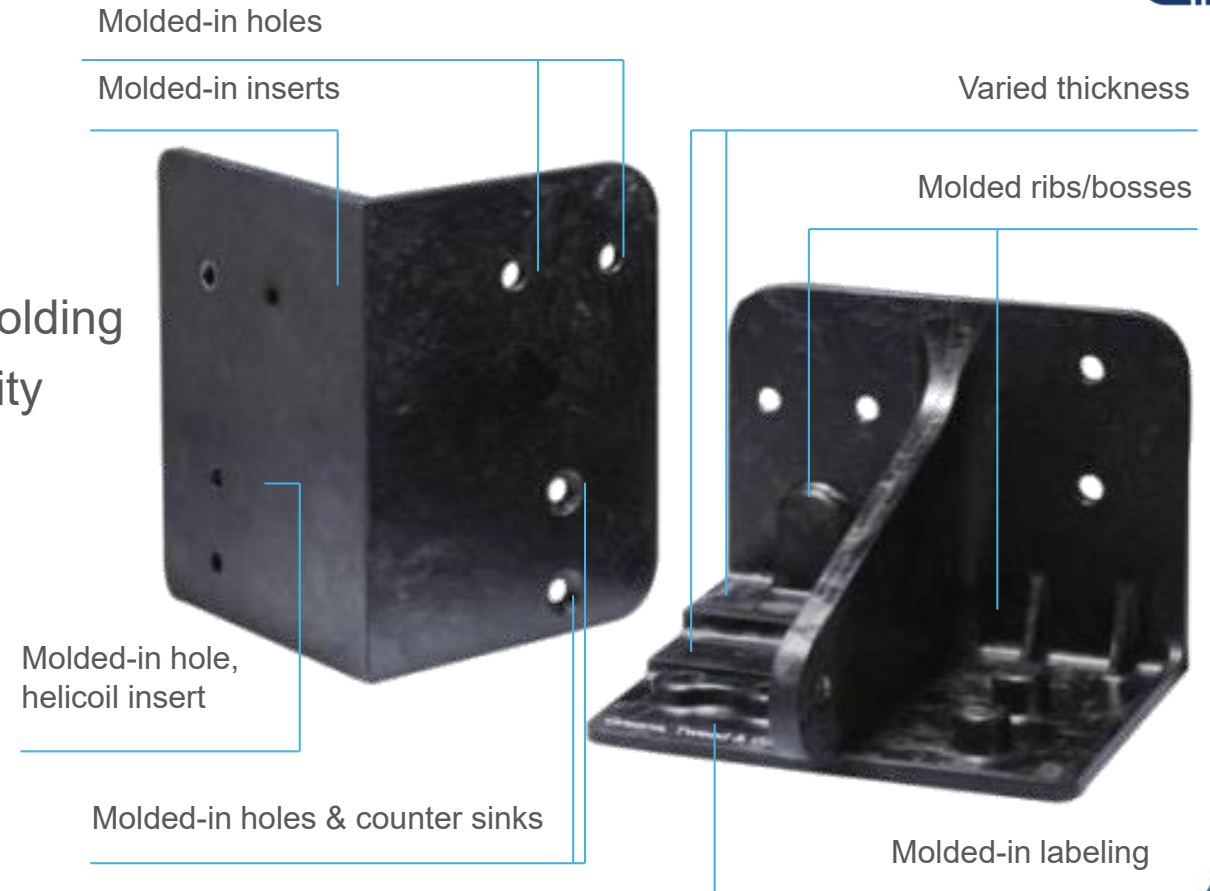
Xycomp® DLF™: Benefits and Capabilities

- Thermoplastic matrix
- Carbon fiber reinforcement
- Net/Near-Net Compression Molded
- Increased performance vs. injection molding
- Cost-effective composite parts capability for complex-shape metal replacement



DLF “chips”

- No material pattern cutting or layup, minimized touch-labor
- Minimal material waste, minimal post-mold trimming/machining
- Molded-in features (fasteners, bushings, inserts, bosses, ribs)

