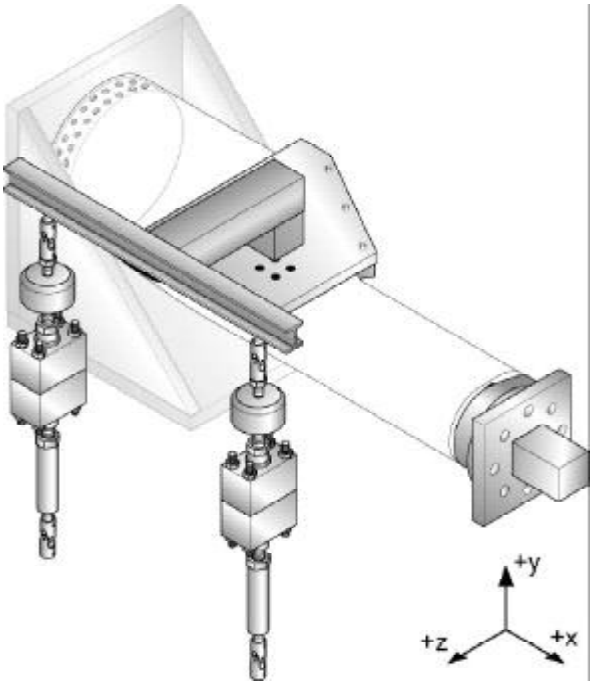
Graphite/APC-2 Composite Tailboom

Although considerable research has been done by the Armed Forces to utilize composites for advanced fighter aircraft, smaller civilian aircraft have adhered to more traditional materials. Bell Helicopter identified an opportunity to improve on the classical aluminum helicopter tailboom by replacing the aft end with a low cost graphite/APC-2 composite. The new concept tailboom was manufactured using Automated Dynamics' innovative in-situ consolidating tape placement machine. This construction offers a significant reduction in the overall cost and weight of the boom.

To demonstrate the structural performance of the boom, Intec was contracted to perform a full-scale test simulating flight loads.

Work began in September when the mechanical design staff received the assigned loading conditions and began transforming the theoretical loads into real, mechanical systems. Unit forces were to be provided by three sets of hydraulic actuators, which connected to lever arms to provide the system moments. The arms were designed such that only two were required for all twelve-load cases. Once the design phase was completed, Intec's in-house machine shop took over. The test set-up required over twenty separate major load fixtures to meet all load cases. Using our precision CNC capabilities, the fixturing was produced in record time. While the machining took place, the tailboom was fitted with over 64 strain gages, 6 electronic displacement indicators, and 3 load cells.

After successfully completing all load cases, the boom was taken to failure in a 6.3° yaw trim maneuver at 237% of limit load.



Technical Tasks described in this article include tasks supported with shared funding by the U.S. Rotorcraft Industry and government under the RITA/ NASA Cooperation Agreement No. NCCW-076, Advanced Rotorcraft Technology, Aug. 15, 1995.

SEE YOU AT SAMPE 1999 - This Year in Long Beach, CA

Intec's Booth - SAMPE 1998

Intec will once again be attending the SAMPE International Symposium held at the Long Beach Convention Center from May 24th - 27th. Look for our representatives and CMT demo (see following page) at booth #819. Attending for Intec this year will be Maryann Einarson, President; Brian Coxon, Director of Engineering; Shreeram Raj, Senior Scientist; Rod Wishart, Operations Manager; and Bob LaMantea, Sales and Marketing Director.

WE HOPE TO SEE YOU THERE!

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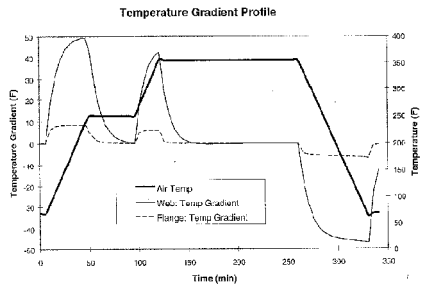
Virtual Autoclave Processing on the PC

Intec and Convergent Manufacturing Technologies Inc. (CMT) have formed a Technology Partnership to market & distribute *COMPRO*. *COMPRO* is a finite element based software package for the simulation of autoclave processing of composite materials. The software has a user-friendly interface and runs on the Windows 95/98/NT platforms. *COMPRO* has the ability to model: part and tool temperature, degree of cure, resin viscosity and resin flow, stress build-up, and final part shape. By using the finite element technique, most part and tool geometries can be analyzed with the software.



The CMT team has applied their software and modeling skills to processes and parts on Boeing's 747, 767, and 777 in the past few years. Examples of production problems they have solved are: the effect of a change in ply lay-up on the flange spring-in of a wing spar, the design of an Invar spar tool to compensate for process induced warpage, and the determination of the stability of an autoclave production process. The parts analyzed have been both solid laminate and honeycomb structures and have varied in size from a few feet up to forty feet and have been made with a number of different unidirectional and fabric prepregs.

