



- FTI Enhances Support for Airline and MRO Customers
- Len Reid Recognized as Engineer of the Year
- New Method for Returning Damaged Panel Holes to Nominal Size

Expanded Grommets in Composite Materials

GromEx®

site at www.fatiguetech.com/news_newsletters.html or request a copy by email from marketing@fatiguetech.com.

Composite Hole Protection

The FTI GromEx system provides hole protection for fastener installations into composites and enhances performance over alternate baseline fasteners. The GromEx system also allows for multiple fastener installations into the same GromEx grommet without the need for additional re-work of the hole. In static and fatigue testing, the GromEx system outperformed baseline interference and clearance-fit fastener installations by a significant margin.

The GromEx system is similar to FTI's ForceMate® Bushing

Installation System except it utilizes thinner walled components that have been optimized for the assembly challenges of composite aircraft structure (please contact FTI for more information on available installation options).

A test program was conducted with the objective of investigating the effectiveness of the GromEx system for hole protection in composites and to identify other potential benefits of using the GromEx system.

As a part of this investigation, FTI tested the GromEx system for:

- Durability in repeat fastener installations
- Laminate integrity
- Retention performance
- Resistance to applied loads without fasteners installed
- Fuel sealing performance
- Static and fatigue performance

Repeat Fastener Installations

A unique characteristic of the GromEx system is that it allows repetitive interference-fit fastener installation and removal without requiring any additional machining or re-work of the hole. Fasteners maintained consistent installation and removal forces after multiple re-installations without dislodging the GromEx grommet (Figure 1).

Also, the grommet inner diameter stayed within the dimensions required for the designed interference of the fastener.

Sustainable Laminate Integrity

Post inspection of laminate integrity (as shown in Figure 2) showed in some cases evidence of interlamina defects that were typically less than the manufacturing allowables for composite hole drilling and machining - even after multiple installations and removals of the fastener into the grommet.

High Retention Performance

The retention performance of the GromEx grommet was tested by pushing the grommet out of the hole with a close-tolerance step pin and recording the maximum force necessary for removal. Even after an interference fit fastener is removed, the grommet maintains excellent retention in the hole, requiring several hundred pounds of force to remove the grommet. This shows that the initial interference created when the GromEx grommet is installed

(See GromEx in Composites on next page)

Editor's Note: This article is part two of a two-part series on FTI's GromEx Hole Reinforcement for Composites product. Part one talked about the extensive lightning strike testing the GromEx system recently passed. You can read part one on FTI's web

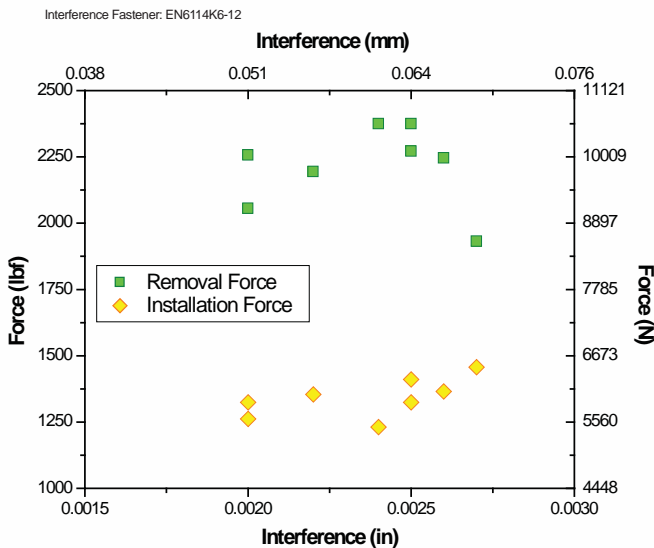


Figure 1 - Fastener installation and removal forces for multiple iterations of interference fit fastener into GromEx grommet.

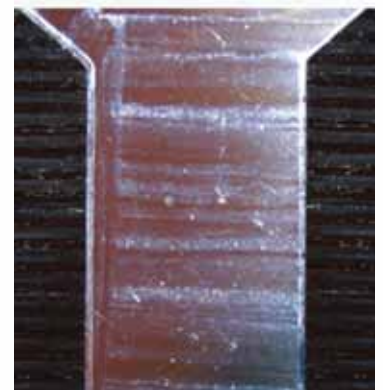


Figure 2 - Cutaway of fastener installed into GromEx grommet in composite.

GromEx in Composites (Continued)

can be maintained after repeated fastener installations. Although the force required to remove the grommet from the composite was found to be less than the force required to remove the fastener from the grommet in the repetitive fastener installation testing, the interference of the grommet itself in the hole and the higher coefficient of friction between the grommet and the composite layers ensures retention of the grommet in the hole.

