CASE APPLICATION:

General Plastics' High-Temperature Tooling Foam and Machining Services

Help Aerospace Innovator Compress its Research & Development Cycle

King Air 250 with BLR Winglet System - - Photo Copyright ® BLR Aerospace

GENERALPLASTICS
MANUFACTURING COMPANY

Faster True-to-Life Prototyping Speeds New Products to Market Thanks to Expertly Machined High-Temp Tooling Board

THE APPLICATION:

Based in Everett, Wash., BLR Aerospace specializes in aerodynamic performance enhancements for helicopters and turbine-powered aircraft. These exterior modifications include proprietary winglet systems, dual tailboom strakes, vortex generators and its FastFin® tail-rotor enhancement and stability systems. They are sold to industry-leading OEMs, notably Beechcraft Corporation and Bell Helicopter, where they've become standard on helicopters and airplanes. BLR's products are also sold in the aftermarket for retrofitting a range of aircraft. The 24-year-old company's performance-enhancing technologies enable operators to fly higher, faster and farther, as well as more efficiently and safely.

A developer of patented technology, BLR is innovation-focused and market-driven. It identifies needs and niche opportunities, then designs and manufactures products to fulfill them. Currently, its emphasis is on bringing new helicopter products to market.

THE CHALLENGE:

KEY REQUIREMENTS:

- Temperature stability – at least 250˚F
- A lower-cost prototype tooling option
- Superior machinability
- Lighter-weight, easy-to-handle material
- Reduced prototyping time
- Expert machining services

BLR Aerospace is continually developing new aerodynamic cowlings it can bring to market quickly and profitably. This necessitates ongoing research and development – including multiple iterations of composite parts to ensure they fit precise specifications and perform as intended. The company required a stable, easily machined tooling material for prototyping composite parts, specifically large-scale, true-to-life carbon fiber and fiberglass parts. Their design engineers sought an affordable alternative to more permanent tooling to allow for various design iterations, while factoring cost and time requirements. Previously, the company used metallic tools, which were time-consuming to produce and expensive. They wanted a material that was not so heavy and cumbersome to handle when laying up parts, and that would cost less to ship to their manufacturing facilities across Washington and Oregon.

One of the other materials BLR experimented with was medium-density fiberboard (MDF), which is relatively cheap and machinable. However, in use it fell short in one key thermal property: temperature stability at a minimum 250 degrees Fahrenheit. A wood-based product, the MDF tool had wild variances in tolerances, creating a lot of distortion. The resulting parts had unpredictable dimensions as well as waves and warping within the part.

"Working with the General Plastics team has been great. They are easy to reach and very fast. .... We've had great results with them, and the speed and accuracy of the turnaround has been a huge plus for us."

-Russell Bezzo, BLR Lead Project Engineer

Bell 412 with FastFin® System - Photo Copyright ® Bell Helicopter

THE SOLUTION:

General Plastics' LAST-A-FOAM® FR-4700 High-Temperature Tooling Board and CNC Machining Services

After the MDF tool proved unacceptable, BLR zeroed in on General Plastics and our LAST-A-FOAM® FR-4700 High-Temperature Tooling series. According to lead project engineer Russell Bezzo, preference for General Plastics' products within the aerospace industry drove them to investigate our materials. They determined that the FR-4700 met their specific needs, and primarily use the 30-pound material as tooling for prototyping parts that become their aerodynamic fairings.

"Machining tools using this foam allows us to lay up the carbon-fiber and composite parts, put them in the oven and make true-to-life prototypes using the actual materials that we'll use in production," Bezzo said.

He explains that the FR-4700 maintains the required properties, remaining very stable and uniform when it expands and contracts during the curing cycle. The foam provides excellent

FR-4700 BENEFITS:

- Withstands peak temperatures up to 400°F
- Supports continuous-use temperatures up to 350°F
- Highly machinable
- Consistently uniform
- Dimensionally stable

machinability and allows for tight tolerances, necessary in the world of prototyping. Moreover, the lower-weight tools are less cumbersome to handle when making prototypes and cost less to ship to their composite manufacturing facilities. As a result, BLR can make a single, life-size composite part and determine if it will fit or satisfy the specific need, at a substantially lower cost and in significantly less time. This is far more economical than machining large pieces of metal for a prototype tool that is used only once, ultimately wasting tens of thousands of dollars.

