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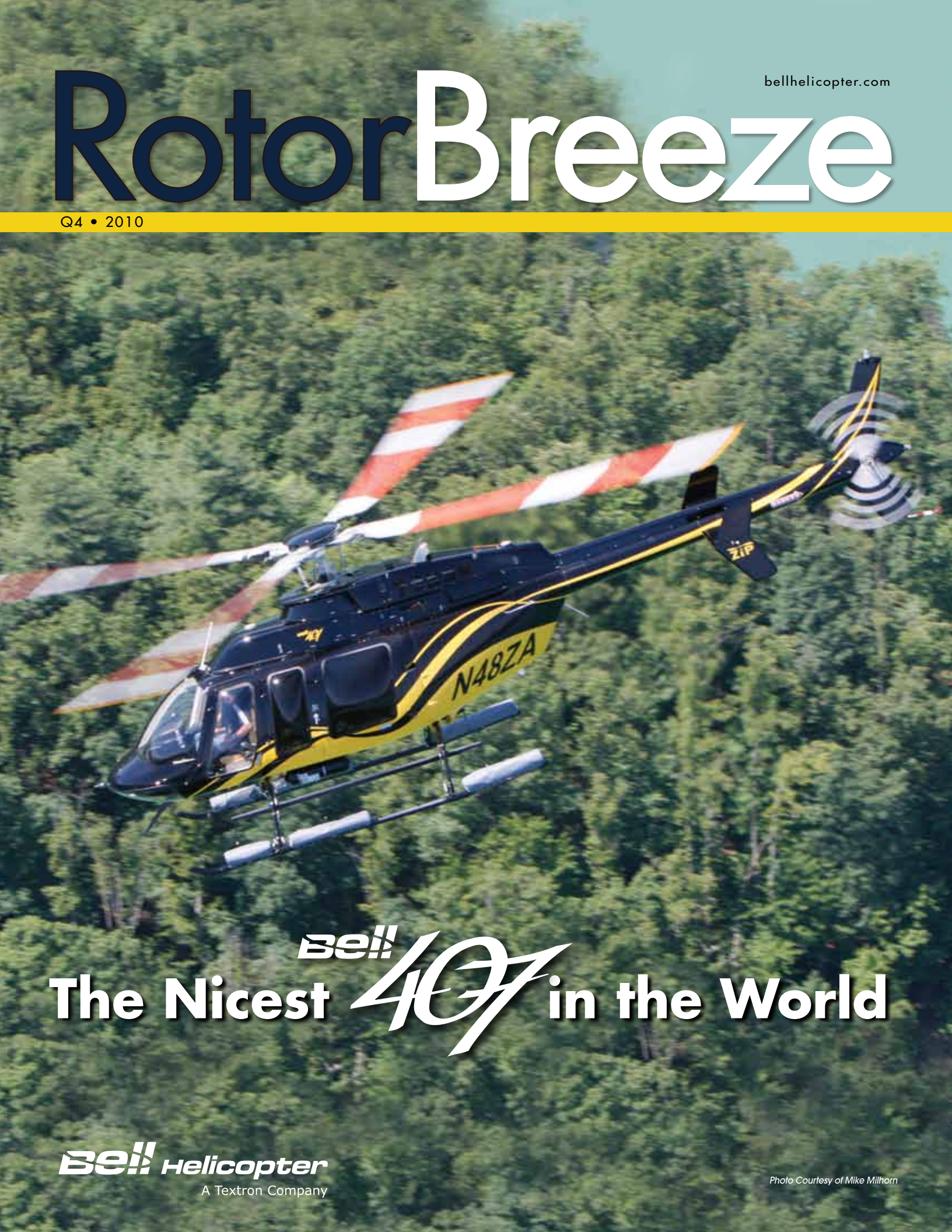
# RotorBreeze

Q4 • 2010




## Bell 407 The Nicest 407 in the World

Bell Helicopter
A Textron Company

*Photo Courtesy of Mike Milhorn*

## Q4-2010 FEATURES

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# Bell Helicopter and Parts Manufacturer Approval (PMA)

by Ross Johnson, *Director of CSS Strategy and Programs*

Parts Manufacturer Approval (PMA) is the title given to a Federal Aviation Administration (FAA) design and production approval for modification and replacement parts. PMA allows a manufacturer to produce and distribute parts for installation on a type-certified product. There are three design approval methodologies employed to grant an applicant a PMA. These include PMA by identicality, test and computation or a supplemental type certificate (STC). This approval process is used for both critical and non-critical aircraft replacement parts.