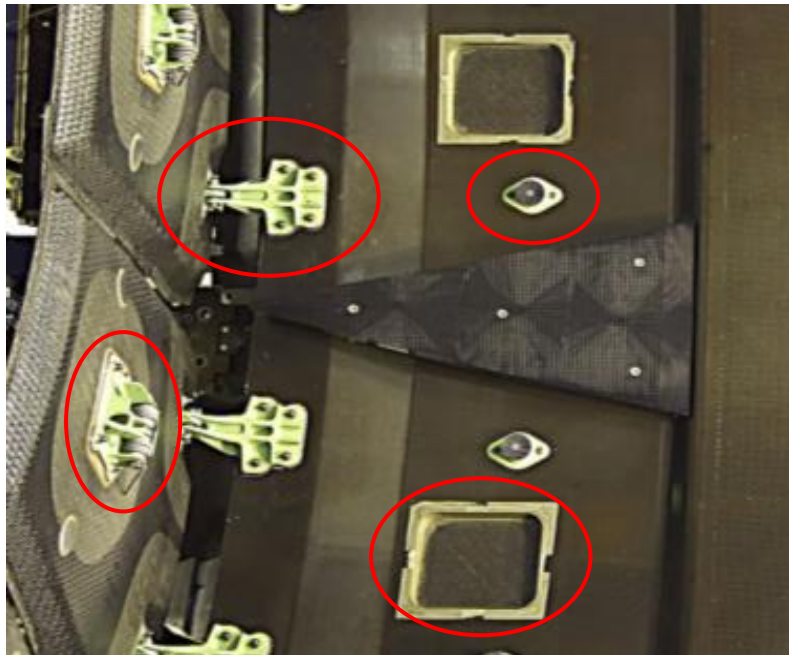


Complex-shape Metal Replacement Gap

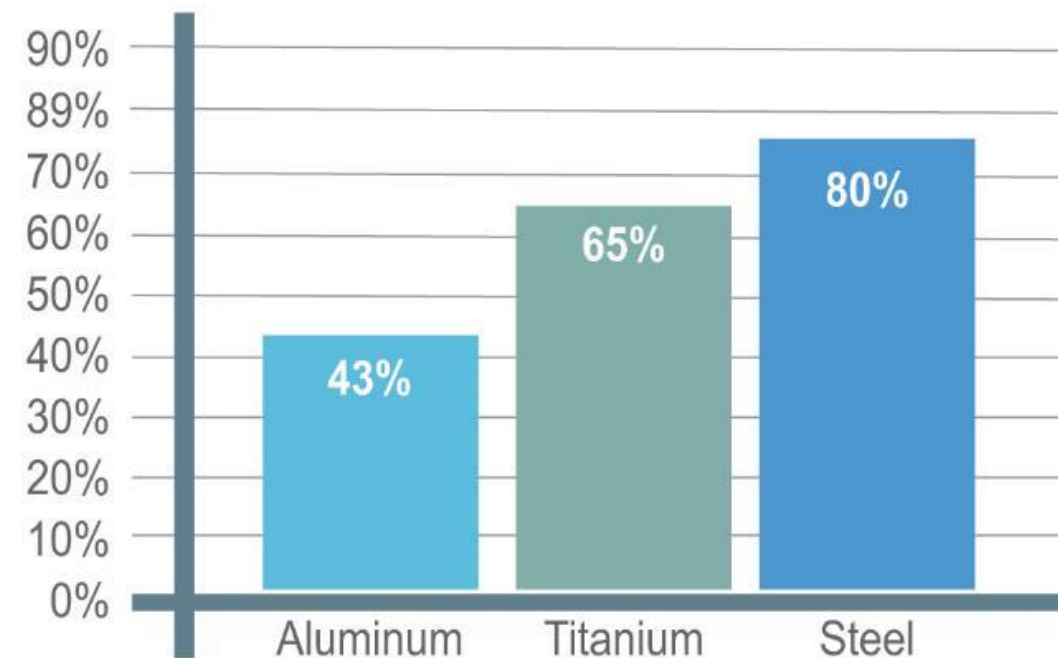
Example

Composite focus / metal issues:

- Weight
- Galvanic corrosion/isolation
- CTE mismatch
- Feasibility/cost limitations for complex shapes with traditional composites



DLF Density Reduction %



Results in typical minimum 35%+ weight savings vs. aluminum in actual parts (typical minimum 40%+ vs. titanium or steel)

Application Focus For Best Value

“Complex” vs. “Simple” Metal Parts Replacement

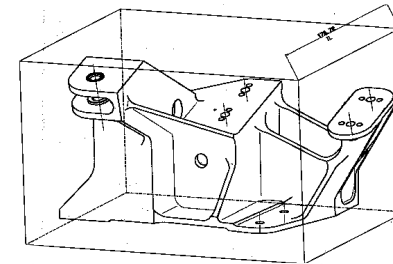
Best value for DLF:

- High complexity machined parts or multi-component assemblies
- Moderate to High quantity (200 – 50,000 + total volume)

