Focus on FTI®
FATIGUE TECHNOLOGY INC.
June 2004

FTI'S BLIND FASTENING SYSTEM

Tukloc will be used for maintenance and new production applications on the F-16 and the Eurofighter in 2004.

TukLoc™ is FTI's blind fastening system that uses the advantages of our proven cold expansion technology to create an interference fit, leak-proof, high performance aerospace nut.

FTI was approached three years ago to develop a solution to the significant leaking problems maintainers were having in the wings of their aircraft. Specifically, it was identified that the installation of the elliptical press nuts degraded over time, and fuel leaks developed.

The configuration of the current elliptical press nut is such that tightening the bolt to reduce leaking is not very effective, and potentially makes the leaking worse. The NAS1734 nuts rely on supplemental sealing to provide a barrier to the leak path. They are also installed with clearance between the nut and the wing skin, which provides no additional torque resistance.

TukLoc is installed quite similarly to the existing NAS1734 installation process, with one significant difference, the barrel of the nut is cold expanded on installation. This creates an interference fit between the hole and the nut. This interference fit eliminates the need for supplemental sealing, provides significant resistance to torque, provides fatigue life improvement along the lines of an interference fit bolt, and eliminates the potential for spinning. Additionally, the end of the nut can be sealed with a cap to prevent leaks through the threads, thus eliminating the need for "gooping" up the bolt on installation.

The benefits of TukLoc include:
- Easy hole preparation
- No elliptical countersink
- No stringent surface cleaning
- Consistent and repeatable process
- No additional sealants required
- Rapid installation
- Can be automated

There are many applications for the TukLoc system. It can be used in a number of blind fastening areas including:
- Fuel sealed joints
- Fatigue critical blind joints
- "Blind" repairs
- Anywhere NAS1734 or NAS1735 are used
- Replacement of "Davis" elliptical nuts
- It can be installed in composite materials

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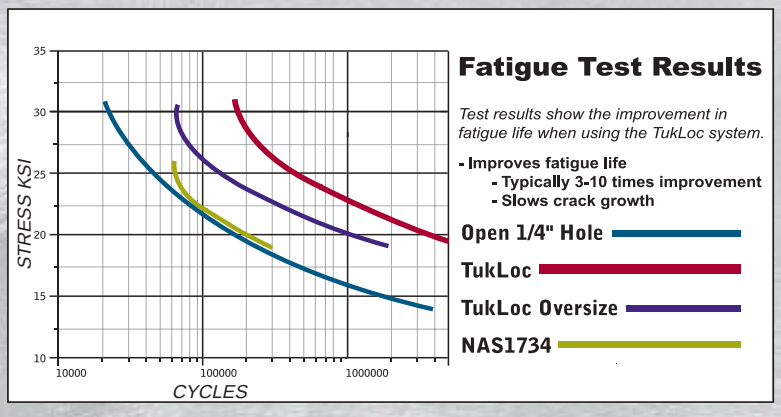
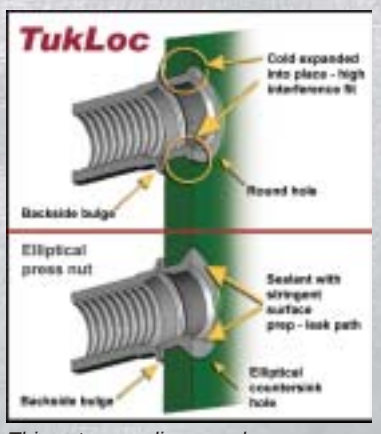




This cut-away diagram shows the difference between TukLoc and elliptical press nuts.

R&D and Engineering Top Priorities for FTI

In order to answer the calls from our customers for even more solutions using our cold expansion technology (on top of what we already provide), we have decided to expand our Research and Development and Engineering Departments. This growth will provide an increased focus on research and development, new product applications and special projects that will continue to exceed our customer's expectations.

Innovative Research and Development

The mission of FTI's R&D Department is to investigate and develop new products and processes utilizing our proven cold expansion technology to further decrease production and maintenance costs, decrease aircraft weight, and increase the life-cycle and fatigue life of today's flying aircraft. This department has already developed many innovative products like TukLoc™ (our blind fastening system), ForceTec® (our rivetless nut plate) and our newest product FleXmate™ (our aerospace fitting installation process).