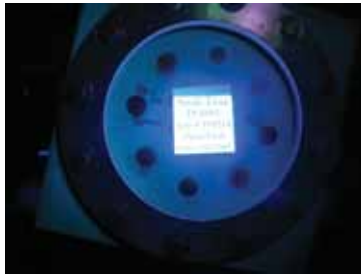


Figure 4 - Post fuel seal leak test images showing no leaks to GromEx installations.

MIL-STD-1312-19A. GromEx grommets were installed into a test plate that was bolted to the pressure pot assembly.

The GromEx grommets were installed with and without primer and interference-fit fasteners were installed into the GromEx grommets with and without sealant. The pressure pot was filled with fluids per ASTM D1655 that were mixed with oil-soluble fluorescent dye. Both a static test to 17 psi (117 kPa) and a dynamic test to 50 psi (345 kPa) for 100 cycles were performed. None of the fastener configurations showed signs of leakage at any time in the testing (Figure 4).

Improved Static and Fatigue Performance

FTI also performed mechanical testing using FTI products to compare the performance of



GromEx does not impair and can improve product life over bare-hole configurations.

FTI has been working with our customers to design the GromEx system for many applications. The benefit the GromEx system offers is a consistent installation of a thin-walled grommet that will protect a fastener hole in a composite material for typical usage. For additional information on this product, please contact us. ✈

Resistance to Applied Loads Even Without Fasteners Installed

In certain situations, it may be necessary to transport an assembly that has GromEx installed without fasteners in the grommets. Testing was performed on a double-fastener single shear test specimen where the grommets were installed through both halves of the specimen and no fasteners were installed. Static testing showed the grommet could withstand significant loading and maintain integrity without a fastener installed (Figure 3).

No Leaks in Fuel Seal Testing

The fuel seal testing was performed using a pressure pot assembly that conformed to

fasteners installed into GromEx grommets and fasteners installed in bare holes. These included both static (Figure 5) and dynamic tests (Figure 6), using single-shear specimens per ASTM D5961. The results of this testing show that the use of

Static Test: ASTM D5961; Specimen Config: Single Shear Double Fastener; Clearance Fastener: TIEN6114T6-12; Interference: EN6114K6-12; Buckling Support: Plate Type; Test Rate: 0.05 inch/min (1.27 mm/min); Env: Ambient Lab Air

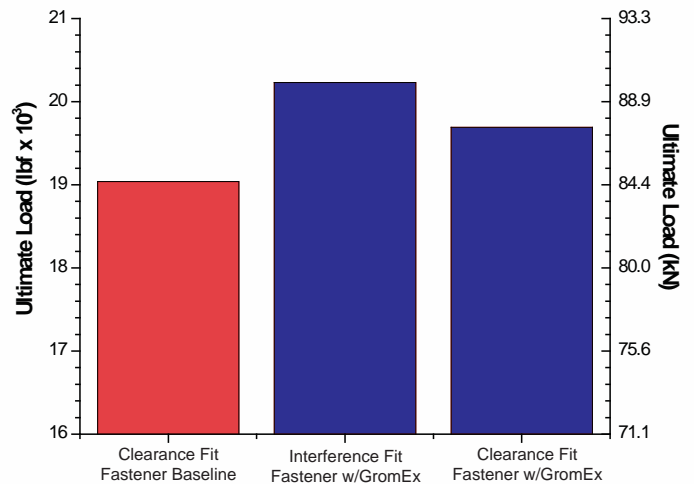


Figure 5 - GromEx static test results.

Single Shear Test: ASTM D5961; Specimen Config: GromEx through Joint; Fastener: None; Env: Ambient Lab Air

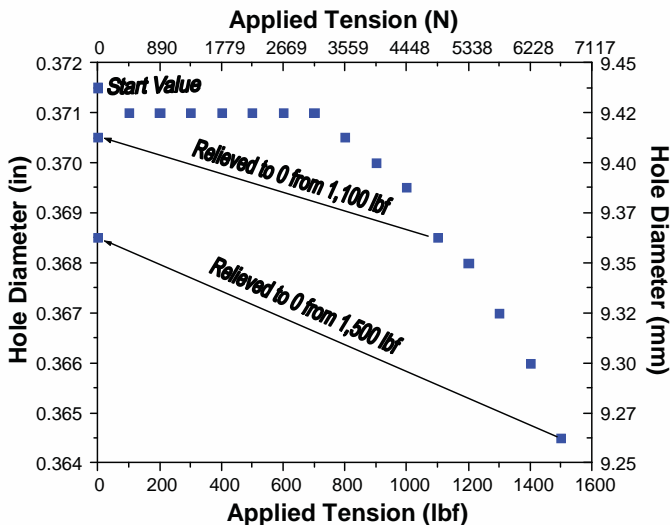


Figure 3 - Hole deformation due to applied tension.