	Complex Metal	Simple Metal	DLF®	Comments
Material Waste	X	—	✓	5X-20X machining waste for Complex, 10%-20% for Simple, net molded for DLF
Machining Cost	X	✓	✓	High machining cost for Complex, minimal for Simple, net molded for DLF
Weight Savings	X	X	✓	Typical 35% or more weight savings for DLF
Parts Consolidation	X	X	✓	Parts-consolidation possible with DLF

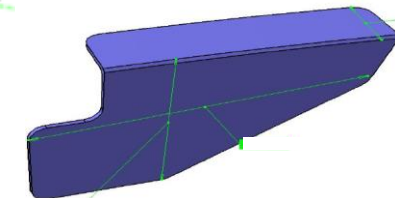
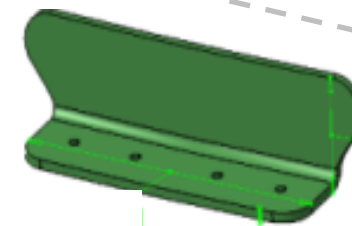
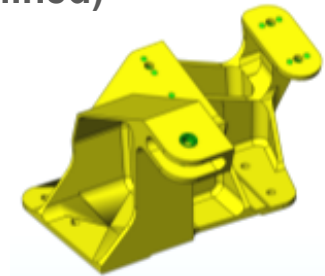
- ✓ **Complex: Machined from plate/billet stock (high BTF)**
- ✓ **Multi-part assemblies (parts-consolidation)**

6 lb. (billet)



20X BTF (7075 AL @ \$6/lb. x 20 = \$120/lb. in finished part)

0.3 lb. (machined)



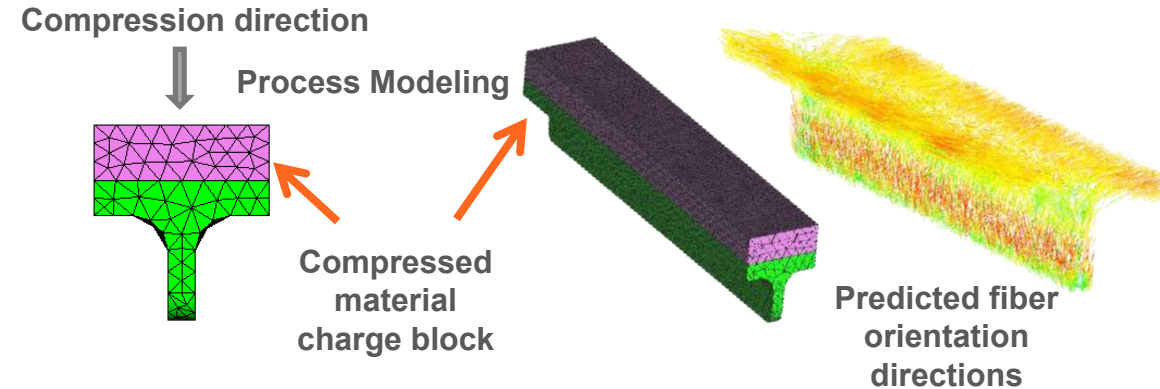
DLF™ Process Modeling & Predictive Analysis

Process Modeling

Mold thermal analysis & modeling

Modified flow prediction software

- Mold filling progression
- Fiber orientation prediction
- Residual stress from process



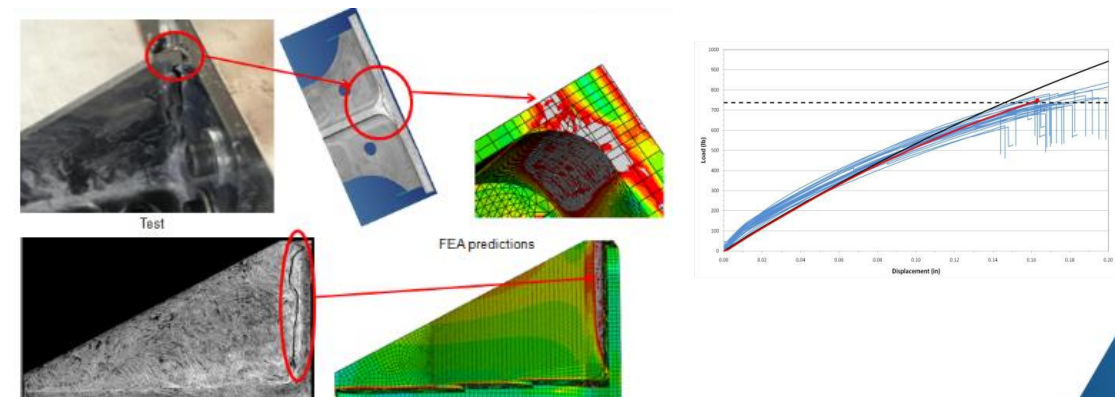
FE Analysis

Nonlinear micromechanics- based model

Predictive performance

- Elastic and nonlinear response prediction
- Progressive damage simulation
- Ultimate load prediction
- Load/displacement curve
- Failure locations

