



Intec Manufacturing Group Produces Laminated Graphite Titanium V-22 Engine Nacelle Test Door



Intec, in association with Bell Helicopter Textron, has been pursuing the use of high-temperature graphite titanium sandwich structure as a lower cost, lower weight alternative to super plastic formed titanium structures in elevated temperature applications. Two research doors were built under the Rotorcraft Industry Technology Association (RITA)/National Rotorcraft Technology Center (NRTC) High Temperature Composite Applications Program. A V-22 Engine Nacelle Work-Platform Door served as the baseline for the technology comparison. Intec developed mechanical allowables and demonstrated manufacturability of two laminated graphite titanium nacelle doors.

The doors are a sandwich construction using titanium core and TiGr facesheets; which are laid-up using graphite prepreg and titanium foil. The nacelle acts both as an engine enclosure and as a work maintenance platform. Intec produced the complex curvature doors using a laminate of thin preformed titanium foil and IM7/PETI-5 prepreg. Intec has developed a critical proprietary process to surface treat the titanium foil with chrome to enhance long-term bond performance at elevated temperature under this program. The doors recently were tested to all structural static and fatigue load requirements and projections are that they will exceed the program goals of a 25% reduction in weight of the baseline super plastic formed Ti parts and cost parity with improved trends. Intec continues to investigate other applications for the TiGr laminates including other low and high temperature parts and the repair of titanium parts that have cracked in service.¹

Demonstration F22 Flaperon Concept Proved



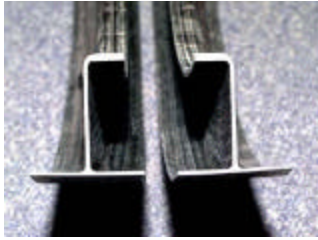
Intec frequently teams with other companies under Government Contract R&D Programs to investigate new processing techniques and material structures. Last autumn, Intec helped BFGoodrich prove the structural integrity of their GRID-LOCK® Composite joint concept by testing a demonstration F22 flaperon article under a Wright Laboratory Program. The design criterion for the test article was supplied by Lockheed Martin who performed as a subcontractor to BFGoodrich on this Program.

The patented BFGoodrich designed GRID-LOCK® joints allow for easy assembly and reduced lay-up and assembly tooling costs. This is accomplished, in part, by incorporating machined grooves into skin build ups, essentially eliminating the need for alignment tools.

The part was instrumented with 49 strain channels of continuously recorded data. A wiffle tree designed and built by Intec was used to apply the correct load distribution (cumulatively 14 kips), to the flaperon via 18 load pads. With solid modeling used to design and position all fixturing and actuation, Intec can integrate models of structural elements and parts onto the 10' x 8' x 6' reinforced strongback. Intec tested the article in cantilever bend to 200% of its design limit load. All instrumentation readings indicated structural integrity which was maintained throughout all loading conditions.



Rotorcraft “J”-Stiffener Produced With VARTM Process



Intec recently completed a research contract demonstrating the feasibility of producing rotorcraft “J”-section stiffeners using the Vacuum-Assisted Resin Transfer Molding (VARTM) process. The client, Bell Helicopter Textron, was interested in a lower-cost alternative to traditional processing approaches.

Foam internal mandrels and external “cradles” were utilized for their cost and schedule advantages. A woven graphite preform was produced by program participant Fiber Innovations, Inc. of Walpole, MA. This preform included graphite rods in the part “cap”, a braided radius-filling “noodle”, and an integrally woven overwrap preform. Applied Poleramic, of Benicia, CA, supplied the two-part epoxy resin used on the program. A slightly modified version of their

SC30 aromatic amine product was selected due to its high T_g and its low viscosity at near room temperature.

Trial “J” section parts were run in straight sections with the final configuration produced in the 43” long curved configuration of a production part. With this challenging geometry, resin inlet manifold design proved to be very critical in successfully filling the part. The feasibility of producing hardware of this type using the VARTM process was demonstrated with process optimization—mainly time to fill - being identified as a significant future area of study.

This program continues Intec’s application of VARTM to complex geometries. Last year a helicopter grid-stiffened engine deck prototype was produced and a contract to manufacture honeycomb core sandwich panels with the process is currently underway.