Len Reid (43 years engineering experience/17 with FTI) will head up the new R&D Department as Vice President, Research and Development. **Chuck Copple** (37 years with FTI) will become the Senior Research and Development Specialist. **Tim Johnson** (13 years with FTI) has been promoted to Senior R&D Engineer and **James Ross** (2 years with FTI) will become an R&D Engineer with **Dale Carter** (2 years with FTI) as the R&D Technical Aide.

> "Listening to our customers has been paramount to our success. This transition will help build on these key relationships for even more industry changing solutions."
>
> - Burke Gibson, CEO/ Chairman of the Board

Customer Driven Engineering

Our Engineering Department will continue to provide support to our customers' current FTI applications. We are in the process of hiring a new vice president of engineering who will oversee the management of this department.

Mark Weiss (16 years with FTI) has been promoted to Senior Engineering Applications Manager and will be responsible for Applications Engineering and Drafting. **Allen Skinner** (11 years with FTI) and **Doug Glenn** (12 years with FTI) have been promoted to Senior Applications Engineers.

Jude Restis (15 years experience/8 with FTI) has moved into a new position as Senior Engineering Program Manager. Jude will take on key programs and focus on high-level engineering support to our Regional Sales Managers and other major company initiatives.

In all, our Engineering Department will have 16 degreed engineers and 6 technical staff supporting our customers.

Other Moves

Bruce Gibson (18 years with FTI) has been promoted to President. Bruce was .formerly the Executive Vice President responsible for day-to-day operations. He replaces **Burke Gibson** who will remain company CEO and Chairman of the Board. **Kevin Dooley** (14 years with FTI) has become the Executive Vice President and will oversee the Manufacturing, Administration and Accounting departments within FTI.

TUKLOC, *(con't)*

TukLoc is available in different coatings, shapes and sizes (including oversize) and an elliptical headed nut for "Davis" nut replacement. For more information, visit us at www.fatiguetech.com or call one of our technical support people at 206.246.2010.

US Navy ASIWG Presents Certificate of Appreciation

On April 26, 2004, the P-3C Airframe Sustainment International Working Group (ASIWG) awarded FTI's Southeast Regional Manager Chris Ratcliffe with a Certificate of Appreciation for his outstanding contribution to the P-3 Inventory Sustainment Program.

Chris Ratcliffe - Southeast Regional Manager

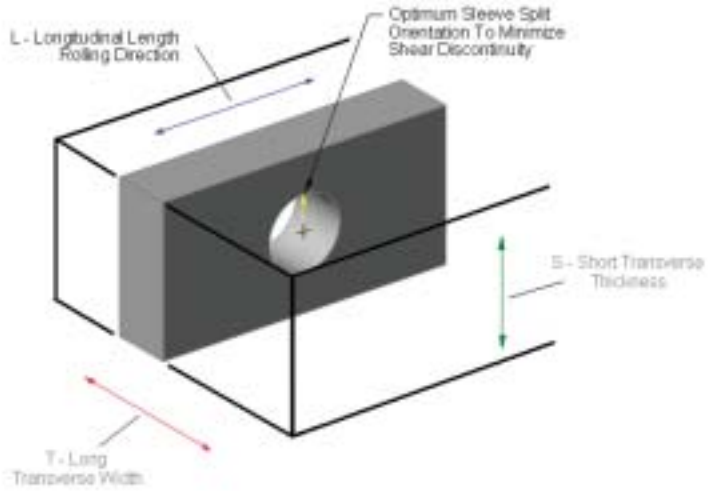
Chris was instrumental in working closely with ASIWG to find innovative ways to use FTI's technology to help keep the P-3s in the air- like using FTI's ForceTec® Rivetless Nut Plates to solve the problem of cracking in the lower wing skin originating at the satellite holes of the installed riveted nut plates. In all, FTI created three maintenance solutions using our innovative cold expansion technology. "I want to thank the ASIWG for this recognition, but I did not do this all on my own," said Chris. "The entire Engineering and Manufacturing team at FTI brought the whole program together."