Map Flow/Fiber Orientation + Material Allowables Data to FEA model



Xycomp® DLF™: Material Characterization / Design Allowables

Building block approach per CMH-17:

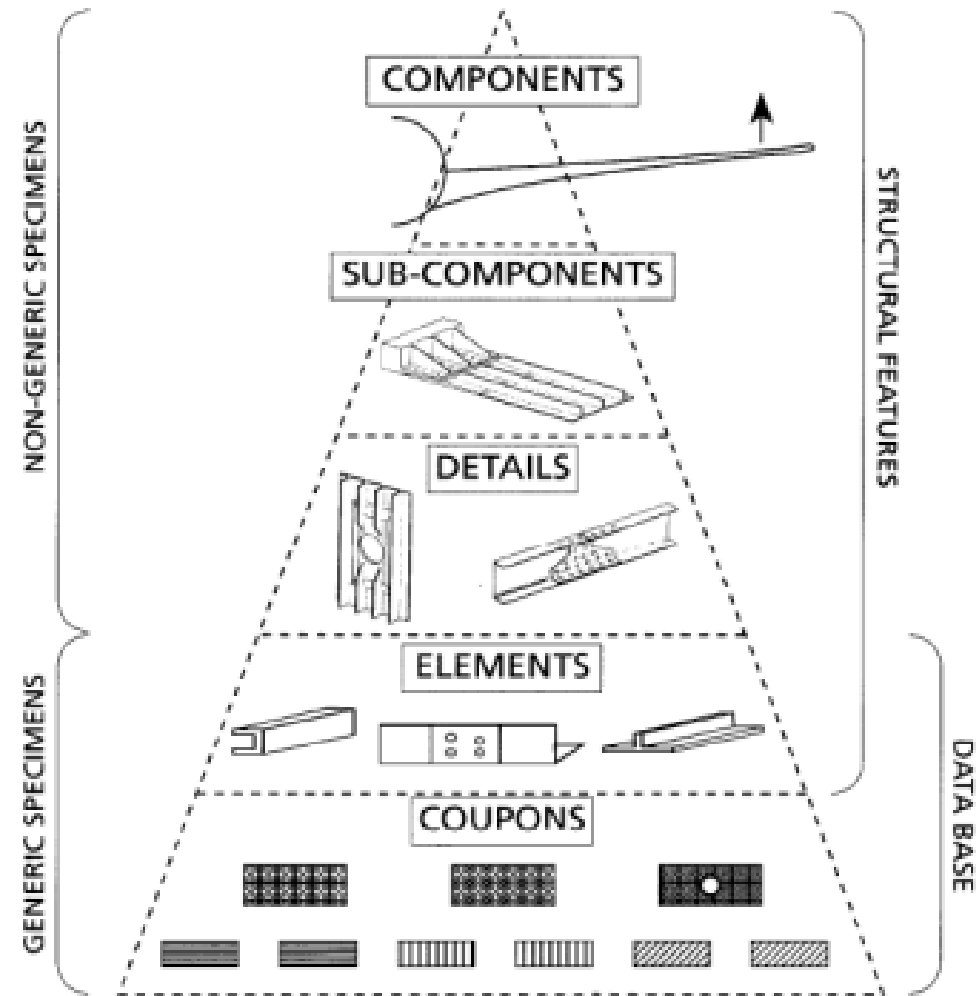
- Multiple material batches
- Controlled material specifications
- Locked-down/controlled molding process

Typical Application Conditions

- Cold, RT, hot, hot/wet environments
- Notched, Un-notched
- Multiple thicknesses, x-y-z directions
- Moisture uptake
- Aerospace solvents
- Fatigue, creep, thermal cycling, impact

Mean and B-Based Values Generated:

- Used for sizing and FEA



DLF™ Pedigree

- First in-flight parts in 2010
- ~ 500,000 DLF components currently in service across 12 commercial aircrafts
- Primarily engines, nacelles, interiors, landing gear brackets

Our clients have chosen to adopt DLF due to:

- **WEIGHT:** Provides 35%-50%+ weight savings vs metals
- **PART CONSOLIDATION:** Replace multiple components into a single molded component
- **PROPERTIES:** Excellent chemical compatibility & temperature performance
- **COST:** Efficient, consistent and automated process for composite manufacturing



Global Certifications

- AS9100 Rev D
- ISO 9001:2015
- ISO/IEC 17025
- Nadcap (NDT-DDA)
- Nadcap (Non-Metallic Material Testing)
- Customer Specifications/Qualifications



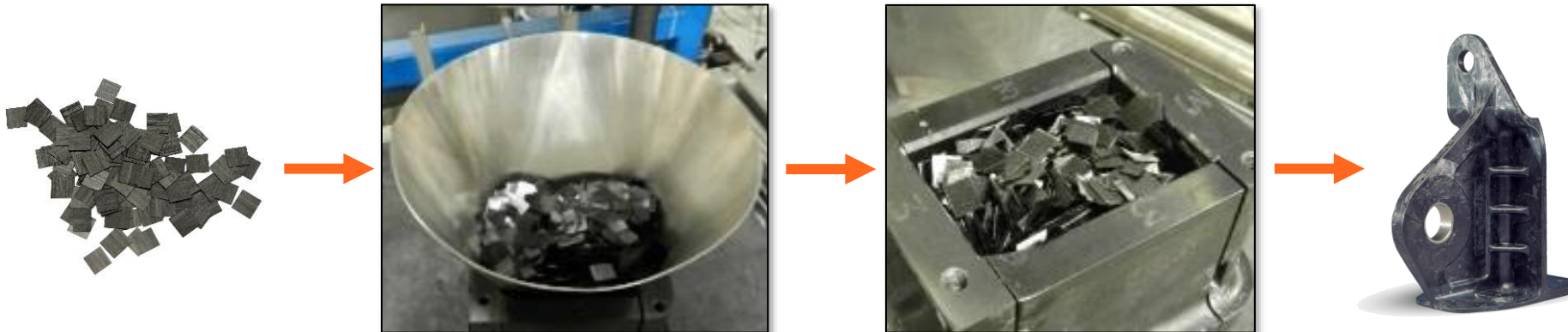
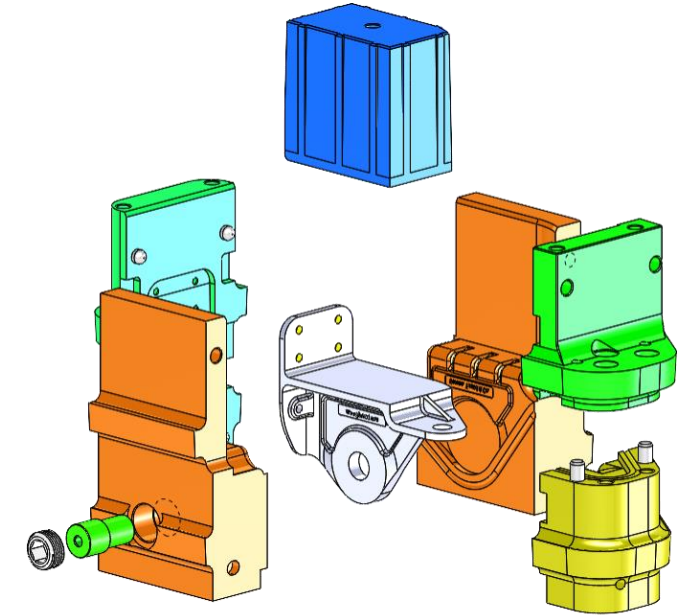
Xycomp® DLF™ Molding

Material:

- Xycomp® DLF™
 - Chopped fiber thermoplastic prepreg
 - Typically PEEK, PEKK, PEI, or PA6 resins

Processing:

- Tailored compression molding process
- Complex multi-piece mold designs
- Processing temps: ~650-750 °F
- Molding Pressure: 1000+ psi



Poll Question:

What is the biggest bottleneck in your prototype-to-part development cycle today?

- Tooling cost and NRE
- Lead time to first functional parts
- Inspection and qualification requirements
- Design iterations and late geometry changes
- Weight or performance targets we can't hit with metal



Why Rapid Prototyping?