INTEC, FAA, and UBC Sponsor the Composite Structural Development Workshop

In association with the FAA and the University of British Columbia, Intec has organized a series of workshops to address topical issues for composite structure used in aeronautic and aerospace products. Because these workshops are scheduled to be in 18-month intervals, sponsors felt that continued discussions on composite developments were essential. A workshop website (www.csdworkshop.org) has been set up to serve as a communication device. The first of these workshops, held in November 2000, focused on advanced engineering methods to assure structural integrity and damage tolerance for safety, while minimizing implementation time and cost.

The development and implementation of composite structure in aeronautic and aerospace products continues to evolve as industry pursues cost and performance advantages. In order to compete with metal, composite concepts must have the supporting structures, manufacturing and maintenance technologies in forms suitable for application. With a limited workforce skilled in the development, implementation, and use of such composite technologies, sharing experiences, pursuing joint ventures, and establishing the necessary training for expanded applications can have vast advantages.

The workshop’s main purpose is to provide a forum that spans the interests of developers, users, and technical management from industry, government, and academia. The following is a select list of topics covered in the November 2000 CSD Workshop:

- Fracture Scaling of Composites
- Continuum Damage Modeling Versus Discrete Damage Modeling in Composites
- Finite Element Progressive Failure Analysis of Composite Structures Using a Multi-scale, Multi-Constituent Approach
- A Strain-Softening Model for Composite Materials Subjected to Quasi-Static and Dynamic Loading
- The Worldwide Failure Exercise: Recent Progress and UK Programmes on Multi-axial Testing in Relation to Rapid Certification
- Characterization of Composites in Multi Dimensional Load Spaces and Dissipated Energy Density Applied to Structural Design and Material Qualification Applications
- A Physics-Based Methodology for Analyzing Failure in Composite Structure and the 10% Rule for the Rapid Analysis of Fiber Failure
- Strength Prediction of Composite Laminate with Single and Multi-site Damage
- Fuselage Residual Strength - Response and Prediction/A Non-local Damage Theory for Laminate Plates
- On-going Development of Bonded and Bolted Joint Strength Predictions Methods



Dr. James Starnes
2000 Presenter

From Aerospace to Outdoor Recreation



Ever on the cutting edge of the latest trends (and what group of engineers isn't?), Intec recently tested K2's answer to the transportation needs of the new millennium – the scooter. K2 has long been recognized as a leader in sporting goods equipment and their reputation is due in no small part to the rigorous product testing their engineering practices demand. Intec has played a key role in the characterization of K2 products for many years and has provided

innovative engineering and testing solutions for products including skis, snowboards, bindings, boots, in-line skates, and now scooters.

The test rides of K2's scooter established its low-frequency dynamic stress response due to typical riding loads at the critical locations of the scooter. (Watching Intec engineers attempt "typical" maneuvers such as jumping off curbs and hopping over obstacles was enough fun that we plan to charge admission next time – we hope the income will help defray our increased insurance costs).

K2's scooter was instrumented with seven strain gages and an accelerometer. Real-time data was collected by a portable data acquisition (DAQ) system designed by Intec. Data collection was possible at up to 1500 points per second per channel, though Intec typically used a rate of 300 hertz to focus on the lower frequency response of the scooter. The DAQ system was hard wired to the scooter and was contained in a padded backpack worn by the rider.

The successful "Real Life" test rides transmitted valuable data back to K2 to assure safety, quality and value for their customers.

Personnel Profile Rod Wishart

Rod Wishart, Intec's Operations Manager and part owner of Intec is one of the longest standing employees (employee #9). Rod's engineering degree from Pacific Lutheran University (1989) coupled with his hands-on composite testing experience has enabled Rod to provide innovative solutions to various engineering challenges.

Rod who recently celebrated his 10-year anniversary at Intec and has not only seen many changes with the growth of Intec, but has also experienced major changes in his personal life as well. Shortly after joining Intec, Rod married Tonya (1991) with which he shares a love of sports and the outdoors. Before the births of their two children Jake (4) and Joey (2), Tonya and Rod completed 3 Seattle-to-Portland rides on tandem bike (Tonya was 22 weeks pregnant on their last ride). Active in his community, Rod has been a Junior High School Group Leader for the last 9 years and is the organizer of the weekly Thursday (5:30 AM) basketball games. Rod recently completed a substantial house remodel and when time permits he enjoys skiing, hiking, and camping.



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