Just six years ago, Boeing Rotorcraft Systems suburban Philadelphia site was plagued by cost and schedule overruns on military helicopter production. Executives invested in lean engineering and manufacturing processes, training, selected outsourcing, and facility improvements that transformed the site.

Today, Boeing has won nearly 20 years of new and modernised production of U.S. Army CH-47/MH-47 Chinooks and is bringing in new international business. The Bell Boeing V-22 Osprey tiltrotor aircraft will reach a full production rate of four fuselages a month early in the next decade. Advanced rotorcraft projects are expanding, functional organisations supporting production programmes are more efficient, and Philadelphia will add new production workers by 2010.

The transformation involved investments of more than $150 million in new plant, equipment and training.

Engineers are talking about driving nearly 50 per cent of the fuselage production cost out of the line at the rotorcraft production facility in Ridley Park.

Dan Meyer, director operations and Philadelphia site manager, Boeing Rotorcraft Systems says: “Focusing on core competencies, process discipline, and increased emphasis on teamwork and employee empowerment were equally critical success factors.”

He adds: “Employees were asked to make difficult changes in technical and functional processes. The Philadelphia team embraced these new practices and committed to new approaches with no guarantee of success. But succeed they did.”
As more commercial and military airplanes are flying beyond their original design life, it has become necessary to answer questions about their continued airworthiness and structural integrity. Most ageing aircraft studies focus on metallic structures, but with the increasing use of composites in primary aircraft structures, it is crucial to address ageing concerns for composite components.

The primary programme objective is to evaluate the ageing effects on composite aircraft structures. It involves the investigation of two aircraft structures, a decommissioned Boeing 737 stabiliser that had a commercial service history of 18 years and a Beechcraft Starship with 12 years of service. The proposed research is divided into small sub-tasks to understand the ageing mechanisms of the structures which include the following:

- Conduct non-destructive inspection to identify defects induced during manufacture or service;
- Investigate the structures for cracks, delaminations, damages, repair and if applicable bond integrity;
- Identify possible changes in mechanical properties and resin chemistry;
- Identify material degradation due to heat, humidity, ultraviolet (UV) radiation, oxidation, etc.
- Evaluate bearing conditions around holes and fasteners
- Investigate possible bearing failures or delaminations around the holes
- Evaluate effectiveness of repairs

How important is AWIATOR to EADs?

It is important enough to invest several million euros in the project and to provide an A340 - albeit a prototype - for the flight testing.

There is no doubt that a positive decision on mini-TEDs in 2007 would be welcome. The two ceos of EADS – Tom Enders and the newly appointed Louis Gallois – are refocusing the company on its operational business.

They said in a recent joint statement: “Our immediate priority is Airbus. We need to stabilise the A380 and we need to move ahead with our product strategy, our resources, our processes and the industrial set up.”

Christian Streiff, the EADS new Airbus ceo, will drive this agenda, with the “full corporate support and attention,” the ceos have pledged.

Assessing the effects that ageing can have on composite aircraft structures

By Dr. John Tomblin and Lamia Salah of the Centre for Composites and Advanced Materials (CECAM) at the National Institute for Aviation Research, Wichita State University

As more commercial and military airplanes are flying beyond their original design life, it has become necessary to answer questions about their continued airworthiness and structural integrity. Most ageing aircraft studies focus on metallic structures, but with the increasing use of composites in primary aircraft structures, it is crucial to address ageing concerns for composite components.

The primary programme objective is to evaluate the ageing effects on composite aircraft structures. It involves the investigation of two aircraft structures, a decommissioned Boeing 737 stabiliser that had a commercial service history of 18 years and a Beechcraft Starship with 12 years of service. The proposed research is divided into small sub-tasks to understand the ageing mechanisms of the structures which include the following:

- Conduct non-destructive inspection to identify defects induced during manufacture or service;
- Investigate the structures for cracks, delaminations, damages, repair and if applicable bond integrity;
- Identify possible changes in mechanical properties and resin chemistry;
- Identify material degradation due to heat, humidity, ultraviolet (UV) radiation, oxidation, etc.
- Evaluate bearing conditions around holes and fasteners
- Investigate possible bearing failures or delaminations around the holes
- Evaluate effectiveness of repairs

Background

These aircraft are examples of two common structural arrangements for composite primary structure. The B-737-200 stabiliser was primarily solid laminate construction, while the Starship was primarily honeycomb sandwich construction. The aircraft are ideal for assessing composite structural ageing effects. They each flew for more than a decade with thousands of flight hours, which provides real-life examples of the ageing of composite structures.