Production-oriented development process is well aligned with FAI, PPAP, and AS13100 requirements

- Production tool design and formal review
- High-precision tool building and fitting
- Molding cycle DOEs
- Machining repeatability
- Inspection gage R&R

Standard development process sets up production success, but also drives NRE cost and lead time

High NRE costs and long lead times have been a barrier to entry in some segments of these industries

We need a rapid prototyping process



Thermoplastic Composites Prototyping

Prototyping for compression molded thermoplastics looks different than for traditional thermoset layups

Because we want production-representative part properties, typical alternatives to compression molding aren't appropriate

Any innovation to produce compression molded prototype parts is likely to still involve compression molding

Aircraft interior panel



Next-gen
composite bracket

Exhaust vent



Seat



Wing rib



VBV door



Xycomp® DLF™ Rapid Prototyping

Constrained to a compression molding process, how can we accelerate the development process, and reduce the upfront costs?

- Alter tool design strategy to enable faster, cheaper tool builds
- Embed prototyping strategy into the part design
- Break down inspection and qualification requirements to the bare minimum for functional prototypes



Tool Design Strategy

Tool design and build strategy can be altered significantly to reduce cost and lead time, if prototyping goals are well understood

Characteristic	Production Tooling Goal	Prototype Tooling Goal
Tooling Life Expectation	10,000+ cycles	50-100 cycles
Fits	Tool fit must minimize flash, and ensure tight, repeatable fits	Tool fits must be good enough to not flash badly
Finishes	Cavity surfaces should be polished to yield smooth, tooling mark free part surface	As-machined cavity surfaces are generally acceptable
Assembly/Disassembly	Must be precise, error proof, and repeatable for operators to perform daily	May require more manual alignment during assembly, more complicated part extraction during disassembly
Turnaround Time	Must to be minimized to maintain production throughput	Turnaround time is not critical for prototype work
Handling	Tool components must have hoist-lift compatible features	Tool components must be able to be lifted, or else have lifting features

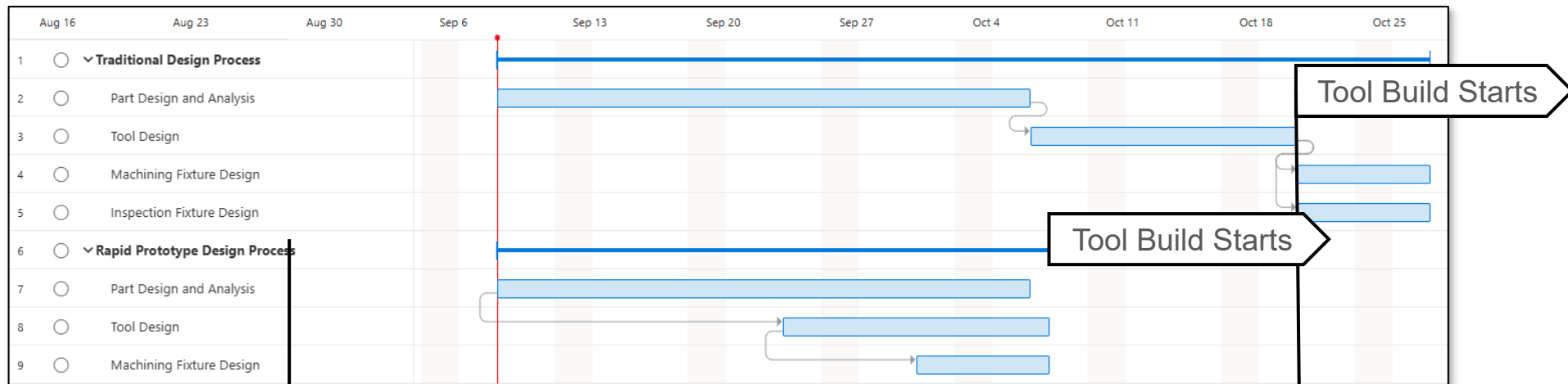
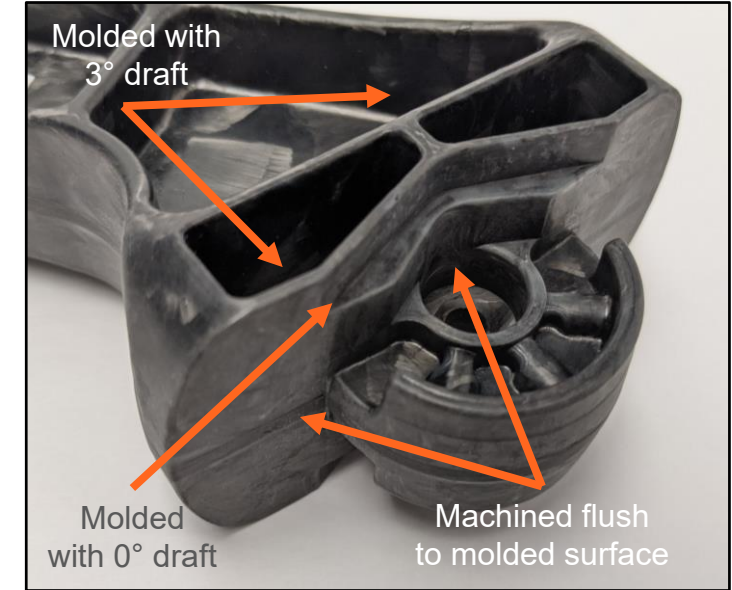
Part Design Strategy

