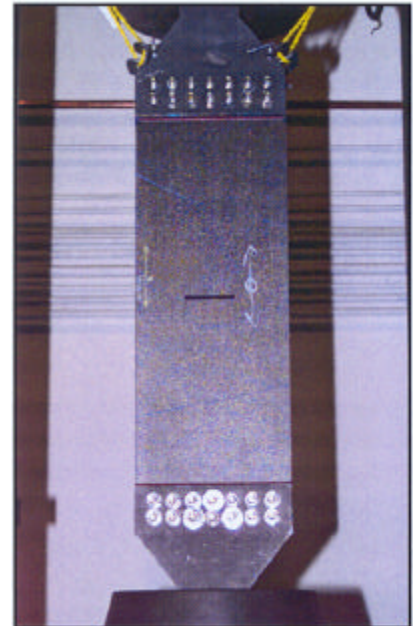




## Large Notch Specimen Testing

One test gaining wide acceptance in the composites community is the 10" X 30" large notch specimen. Classical methods of correcting for finite width effects are often found lacking in composites, and cannot accurately predict large notch strength from small notch (e.g. 1/4" open hole) data. Conventional stress concentration models are inadequate due to the development of a zone of matrix cracks and fiber failure that occurs in front of a growing crack. The resultant material response can be described by strain softening. The large notch specimens are commonly tested with 1" and 2.5" notches in compression. Tensions use a 2.5" notch in a 10" X 30" specimen and a 7/8" notch in a 3.5" X 12" specimen. This data can be used to parameterize models (such as a modified Mar-Lin), which give reasonably accurate projections to large notch effects typically encountered in structural panels.

Large notch specimens provide an excellent alternative to costly structural panel tests by providing realistic scaling factors for smaller tests. Reductions in the time and expense of this test are made possible by Intec's large notch compression fixture. In response to the large number of composite laminate notch testing Intec performs (approx. 150 per year), Intec designed a fixture which features hinged face supports able to accommodate thicknesses up to almost 2".



For additional information on large notch testing see the following articles:

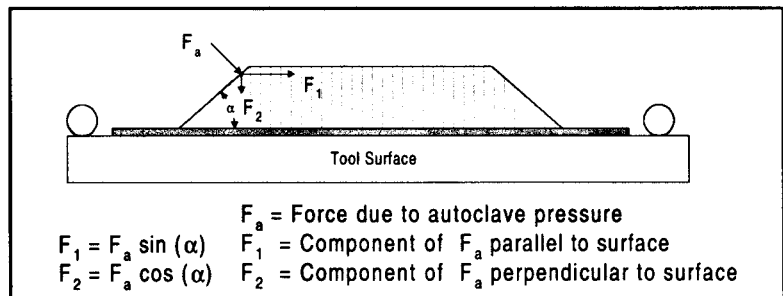
- \* Matthew Nahan and Timothy Kennedy, "A Nonlocal Damage Theory for Laminated Plate with Application to Aircraft Damage Tolerance", 8th U.S. - Japan Conference on Composite Materials, 24th and 25th September 1998, Baltimore, MD
- \* Kevin Williams and Reza Vaziri, "Finite Element Analysis of the Impact Response of CFRP Composite Plates", 10th International Conference on Composite Materials, 14th - 18th August 1995, Whistler, B.C., Canada.
- \* K.V. Williams, I. Kongshavn, A. Poursartip, and R. Vaziri, "Optimization of the Strain Softening Curve by a Taguchi Method to Model the Notch Behaviour of a Laminated Composite Material", 6th AIAA/USAF/NASA/ISSMO Symposium on Multidisciplinary Analysis and Optimization, 4th - 6th September 1996

## Eliminating Core Crush

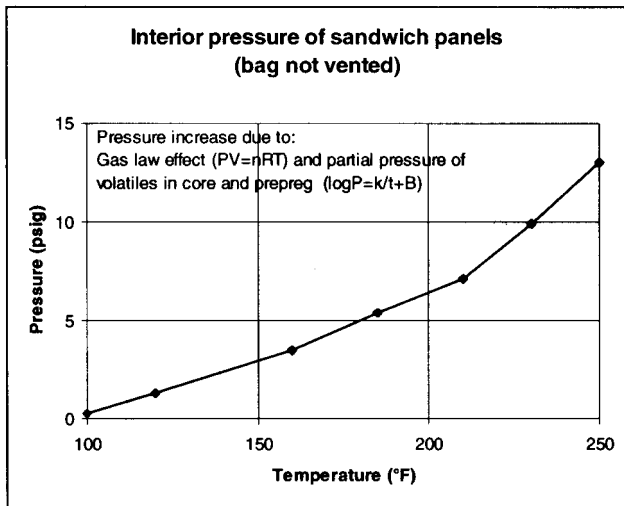
Over the years many techniques have been developed to control undesired movement of honeycomb core and face sheet plies during sandwich panel manufacture. This movement is caused in part by low lateral stiffness of the unsupported core. Core crush has been addressed with a variety of 'tricks' ranging from septums in the core to simple grip strips in the tool. Each of these 'tricks', however, add cost and weight. In addition, the core crush phenomenon has placed constraints on designers by limiting ramp angles, core thickness and core density.