Bell Helicopter is known throughout the industry for safety and reliability of its aircraft. For that reason, Bell is paying close attention to the PMA market in flight critical parts. The issue at hand is the replacement of a Bell-approved critical part with a PMA part that is not Bell approved. Bell firmly believes that all critical parts used on Bell aircraft should meet Bell's stringent requirements for safety and reliability. This is not to say that parts approved through the FAA PMA process, without Bell involvement, are unsafe or unreliable. What it does say is that Bell cannot attest to that fact nor can Bell attest to the impact on overall aircraft operability; eg. drivetrain dynamics, flight characteristics etc. In addition, Bell warranty coverage could also be impacted and in some cases specific technical or engineering support may not be available.

Having stated that, it is important that customers are provided choices in this market. It is Bell's belief that Bell approval brings value, particularly as it relates to critical flight control, drivetrain and rotor component replacement parts. Over the past months, Bell has been listening to customers and we understand the need for improved, cost-effective replacement parts, especially in the legacy aircraft market.

Bell has the capability to develop, test and certify market-competitive replacement parts and currently offers many of these parts through Aeronautical Accessories Inc. (AAI). The difference between third-party PMA and AAI parts is that AAI develops and certifies its parts through the PMA process using Bell engineering to ensure full compatibility with the aircraft design.

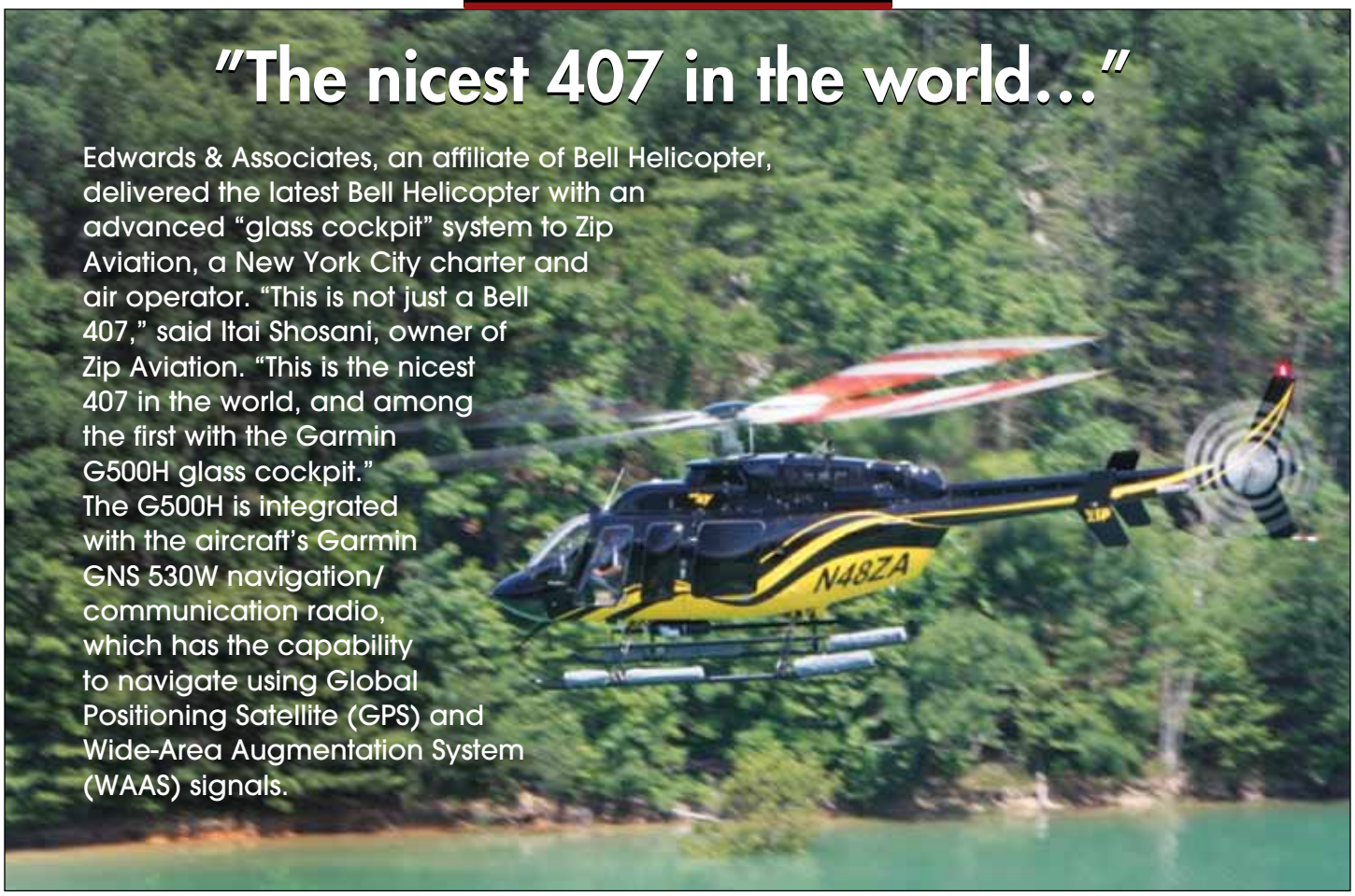
In order to provide customers with flexible and cost effective parts solutions, Bell is also committed to developing relationships with strategic third party providers to help compete in the PMA market. It is important to note, this strategy includes critical parts as well. Customers will see more products added to the AAI catalog as we move forward.