Embed prototype strategy into part design

- Tooling splits, molding orientation, draft requirements, to reduce tooling complexity and cost
- Determining machined vs net-molded features

Consolidate part/mold/fixture into simultaneous design

- Tooling design is completed as part design is completed

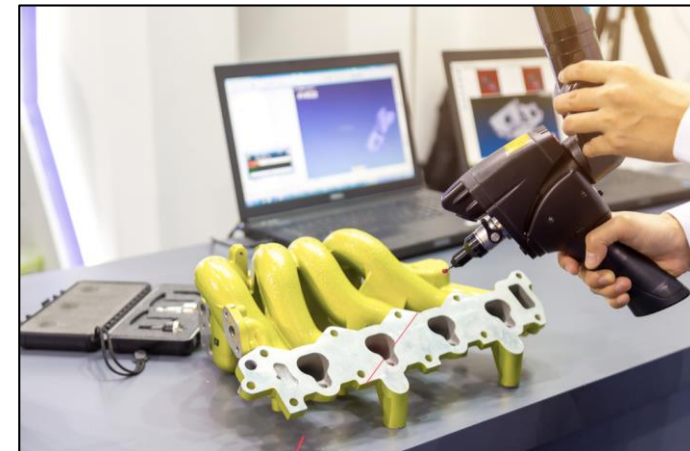
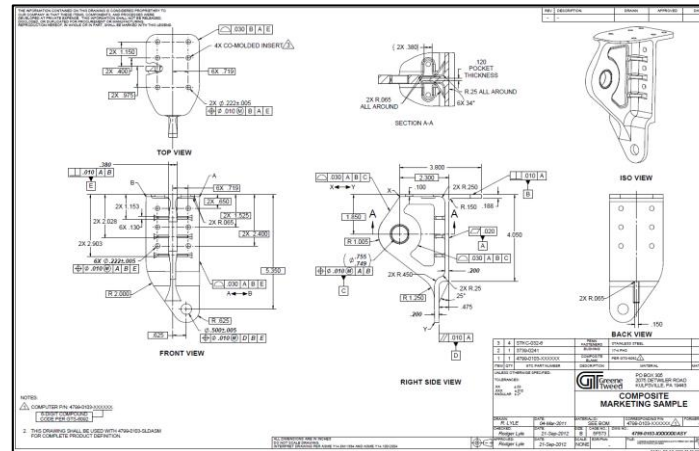
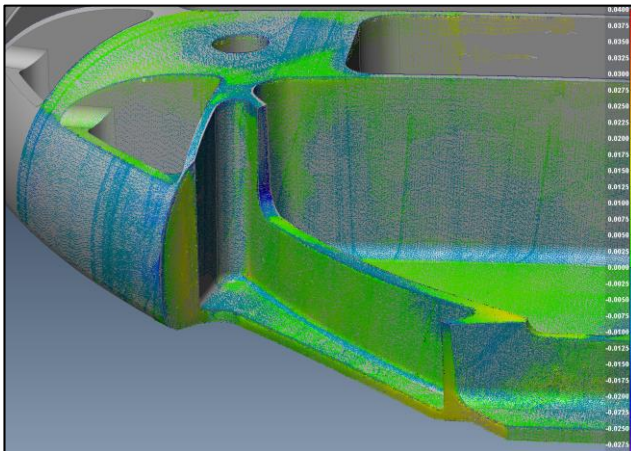


Inspection and Qualification

Reduce inspection and qualification requirements to the bare minimum required for prototype use

- Print requirements
- Critical dimensions
- Hand checks vs CMM
- Inspection data & FAI