Dr. Goran Fernlund of CMT explains that "*COMPRO* can help clients shorten development cycles and time to market. It can also help them cut costs by reducing preliminary prototype fabrication and testing". Dr. Anoush Poursartip adds "Our partnership with Intec will help us get our software and services known in the industry and give us access to Intec's vast experience in advanced composites manufacturing".

For more information: CMT@in-tec.com

Göran Fernlund and Anoush Poursartip of CMT

Ultrasonic Welding Investigations of PEI/Carbon Composite

Having the ability to easily join thermoplastics creates great advantages when pursuing low cost manufacturing approaches. Diffusion bonding has been used successfully in joining un-reinforced and, to a more limited degree, reinforced thermoplastics in structural applications. New technological developments have made it possible to diffusion bond fiber-reinforced materials at typical joint depths without disturbing the surrounding structural material. Typical joining methods include hot plate, vibrational, induction, spin and ultrasonic, and electron beam welding.

Intec has recently initiated an investigation of the joining properties of continuous fiber reinforced PEI with Boeing and Bell Helicopters. The goal is to demonstrate automateable technology that yields equivalent structural performance to current adhesives. Demonstration testing will be conducted throughout 1999 culminating in the manufacturing and testing of large bonded panels.

Ultrasonic welding utilizes an acoustical vibrational energy tool to transfer vertical vibrations are through the part to the joint area, where it is then converted to heat through friction, which in turn melts the plastic. These vibrations are generated at frequencies between 10 to 70 kHz and amplitudes from 10 to 100 microns. Small projections in the bond line (energy directors) are used to increase stresses at the point of contact that melts the plastic faster, thus decreasing weld times.

Inductive welding uses an alternating magnetic field to induce a current in the conductive layer of the part. Placement of the conductor, conductor length, and resistance, as well as magnetic field size and strength determine the effectiveness of melt. Intec has successfully applied this technique to a variety of production composite processes.

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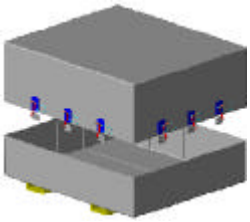
Intec's Latest "ProWall" Air Cargo Shipping Container

Intec was awarded a contract to design and build 2 prototype shipping containers for C-130 Military Air Cargo applications. The shipping container design and materials were developed to contain a 4000 lb. cargo to a 4.5g forward impact. This development effort is a derivative of prototype land transport containers originally developed in 1997 using ProWall, a highly consolidated continuous fiber glass/polypropylene material. ProWall containers are seam free, highly durable and resistant to impact and environmental exposure. Due to the unique manufacturing process, ProWall containers are lighter, less expensive, and more durable than traditional containers.



The ProWall container is designed with an advanced lightweight thermoplastic structural material system that can be formed into a continuous shell. This unique combination of continuous fiber fiberglass in a polypropylene matrix is extremely rugged and demonstrates excellent impact resistance with good mechanical characteristics.

The material is waterproof and is resistant to most aircraft and environmental fluids (jet fuel, hydraulic oil, etc.). ProWall passes FAA burn test requirements FAR 25.853 & 25.855 and the Federal Motor Vehicle Safety Standards MVSS 302-Flammability of Interior Materials (49 CER Part 571).

Prowall containers take advantage of material performance and container geometry. The structures were designed to be globally stiff, but locally compliant to protect the container and its contents from damage. Prowall even offers the contents limited primary ballistic protection and significant protection against secondary projectiles. Prowall containers have been in service for more than two years and are performing above expectations!
For more information: prowall@in-tec.com

PRO WALL Composite Mechanical Charactistics				
Iso 527	**Tensile**	*Strength*	**700 MPa**	(101ksi)
		Modulus	**28 GPa**	(4.0ksi)
ISO 178	**Flexural**	*Strength*	**470 MPa**	(68ksi)
		Modulus	**24 GPa**	(3.5ksi)

Relative values shown are accurate, but should not be used since absolute values can be influenced by fabricator processing conditions.

Intec's ProWall Shipping Container

Personnel Profile: Shreeram Raj

Born and raised in Southern India, Shreeram brings unique insights and innovative ideas to Intec. After earning his BE degree at Bangalore University in India, Shreeram moved to the U.S. to complete his master's degree in Mechanical Engineering at Montana State University. While in Montana, Shreeram enjoyed experiencing many new sights as part of his life in the States. Shreeram was particularly taken by his first exposure to something most of us in the Northwest are quite familiar with – snow!

Shreeram joined Intec in 1991 and now serves as both Intec's Senior Scientist and Quality Control Manager. Shreeram also has the opportunity to share his expertise in testing of fatigue and fracture with Intec's junior engineers, for whom he acts as a Technical Mentor. His intuitive nature, along with his close eye for detail, make Shreeram successful in his many roles at Intec.

In 1994 Shreeram flew to his hometown of Thiruvananthapuram (you'll have to call Shreeram for the pronunciation) to marry his wife Meera. Shreeram and Meera had a small, traditional Indian wedding of 2,000 guests! Shreeram and his wife Meera now live in Bellevue where they enjoy sailing, racquetball, and making the perfect Indian curry.

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