Constant Amplitude Fatigue, R-Ratio: -0.2, Frequency: <5 Hz; Specimen Config: Single Shear Double Fastener; Clearance Fastener: TI EN6114T6-12; Interference: TI EN6114K6-12; Buckling Support: Plate Type; Failure Mode: Fastener Failure

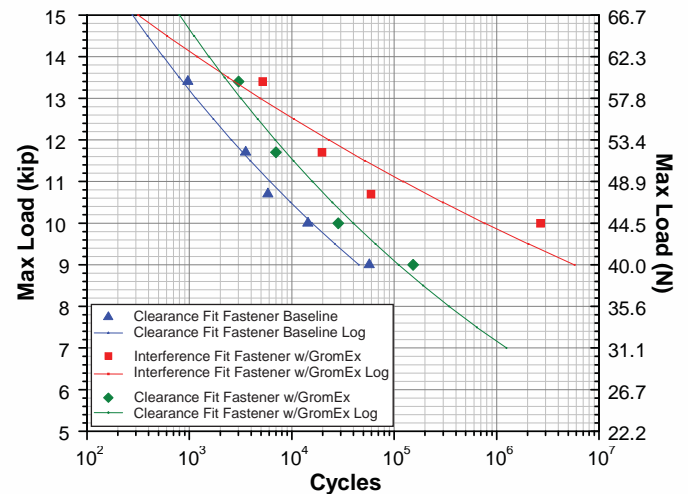


Figure 6 - GromEx dynamic test results.

FTI Earns 2008 Boeing Performance Excellence Award



The Boeing Advanced System Supplier Management Team awarded Fatigue Technology the Boeing Performance Excellence Award for 2008. Fatigue Technology met the stringent award criteria of maintaining a silver level for 12 months performance from October 1, 2007 to September 30, 2008. This is the second year in a row FTI has earned this recognition.

"We extend our sincere congratulations to the employees of FTI for demonstrating their dedication to the high performance standards necessary to meet customer expectations and remain competitive in the global economy" wrote Steven Schaffer, VP and General Manager of Boeing Supplier Management. ✈

FTI Enhances Support for Airline and MRO Customers

For 2009, FTI is expanding our aftermarket support to ensure that airline and MRO customers receive the best possible saving and service from FTI.

Our first step was to assign a dedicated manager for all airlines and MRO activity. We are pleased to introduce Shaun Christian as our new Commercial Airline Sales Manager. Shaun holds an FAA Airframe and Powerplant mechanics license and brings with him over 15 years of experience in the aviation industry. Shaun's career path includes a position as a buyer for a regional airline, which gives him a unique perspective on the procurement process and an understanding of the requirements of our commercial airline and MRO customers.

Shaun joined FTI in 2006 and has managed customer projects, provided inside sales support, and delivered technical instruction on the use of FTI's

products and equipment. He will be working out of FTI's Seattle, Washington headquarters and will work closely with FTI's regional sales managers. He will serve as the primary point of contact for technical and commercial activities that relate to commercial aircraft maintenance.

Here is Shaun's information should you wish to contact him:

Shaun Christian
Commercial Airline Sales Mgr.
schristian@fatiguetechnology.com

Other improvements being made to our MRO services will be the ability to search our web site for the over 500 service bulletins and major aircraft modifications that use FTI tooling. This will allow fleet maintenance and procurement personnel to quickly and easily search service bulletin tooling lists to determine what tools they need to complete an OEM service bulletin. They will also be able to sign up for email



Shaun Christian
Commercial Airline Sales Manager

alerts that will inform them when a service bulletin is about to be published and how they can get special pricing for pre-ordering the FTI kits.

These are just a start to the many improvements FTI is going to make in order to better serve our airline and MRO customers. ✈

Did You Know ...

Fatigue Technology offers the only cold working tooling that is approved by all the major OEMs? This is good news for mixed fleet operators, who may be able to reduce durable tooling costs by maintaining their entire fleet using FTI's cold working tool set.

FTI's Len Reid Recognized by the Puget Sound Engineering Council as Engineer of the Year



Len Reid (with his wife Pat) accepts his award for Engineer of the Year.

Len Reid, Vice President of Research and Development at Fatigue Technology, has been recognized as the Industry Engineer of the Year for 2009 by the Puget Sound Engineering Council (PSEC).

Since 1969, the PSEC has awarded outstanding engineers in the academic, government, and industry fields who have significantly advanced the state of the engineering art, shown leadership in improving the industrial process, and have

demonstrated use of engineering to minimize environmental impacts.