Trust and collaboration are critical during this stage



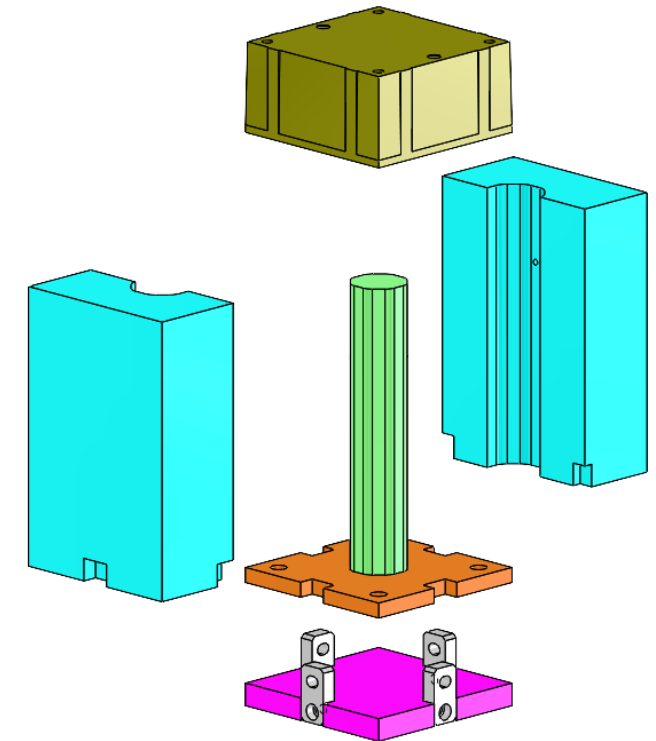
Results: Lead time reduced to 8 weeks

Since introduction in 2024, we have implemented this rapid prototyping approach successfully on multiple projects

- Lead time cut from 16-20 for production-oriented process, to 8 weeks for prototype process

Example: Demo Handguard

- Functional and dimensionally compliant prototypes were needed for testing
- Parts delivered 8 weeks from design lock



Prototype Mold Inserts

Xycomp® DLF™ Application Examples

- Fairings, structural brackets, supports, enclosures, covers, interiors
- Birdstrike, hail impact, erosion, fire considerations
- CNC machined metal and lay-up replacement



Airflow Structures

Fittings/Brackets

Enclosures/Covers

Summary and Conclusions



Proven in flight:
~500,000 Xycomp®
DLF™ parts on 12
commercial aircraft,
35%+ lighter than metal



Faster prototypes: rapid
prototype tooling cuts lead
time from 16–20 weeks to 8
weeks at lower NRE



Best value: complex
machined parts and multi-
piece assemblies across
aerospace, defense, and
advanced air mobility

The Greene Tweed team welcomes the opportunity to help you solve your technical challenges with these innovative, patent protected material platforms

Resources to browse

WHITEPAPER

Xycomp® DLF™: High-Performance Thermoplastic Composites' Role in Reshaping Aerospace Component Manufacturing



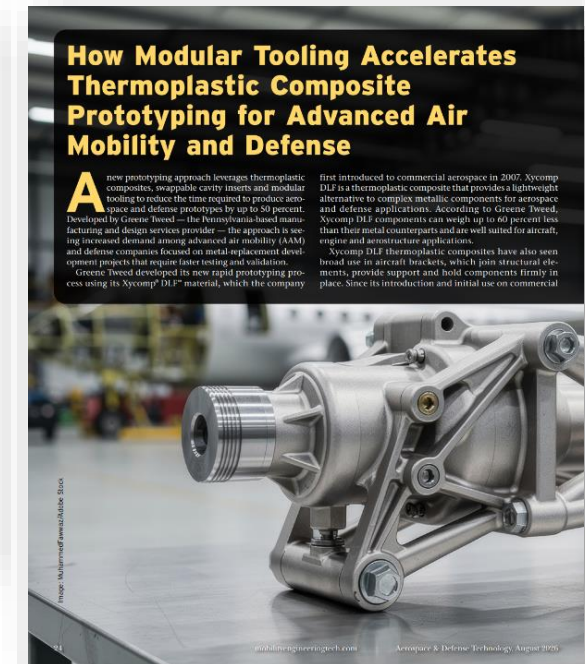
CASE STUDY

Engineering the Margins of Victory:
Xycomp® DLF™ Anti-Roll Bar Lever
– Arrow McLaren IndyCar Team &
Greene Tweed Collaboration



TECHNICAL ARTICLE

How Modular Tooling
Accelerates Thermoplastic
Composite Prototyping for AAM
& Defense



Join Us at These Upcoming Events

DEFENSE

AUSA Annual Expo

Meet us on the floor

- October 12-14
- Washington, DC

AAM

eVTOL Show USA

Meet us at our tabletop

- November 17
- San Jose, CA

AERO

JEC World 2027

Meet us at our booth

- March 2-4, 2027
- Paris, FR

Questions or Comments?

