

Flexmate®

EXPANDED FITTING SYSTEM



**CONNECTS AIRCRAFT
SYSTEMS THROUGH
STRUCTURAL
PENETRATIONS USING
COLD EXPANSION
TECHNOLOGY.**

ADVANTAGES OVER LEGACY SYSTEMS:

- Faster installation
- Improves fatigue life of parent structure
- Reduces structural weight
- Smaller footprint for optimal system routing
- Simple one-piece designs for reduced part count
- Eliminates fastener holes with associated stress concentrations
- Overall cost savings
- In most cases, no additional sealant required



**Proven for Fuel, Inert Gas,
ECS, Electrical, and
Drain Applications
on the World's Most
Advanced Aircraft.**



FATIGUE TECHNOLOGY INC.

FleXmate®

FLEXMATE SYSTEM

FleXmate fitting technology connects fuel, inert gas, ECS, electrical, and drain lines through structural penetrations using FTI's cold expansion process. Individual components incorporate industry standard end fittings but can be designed with almost any end geometry to suit application requirements.

- In service since 2002
- Backed by solid engineering design and manufacturing
- Independently tested by outside agencies
- Installed customer base includes:
 - > Airbus
 - > Boeing
 - > Lockheed Martin
 - > Northrop Grumman
 - > U.S. Department of Defense
 - > Avic I

Why do industry leaders use FleXmate?

- To reduce manufacturing and maintenance costs
- To reduce structural weight
- To improve structural fatigue life
- To optimize system design and flow through the aircraft
- To increase production throughput

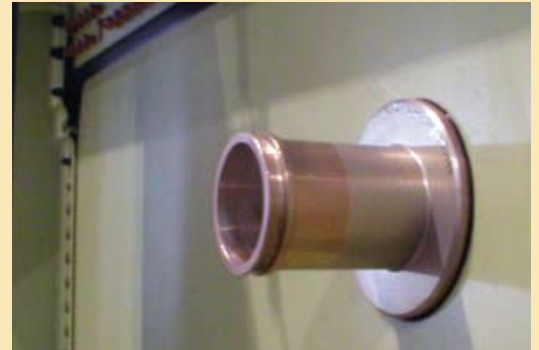
Save weight by reducing or eliminating pad-ups, flanges, fasteners, and sealant.

Each FleXmate fitting is radially expanded from an initial clearance fit to lock it into the structure and provide a uniform interference fit. In some cases the installation will induce a beneficial compressive residual stress field around the fitting. Unlike a traditional fitting, an expanded FleXmate fitting resists movement and seals the penetration without fasteners or sealant. Additional weight savings are gained by reduction of the flange envelope on the FleXmate fitting and the possible reduction of the structural pad-up around the penetration due to the elimination of fastener holes and the associated stress risers. The interference fit of the FleXmate fitting provides structural strength benefits in both metallic and composite installations that may enable further weight savings.

Before Weight Reduction:
Standard legacy fitting with pad-up, fasteners, and large flange.



After Weight Reduction:
FleXmate fitting with small flange, no fasteners, and reduced pad-up.



SMALLER FOOTPRINT OPTIMIZES SYSTEM ROUTING

FleXmate fittings facilitate closer and more economical routing of aircraft systems through the structure. Its components have a smaller radial envelope, are lighter, and have fewer structure penetrations than a typical mechanically fastened legacy fitting.

FleXmate fittings installed in bulkhead.

Installation of FleXmate fitting using FTI puller.



FLEXMATE FITTINGS ARE DESIGNED TO YOUR UNIQUE SPECIFICATIONS

FTI can manufacture any type of fitting to your design or connection specifications. The Flexmate expanded fitting ends can be designed for use in many different aircraft systems, including but not limited to: fuel systems, hydraulic systems, electrical systems, drain systems, pneumatic systems, and lubrication systems. Different ends can be combined to create fittings required to solve new design challenges.