Beyond the performance and cost efficiencies of the FR-4730 foam, BLR takes advantage of General Plastics' expertise and CNC machining capabilities to make its prototype tools.

According to Bezzo, this provides multiple benefits:
- The entire process is controlled within one facility.
- It expedites the timeline by cutting out the middleman. BLR doesn't have to ship huge foam blocks to a separate shop to be machined and then ship the machined tools to another to build its parts.
- The experts who produce the foam know the materials and how to machine it best – what kind of bits and which feed rates to use, eliminating the guesswork.

"Working with the General Plastics team has been great. They are easy to reach and very fast. We email back and forth directly with the machining team," said Bezzo. "We've had great results with them, and the speed and accuracy of the turnaround has been a huge plus for us."

Overall, relying on General Plastics for both its high-temperature tooling foam and CNC machining capabilities has allowed BLR to maintain a short timeline and cost targets. They have been able to achieve tighter tolerances with their prototype FR-4700 tools.

Additionally, BLR can use the actual production material instead of a prototype material, resulting in highly accurate, true-to-life prototypes for testing and installation on aircraft. A shorter turnaround for tools means faster design and prototype iterations, compressing research and development time.

The upshot for this aerospace innovator? It gets new products to market faster and with greater cost efficiencies for a bigger business lift. So, with the performance enhancements provided by General Plastics, BLR Aerospace can fly higher, faster and farther.

GENERAL PLASTICS' CNC MACHINING SERVICES:

- One-stop shop for foam production, bonding and machining
- Support any data file format
- Can work from dimensioned part drawing
- Extra-large routers for large projects
- CNC vertical milling machines for intricate details and production work

Bell 2016 with BLR Dual Tailboom Strakes - Photo Copyright ® Bell Helicopter

LAST-A-FOAM® FR-4700 TOOLING BOARD TECHNICAL DATA

PROPERTY	FR-4718	FR-4730	FR-4740	TEST METHOD
Density, pcf (kg/m^3)	18 (290)	30 (480)	40 (640)	ASTM D-1622
Compressive Strength, psi (MPa)				ASTM D-1621
Parallel to rise @ 75°F (24°C)	1,350 (9.29)	3,350 (23.1)	4,950 (34.1)	
Parallel to rise @ 350°F (177°C)	665 (4.59)	1,640 (11.3)	2,700 (18.6)	
Perpendicular to rise @ 75°F (24°C)	1,060 (7.34)	2,790 (19.2)	5,000 (34.5)	
Perpendicular to rise @ 350°F (177°C)	387 (2.67)	930 (6.41)	2,750 (18.9)	
Compressive Modulus, psi (MPa)				ASTM D-1621
Parallel to rise @ 75°F (24°C)	46,400 (320)	71,200 (491)	110,000 (758)	
Parallel to rise @ 350°F (177°C)	26,100 (180)	44,700 (308)	72,800 (502)	
Perpendicular to rise @ 75°F (24°C)	31,800 (219)	59,300 (409)	106,000 (733)	
Perpendicular to rise @ 350°F (177°C)	10,000 (69.2)	23,000 (158)	68,600 (473)	
Flexural Modulus, psi (MPa)	14,200 (98)	67,700 (467)	153,000 (1050)	ASTM D-790
Flexural Strength, psi (MPa)	282 (1.94)	1,280 (8.83)	2,170 (15.0)	ASTM D-790
Tensile Strength, psi (MPa)	290 (2.0)	690 (4.8)	2300 (16.0)	ASTM D-1623
Coefficient of Thermal Expansion (CTE)	75°F-400°F, 27x10^{-6} in/in*°F (24°C-205°C, 46x10^{-6} m/m*K)			ASTM E831 (modified-temp range)
Glass Transition Temperature [T_g], °F (°C)	428 (220)	426 (219)	424 (218)	ASTM E-1824
Thermal Conductivity, BTU*in/ft^2*°F*h (W/m*K)	0.42 (0.06)	0.63 (0.09)	0.91 (0.13)	ASTM C-518 AT 75°F (24°C) mean temp

This data is subject to revision and changes due to development of and changes to the material. The data is derived from tests and historical usage. The data is averaged data and should be treated as such. Calculations should be verified by actual tests. The data is furnished without liability for the company and does not constitute a warranty or representation in respect to the material or its use. The company reserves the right to release new data sheets in replacement.

Call us at 866-825-1378 to learn more about our high-temperature tooling foam series or CNC machining capabilities.

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