ENGINEERING

Cold Expanding High-Strength Aluminum Alloys

AUTHOR: Len Reid, Vice-President, Research and Development

Split sleeve cold expansion is the preferred method of enhancing the fatigue life of holes in straight or curved structural joints. However, it is also known that in materials having low ductility, such as 7050-T73651 aluminum plate, this method can occasionally create small cracks, or shear tears, at the edge of the holes in the short transverse direction (2% elongation minimum). The normal expansion level for split sleeve cold expansion is around 4%, which can exceed the elongation in this grain direction.



In the late 1970s, Northrop Corporation conducted extensive fatigue tests (1) using open hole specimens in 7050 aluminum plate with holes drilled normal to the short transverse direction to determine the influence of several variables on fatigue behavior of the split sleeve cold expanded holes. Most of the cracks were less than 0.030" long and less than 0.008" deep, however an occasional longer crack was observed. In general, the life improvement factor using split sleeve cold expansion ranged from 3 to 8. None of the fatigue failures were related to the shear discontinuities produced by the split sleeve cold expansion method.

Since these early tests, a number of evaluations have been conducted to assess the effect of normal split sleeve cold expansion of these high-strength alloys because more structural members are being machined from single billets of material. In doing so, many structural attaching holes are drilled normal to the short transverse grain direction. In virtually all cases, FTI has been able to successfully cold expand these holes by varying the applied expansion level and also by defining the split sleeve orientation. To further highlight the sensitivity of these materials, it should be pointed out that cracking can happen during installation of regular high interference fit fasteners in holes of this orientation. Thus caution should be observed when joining through the short transverse plane using any method in susceptible materials.

> None of the fatigue failures were related to the shear discontinuities produced by the split sleeve cold expanded method.

Through our testing lab and static application (2), we found that the shear discontinuity resulting from the split at 45 degrees to the longitudinal grain direction produced the highest probability of inducing shear tears due to the resultant high shear strain in the short transverse plane. By placing the split at 90 degrees to the longitudinal plane (as shown in the diagram), with reduced applied expansion, the incidence of shear tears was eliminated. Control of the split orientation is easily achieved with the single split sleeve as opposed to the multiple splits associated with other processes that induce similar shear discontinuity at the splits. The split sleeve method is successfully employed in a number of aircraft assembled joints in both production and rework.

In another report (3) on fatigue life improvement using split sleeve cold expansion in 7050 aluminum, shear cracks were observed, however it concluded that they did not significantly influence fatigue life. To quote: "Although there were often multiple flaws due to cold working, almost all the fatigue cracks initiated at the mandrel entrance side of the hole. However, all the pip (*sleeve ridge*) defects were observed at the mandrel exit side of the hole. Therefore, it was concluded that the pip flaws had little or no influence on the fatigue life of the specimens."

FTI is actively working with aircraft and material manufacturers, as well as research establishments, to improve material elongation properties and to find new methods of cold expanding holes at higher levels to further enhance the fatigue life improvement of these materials. A couple of experimental methods are underway in our new Research and Development Department. In the meantime if you have a need to cold expand holes in this critical grain direction, please call FTI for guidance.

(1) Northrop Corporation Report #NOR 82-80 dated August 1982

(2) FTI Technical Report #65024 "Shear Tears at Cold Expanded Holes," February 1998.

(3) Ozelton and Coyle "Fatigue Life Improvement By Cold Working Fastener Holes in 7050 Aluminum," ASTM STP 927, 1986, pp. 53-71.

To receive a technical spec, please call 206.246.2010 and ask for the Marketing Department, or e-mail your request to marketing@fatiguetech.com

2004-2005 Tradeshows and Events

FTI will be exhibiting at the following events. Stop by our display and say hello to our delegates.

June 7-10
Aeromat
Seattle, WA

June 8-10
AHS International
Baltimore, MD

July 19-25
Farnborough International
Farnborough, UK

September 20-23
Aerofast
St. Louis, MO

October 25-28
DoD Maintenance Symposium
Houston, TX

January 31-February 3
Aging Aircraft
Palm Spring, CA

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If you would like to receive FTI's quarterly newsletter via e-mail, please send an e-mail to focus@fatiguetech.com with "e-newsletter" written in the subject line.

Focus on FTI®
FATIGUE TECHNOLOGY INC.

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