FUEL FITTING



ELECTRICAL CONNECTOR



DRAIN FITTING



GREASE NIPPLE

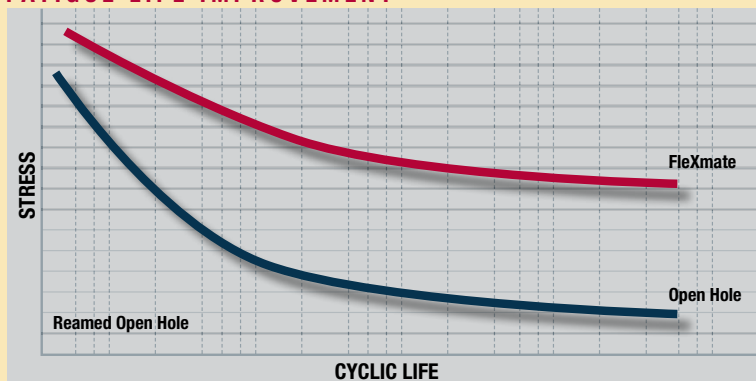


CONDUIT FITTING

USING FLEXMATE CAN INCREASE THE FATIGUE LIFE OF THE STRUCTURE

The key component of this technology is the expanded fitting that is secured to the structure or bulkhead. In most cases the fitting is installed into a single hole eliminating the problems associated with small rivet or fastener holes, including increased stress concentrations, placement problems in short edge margin configurations, and increased crack initiation sites. The installed fitting provides superior fatigue performance when compared with clearance fit products by virtue of the beneficial interference fit between the material surrounding the hole and the installed fitting.

FATIGUE LIFE IMPROVEMENT



Flexmate's high interference installation accommodates higher operating stress levels and/or longer structure life. Aircraft design can be optimized with tighter edge distances and possibly reduced structural weight.



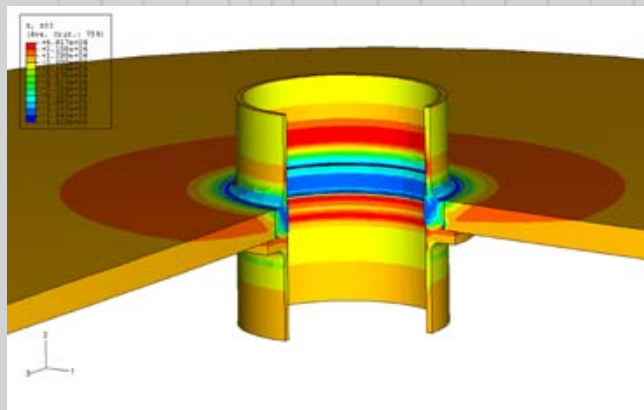
Flexmate fitting



Legacy fitting

FINITE ELEMENT ANALYSIS

FTI provides Finite Element Analysis to tailor the features of the expanded Flexmate fitting and optimize its performance for structural life and durability. We analyze the performance of different fitting materials in different parent structures as well as resistance to fitting migration and pushout.



FLEXMATE INSTALLATION

The Flexmate system of tooling installs fittings using proven cold expansion technology. Other important features of the Flexmate System are the speed and consistent quality of the fitting installation.

EASE OF FLEXMATE INSTALLATION VS. DOUBLERS WITH COLD WORKED HOLES IN ALUMINUM STRUCTURES

Standard Fastened Fitting

- 1 Machine through hole
- 2 Cold work through hole
- 3 Perform final ream of through hole
- 4 Alodine and prime through hole
- 5 Machine pilot holes through bulkhead for doubler
- 6 Machine fastener holes through bulkhead to pre-cold work size
- 7 Cold work fastener holes for doubler
- 8 Perform final ream of fastener holes for doubler
- 9 Alodine and prime fastener holes for doubler
- 10 Install doubler and torque fasteners as required
- 11 Machine pilot holes for fitting through the bulkhead
- 12 Machine fitting fastener holes through the bulkhead to pre-cold work size
- 13 Cold work fastener holes through bulkhead
- 14 Perform final ream of fastener holes for fitting
- 15 Alodine and prime fastener holes for fitting
- 16 Install fitting and torque fasteners as required

Flexmate

- 1 Machine starting hole
- 2 Alodine starting hole diameter
- 3 Install FTI Flexmate fitting

PROCEDURE

STEP 1. FTI manufactures a prelubricated fitting that meets your design specifications.



STEP 2. Your fitting is placed on the FTI expansion mandrel.

STEP 3. The mandrel and fitting are positioned through the hole.



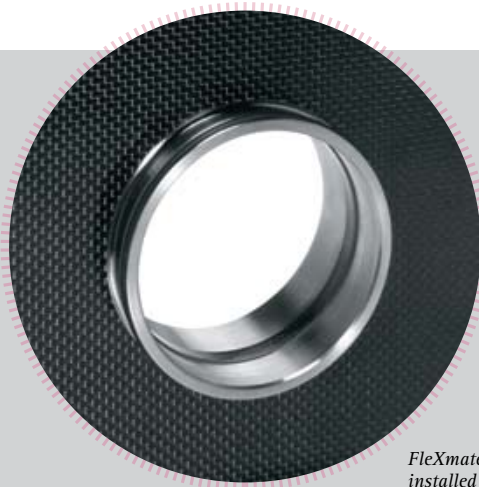
STEP 4. The mandrel is placed into FTI hydraulic puller.

STEP 5. The puller unit is activated to draw the mandrel through the fitting.



STEP 6. The fitting is now cold expanded into the structure.