Len is internationally regarded as a leading authority in structural life enhancement methodology and application of practical solutions to structural fatigue problems. He is routinely called upon to address international forums and has presented over 100 papers at all the major aircraft and helicopter structural fatigue conferences and aging aircraft forums. In his 22 years

with FTI, he has been named on 18 U.S. and European Patents and has contributed to a number of professional societies through active membership. ✈

Contact us if you have any questions or would like more information.

*If you would like to receive FTI's newsletter via email, please send an email to:
focus@fatiguetechnology.com
or visit us at
www.fatiguetechnology.com*

FTI Introduces a New Method for Returning Damaged Panel Holes to Nominal Size

This ...



Damaged holes returned to nominal size using the ForceMate 2 Panel Repair system

Instead of This.



Custom doublers riveted to panels

FTI has taken its proven ForceMate bushing installation process one step further to create a quick and easy method for repairing damaged countersunk holes in access panels and other thin grip surfaces. The new process, **ForceMate 2**, brings fastener holes that have been ovalized, oversized, shifted off-center, or otherwise damaged back to nominal size.

The ForceMate 2 system installs two nested bushings into a hole using a single pull from FTI's cold expansion tooling. Both bushings are fitted onto the end of an expansion mandrel before installation. The mandrel is then drawn through the hole expanding the outer bushing radially and then locking the inner bushing into place by the outer bushing's elastic springback after expansion.

The ForceMate 2 Panel Repair System is designed for fastener

hole repairs ranging from 1/4 inch to 3/8 inch in diameter and is compatible with most countersunk panel fastener systems (including Milson and Tridair) and some Hi-Torque fasteners. It is suitable for use in metal, composite and honeycomb panels.

A number of other hole repair methods are used in the aircraft industry including shrink-fit bushings, large dimpled washers, riveted custom doublers, and bonded patches. All of these repairs have shortcomings which may include man power requirements, repair time, added weight, repair consistency, and field reparability. By comparison, ForceMate 2 Panel Repair offers a simple, lightweight, consistent repair in one-quarter to one-half the time of the other methods.

The ForceMate 2 Panel Repair System offers continued hole protection where high cyclic

loads and repeated installation and removal of fasteners can contribute to wear of the fastener holes.

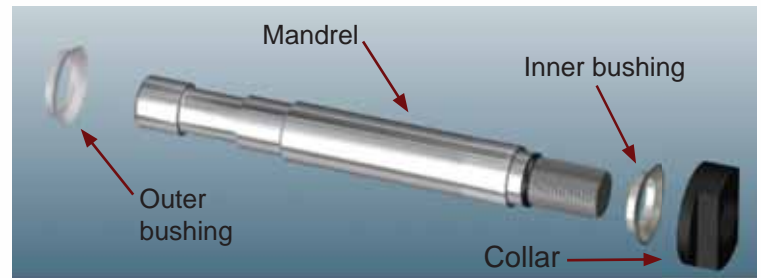
The ForceMate 2 bushings increase the bearing area in the hole to reduce the repeated

stresses that ovalize the hole and cause damage.

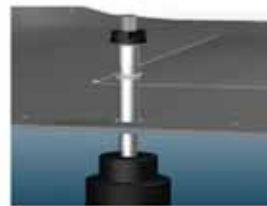
ForceMate 2 has passed strenuous testing for both pushout and push-through resistance.

For more information about the ForceMate 2 process or the Panel Repair System, please contact us at marketing@fatiguetech.com. ✈

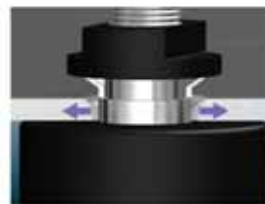
ForceMate² Panel Repair



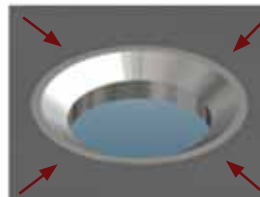
Assemble mandrel with ForceMate bushing, inner bushing and collar.



Place mandrel assembly through damaged hole, which has been prepared for the system by drilling to oversize and countersinking. Slide FTI puller unit onto the mandrel.



Activate puller unit to cold expand outer bushing and lock-in inner bushing.



Inner bushing is held into place by the outer bushing's elastic springback after installation.

"In my 33 years this is probably the best thing that has ever come out. You don't need an engineering degree to put these in, you can train anybody – it's easy. The benefits are huge. You can't see what's going on below a dimpled washer or doubler - now you can fix the damaged hole properly and fix it right the first time."

- CMSgt. John Rassmussen
Quality Assurance Supervisor
Oregon Air National Guard