Air Force SBIR/STTR

Innovation

Air Force SBIR/STTR Innovation Story

SBIR Topic Number:
AF01-158

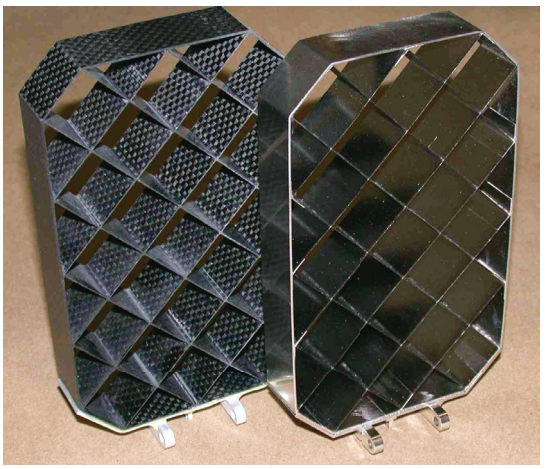
SBIR Title:
Lattice Fin Manufacturing

Contract Number:
F08630-02-C-0014

SBIR Company Name:
KaZaK Composites, Inc., Woburn, MA

Technical Project Office:
AFRL Munitions Directorate, Eglin AFB, FL

This Air Force SBIR/STTR Innovation Story is an example of Air Force supported SBIR/STTR technology that met topic requirements and has outstanding potential for Air Force and DoD.



Improved Lattice Fin Technology

- Lattice fin technology provides the Air Force with enhanced ability to compactly package deployable control surfaces used on unmanned aerial vehicles (UAVs) and weapons
- KaZaK Composites developed a new manufacturing approach for both metallic and metal/composite hybrid fins that meets both structural and aerodynamic requirements
- KaZaK's manufacturing technology demonstrated a factor of 10X cost reduction compared to pre-SBIR industry
- KaZaK has also developed a system to absorb fin deployment energy, increasing the speed at which weapons can be launched compared to previous baseline lattice fins

96ABW-2010-0082

Air Force Requirement

The Air Force recognized that lattice fin technology provided considerable packaging advantage over conventional control surfaces used to stabilize and direct the flight path of most munitions and unmanned aerial vehicles (UAVs). However, lattice fins made by pre-SBIR manufacturing technology were cost prohibitive. The Air Force needed to greatly reduce the production cost of composite, metal, and hybrid material lattice fins before they could be considered as a viable alternative on current and developmental systems.

SBIR Technology

During this SBIR program, KaZaK worked to develop, compare, and experimentally demonstrate technology required for the cost effective production of lattice fins meeting the Air Force's specifications. The two main obstacles facing KaZaK were the economic viability of the fins and the potential increase in drag with the composite fins. KaZaK had to not only improve performance of the fins but also had to dramatically cut manufacturing costs.

During Phase II of this project, KaZaK's engineers worked to develop specific composite, metal and hybrid designs that would meet structural, mechanical and aerodynamic requirements of the identified baseline configurations. They also conducted finite element analysis for both static and dynamic deployment loads and fluid dynamic computer analyses of alternative fin design which included consideration of various leading-edge shapes on the performance of the fins.

Additionally, KaZaK fabricated production-quality tooling to build alternative composite, metal and hybrid solutions for the baseline lattice fin configurations, including consideration of alternative approaches to achieving leading edge shaping. Phase II objectives also included performing static mechanical tests, followed by several rounds of dynamic load and deployment tests in a wind tunnel in order to iteratively evolve and ultimately verify the structural and aerodynamic performance of the new, low-cost fins. Finally, KaZaK prepared and presented data comparing cost and drag performance of various metal, composite and hybrid material solutions with varying leading and trailing edge geometry.

Potential Air Force Application

The Phase II technical work concluded with lattice fin hardware having been developed and tested sufficiently so that the Air Force was confident in the ability of KaZaK's fins to perform to the specified structural and aerodynamic requirements. Additionally, the manufacturing processes ultimately selected were sufficiently developed and demonstrated to allow confident projections of low fin pricing (targeted to be 10 to 20 times less expensive than the Air Force's baseline EDMed stainless steel fin), removing acquisition cost concerns from the list of barriers to the use of lattice fin technology.

Through fabrication, analysis, and testing KaZaK has developed tools that predict the structural behavior or performance of the fins during deployment. The firm also developed a system to reduce the energy in the deployment system, thereby increasing system performance from previous tests. KaZaK has shown the ability to design and fabricate fins to withstand some regimes of the small diameter bomb (SDB) flight environment using low-cost production methods and testing.

Company Impact

"This Phase II program was a success," said Dr. Jerome Fanucci, President of KaZaK Composites. "We have developed a new manufacturing approach for both metallic and metal/composite hybrid fins that lowers the unit cost by an order of magnitude in cost from $2000 a fin to approximately $200 each. The new technologies enable the manufacture of these complicated parts for much less cost than previously utilized. These fabrication processes use lower cost methods but provide a structure that is well understood and can be designed to meet a variety of requirements. KaZaK possesses the ingenuity and expertise to do this and is poised to meet those requirements. We have applied the SBIR-funded technology to produce lattice fins now undergoing testing as part of several military systems."

KaZaK integrates engineering design and low-cost manufacturing to produce high performance composites for the aerospace, military and commercial markets.

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