STEP 7. Connect or couple your system line.



Flexmate fuel fitting installed in composite.

USE FLEXMATE IN COMPOSITES FOR IMPROVED ELECTRICAL AND MECHANICAL PERFORMANCE

A Flexmate fitting is radially expanded from a clearance fit starting hole to a final interference fit to produce uniform contact around the hole and achieve excellent electrical bonding and grounding performance. The hole-filling effect of Flexmate also improves the open hole compression strength of the composite.

THOROUGHLY TESTED TO MEET HIGH AEROSPACE STANDARDS

FTI and outside agencies have substantiated the performance of many FleXmate fittings through aggressive testing that represented how the fittings will be used on an aircraft. For each test, FleXmate passed easily and in most cases exceeded the testing parameters.



Torque



Pushout



Static Loading



Dynamic Loading



Vibration



Pressure

CASE STUDIES

Production Aircraft COST REDUCTION

After 15 years of production, a major OEM converted 24 legacy OBIGGS fittings to FleXmate eliminating:

- 40 hours of assembly labor per aircraft
- 300 fasteners per aircraft
- Operator costs associated with the weight of the older installations

New Aircraft WEIGHT REDUCTION

Many of the flanged fuel fittings selected for a newly designed aircraft would not fit through the pockets in the bulkheads. The fittings were converted to FleXmate eliminating:

- Costly re-design
- 0.25 lbs. on average per location
- 3 to 4 fasteners per fuel line penetration



Using FleXmate fuel fitting on a newly designed aircraft reduced weight by .25 lb. per fitting location.

CORROSION RESISTANCE

FleXmate fittings are initially placed in the hole of the structure with a clearance fit. This initial clearance ensures the corrosion preventive coatings and platings are not damaged or scratched during installation. Once a FleXmate fitting is expanded into place, any corrosion preventive coatings are uniformly distributed at the interface of the fitting and the hole to provide the best coating/plating integrity available.



Salt fog and electrical conductivity tests confirmed that FleXmate fittings were resistant to corrosion and the electrical resistance between fitting and structure did not change a significant amount.

A COMPLETE SYSTEM

Your FleXmate system comes complete with a parts standard that contains relevant information for your internal design teams and installation procedures for your manufacturing and maintenance departments.

The FleXmate system uses the same PowerPak and puller units as other FTI cold expansion systems. The durable tooling including the nose cap and mandrel are specially designed for FleXmate installations.



FTI designs and manufactures a full range of cold expansion products for the aerospace industry. These products are specifically engineered to achieve aircraft production and cost initiatives; meet design goals, production rates and aircraft performance objectives; and provide life-cycle cost savings.

Here are some of FTI's other innovative products:



Split Sleeve Cold Expansion™

Fatigue Life Enhancement of Holes in Metal Structures

- Enhances structural fatigue life
- Increases the durability and damage tolerance of holes
- One-sided operation
- Over 38 years proven service



ForceTec®

Rivetless Nut Plate

- Fast, consistent installation
- Meets or exceeds NASM25027
- Easily replaceable nut element – sealed or non-sealed
- Resists lightning strike damage in composite structures



ForceMate®

Bushing Installation System

- Reduces labor time and installation costs
- Consistent interference fit
- Resists migration and rotational forces
- Improves fatigue life and damage tolerance of parent structure
- Superior installation reliability



TukLoc®

Blind Fastening System

- Easy hole preparation
- No additional sealants required
- Rapid installation
- Highly reliable process



FTI's corporate headquarters and manufacturing plant is located just 5 minutes from the Sea-Tac International Airport and 10 minutes from downtown Seattle, Washington.

FTI SERVICES

Fatigue Technology Inc. is the world leader in cold expansion technology. We have pioneered this science since 1969 and have advanced the cold expansion process to develop cost savings ideas for production simplification, manufacturing and maintenance time-saving, and improved aircraft structural performance. We offer our customers a full range of services to support their applications.

THESE SERVICES INCLUDE:

- On-site product support
- Technical training
- Engineering/design support
- Product and materials testing
- Research and development services
- Field repairs and upgrades

(Please contact us to discuss your current application.)



FATIGUE TECHNOLOGY INC.

CORPORATE HEADQUARTERS

401 Andover Park East
Seattle, WA 98188-7605 USA

Phone: 206.246.2010

Fax: 206.244.9886

Email: sales@fatiguetech.com

www.fatiguetech.com

OFFICES:

Atlanta, GA
Dallas, TX
Los Angeles, CA
Oklahoma City, OK
Salt Lake City, UT
Washington, DC
Broughton, United Kingdom
Hamburg, Germany
Toulouse, France

REPRESENTATIVES:

Australia
China
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