In mid 1998 Intec began a joint R&D project with DuPont to develop an alternative method of processing sandwich parts. The goal of this partnership was to reduce the cost of sandwich parts by defining new, robust process conditions.

Typical processing cycles for sandwich parts require external pressure to hold the prepreg and core details in place during cure, this pressure also consolidates the prepreg. Acting laterally on the panel, this pressure can generate undesired movement of the face sheet and core during processing. Lateral core strength (3-10 psi, depending on core type), the friction of the core on the tool side prepreg (dependent on ramp angle and core thickness), and internal core pressure resist these movements.



(Core Crush continued on page 2)



Of the variables affecting core crush, the manipulation of internal core pressure appeared most straightforward. Most typical processes vent the bag (core) during processing, producing large compaction forces. On the other hand, if the bag is not vented, internal pressure will increase as the temperature rises. This pressure is due to the expansion of trapped air and the partial pressure of volatiles driven out of the prepreg. Processes that vent the bag require the movement of significant volumes of low pressure gas through small holes, which is inefficient, nonuniform and unreliable.

By controlling the internal pressure, it was predicted that a quality part could be produced with as little as a 10-20 psi differential between the au-

Crushed Core

Nomex<sup>®</sup> Uncrushed Core

he problems of core movement  
at [www.in-tec.com](http://www.in-tec.com).

## Full Scale Kayak Tool Machining

Intec's machining group recently completed the first of three 5-axis foam plugs for a state-of-the-art sport kayak manufacturer. This 14' long, 8 pcf foam master is used in the process to make cast aluminum rotational molding tooling for mass production.

Working closely with the designer and the production staff, Intec developed electronic solid models to reflect several design concepts. These concepts were easily reviewed against hydrodynamic, structural and producibility criteria. Although large distances were involved between the designer, manufacturer and tooling maker (Intec), working with solid model data sets allowed detailed issues to be resolved expeditiously with limited face-to-face interactions. This process was more efficient than anticipated and allowed time to be spent on secondary design issues improving the part's performance and cost beyond initial expectations.

Intec continues to develop its advanced techniques for rapid prototyping, design and production interaction. By developing a library of standard parasolids that have programs for tool paths, modifications and additions can occur quickly with minimal reprogramming.

## Intec Machines Critical Parts for Boeing JSF Prototypes

Assembly of the X-32B forward fuselage, or forebody, began at the Phantom Works prototyping center in St. Louis, where workers placed five aluminum frames and a large, one-piece inlet duct into a simple, low-cost holding fixture. Intec's machining department produced 20 early assembly parts critical to the support of the forebody in the initial stages of assembly.

Due to programs that are automatically translated from a common database with automatic, numeric controlled machines, Intec is able to produce hardware, such as aluminum frames, and composite inlet ducts with first-time quality. Instead of costly hard tooling, self-locating features are designed into the parts to allow for quick and easy assembly in inexpensive holding fixtures.



Intec machined many of these parts for the first two prototypes. Boeing's project management made this prototype effort a very clean and straightforward task that saved both time and money in the prototype machining. The forebody assembly was delivered early, below budget, and under the target weight.



JSF Prototype



## Personnel Profile Brian Coxon



Many of you may know Brian Coxon who has been with Intec since its inception. Brian's diverse abilities support not only his key position as the Director of Engineering, but also his role as an advisor to Intec's sales and marketing department. This multi-disciplined approach enables Brian to interact with a wide variety of Intec's clients and projects.

Brian's background includes a love of airplanes and composites, a BS in Aeronautical Engineering, and a MS in Chemical Engineering composites. Brian has also been involved in various work study programs including Airbus/Lufthansa in Germany, Rhone Poulenc in France, and in the Seattle area Fatigue Technologies and Boeing.

Brian has a great appreciation for outdoor activities where he enjoys skiing, bicycle and motorcycle riding, and sailing - especially sailing! He is an avid sailor who takes pleasure in discovering the San Juan Islands and beyond with his wife and two daughters, Margo and Sydney. Brian's most recent accomplishments include the Swiftsure Light Ship race in the straight of Juan de Fuca and completing the Seattle to Portland (STP) bike race.