The B-737-200 graphite/epoxy stabiliser was developed by The Boeing Company as part of the NASA Aircraft Energy Efficient (ACEE) programme initiated in 1975. The purpose was to challenge aircraft manufacturers to redesign existing aircraft components using graphite/epoxy composites. Boeing manufactured five shipsets, and received FAA Type Certification in August 1982.

The B737 composite horizontal stabiliser consists of a co-cured skin and stiffener panel, 191 inches long and 50.5 inches wide at the root with stringers spaced 3.85 inches apart. Bolted titanium spar lugs — consisting of two titanium plates bonded and bolted externally to a pre-cured graphite-epoxy spar — were used to fasten the stabiliser to the fuselage centre section. Honeycomb ribs were used for simplicity in terms of tooling, fabrication and cost. The composite design yielded an average weight savings of approximately 21.6 percent with respect to the metal configuration or a final weight of approximately 206 lbs.

The Beechcraft Starship program was officially launched in 1982. The objective was to produce the most advanced turboprop business airplane feasible at the time and to promote the use of composites in a business aircraft. The first Starship was flown on 15 February 1986. The second joined the test flight programme in June 1986, and the third was ready for flight in
the early spring of 1987. In the course of a two-year flight test programme, these aircraft flew nearly 2,000 hours. The Starship achieved FAA Type Certification on June 14, 1987.

The Beechcraft Starship pressure cabin is a sandwich construction consisting of only two parts, a right- and left-hand side bonded and riveted at the centre section along the top and the bottom centrelines. The main wing is also a sandwich construction with no span-wise stringers, three spars and five ribs.

**Expected outcome**
The initial teardown of the B-737-200 horizontal stabiliser has shown little effects of the long service experience. The first mechanical and physical property tests have shown little difference in the values after 18 years and 52,000 flight hours. The mechanical and physical property testing of the stabiliser continues, and, in conjunction with information gained from the Starship teardown and testing, the evaluation team will assess service performance and durability of aged composite structures.

This data will be used by the FAA to assess current/ emerging certification methods. It will also assist the FAA in developing policies for composites ageing effects.

Dr. John Tomblin is executive director, NIAR and Lamia Salah is a research associate and manager of the fatigue and fracture laboratory, NIAR. Printed with permission from CECAM and the FAA.

---

**Spiralock threads its way through those complicated joint problems**

By Daniel Cook

Some of the most advanced airframes in the world – the F-35 Joint Strike Fighter, Boeing’s 787 and NASA’s Huygens probe – have one simple innovation in common: they make use of a tougher form of female screw thread called Spiralock.

Tooling company Spiralock, a small firm with fewer than 100 employees, claims its unique thread is more resistant to stripping and loosening as it reduces the damage caused by vibration, and increases resistance to severe shock and thermal variation.

Designed to be compatible with a standard 60-degree bolt, the thread incorporates a 30-degree “wedge ramp” at the base of the female thread. When load is applied during assembly, the Spiralock thread form locks the standard male threads tightly against the wedge ramp, preventing movement in the joint – in short, it holds the bolt tighter than the average thread.

Spiralock says its thread also helps to distribute the joint load throughout all engaged threads, while conventional screw threads place up to 80 per cent of the load on the first two notches of the thread.

Engineer Brian Mann has been with Spiralock for 13 years. Recently his focus has shifted under the title “application engineer” – it is his job to make the transition from standard threads to Spiralock painless for manufacturers.

“It’s not much trouble to switch to Spiralock from a standard bolt. The only difference is the thread,” he told Airframer.

“We sell Spiralock in two ways: number one, we go into a new design, contact people about creating new products, we try to design a thread form with them, if it’s a demanding threaded joint.

“But a lot of what we do is help customers change what they’re doing to help fix thread loosening problems. Most likely we can put in a Spiralock thread in place of what they had there, to create better thread integrity, to help the product have a longer life.

“We can put our thread form in any product that has an internal thread. It doesn’t matter what the material or the size. If you can put a standard thread into it, you can put a Spiralock thread into it,” he said.

One of Spiralock’s aerospace customers is Hamilton Sundstrand, which has put the thread form in its generators.

“From an engineering standpoint, making the change from prevailing torque nuts to Spiralock nuts was as easy as picking up the phone to place an order,” said Darin Morman, manager of generator engineering at Hamilton Sundstrand. “Implementation has been straightforward, transparent to our assemblers as well as our customers.”

“The Spiralock nut not only met the required clamping force when exposed to 50Gs of vibration and 200Gs of shock load,” added Morman, “but also maintains this performance for thousands of hours of