Bell Helicopter will stand behind products that have Bell-approved critical parts installed. This includes all parts certified through a type certificate (TC), supplemental type certificate (STC) or PMA approval, provided they are Bell approved. Bell's goal is that "Bell approved" does not translate into "non-competitive". The industry has sent manufacturers a clear message and Bell is responding. Bell Helicopter and the Customer Support and Services Team are committed to the process of reducing the direct maintenance costs (DMC) of our legacy aircraft. Market-competitive replacement parts are one of the key elements of this initiative.

A clear strategy for legacy aircraft support exists at Bell. Customers will hear more on legacy support and related cost reduction initiatives in future editions of RotorBreeze.

# "The nicest 407 in the world..."

Edwards & Associates, an affiliate of Bell Helicopter, delivered the latest Bell Helicopter with an advanced "glass cockpit" system to Zip Aviation, a New York City charter and air operator. "This is not just a Bell 407," said Itai Shosani, owner of Zip Aviation. "This is the nicest 407 in the world, and among the first with the Garmin G500H glass cockpit." The G500H is integrated with the aircraft's Garmin GNS 530W navigation/ communication radio, which has the capability to navigate using Global Positioning Satellite (GPS) and Wide-Area Augmentation System (WAAS) signals.




## First 429 to be delivered into Latin America


The first Bell 429 going to Latin America awaits ferry flight at the Bell Helicopter Customer Center in Fort Worth, Texas. The aircraft was ferried to Argentina and delivered to Harrinfrod, Ltd in September.

## Bell Helicopter Retains Number One Ranking in Product Support

Bell Helicopter once again claims the number one ranking in product support by readers of Aviation International News magazine. Bell has been awarded this honor every year since the magazine began including helicopters in the polls in 2006. "At Bell, our goal is to provide our customers complete mission solutions," said John L. Garrison, Bell Helicopter President and CEO. "From the day they sign a purchase agreement to the day the aircraft is no longer in service we are committed to providing Bell Helicopter customers with the highest level of product support."

# Balancing Bell 206L Series Rotors with RADS and/or Charts

by Steve Bornais, Product Support Engineering

This article will provide operators guidance and useful information regarding track and balance exercises to reduce Main Rotor (M/R) vibrations and resulting down time.

Operators must be aware that several components exterior to the M/R assembly may be responsible for unwanted vibrations. Prior to beginning a track and balance exercise, control linkages (including swashplate), transmission mounts, skid gear and external components must be securely installed and exhibit no mechanical looseness. Bell Helicopter recommends working the M/R with high gross weight and mid CG.

Operators should know that all M/R assemblies go through what is called a "zero load" condition during flight. This condition normally occurs on 206L models while the helicopter is in hover, and in transit to forward speed. Consequently, if the vibration level recorded in a hover, low air speed or let down is greater than during high speed, it may indicate a mechanical looseness somewhere in the control path. A detailed inspection of the entire M/R control system must be carried out to detect the source vibrations. A M/R adjustment cannot reduce vibration caused by mechanical looseness.

Bell Helicopter recommends recording track and balance data prior to major maintenance. Data should be equivalent or better following maintenance. If not, what was recently performed should be reexamined as it is probably the source of the problem. It is also essential to install the Rotor Analysis and Diagnostic System (RADS) equipment properly. Ensure that the swashplate interrupter is at the correct location, accellerometers are oriented properly and connected to the correct channel.

Operators without RADS equipment, or using RADS but not obtaining satisfactory diagnostic results, may need to use balancing charts to reduce M/R vibrations.

When perfectly executed, these three following steps will significantly simplify the track and balance exercise. Each step must be strictly followed and must be successfully completed prior to proceeding to the next one.

1

**1.** Trunnion centering is critical. Be aware that a perfect centering will:

a) Reduce tail wag at idle

b) Increase rotor efficiency

c) Reduce track and balance time (NOTE: Working M/R on ground does not accumulate component hours and will reduce the number of track and balance flights.

*Contact Product Support Engineering (PSE) or your local Customer Support Representative (CSR) for instructions regarding an improved M/R trunnion centering tool.*

2

**2.** Track main rotor at idle and 100% RPM with 35% torque (100/35) test conditions within 4 mm (lateral balance at this time is considered secondary and will be fine tuned during flight). The effect of tab at idle is considered negligible. Therefore, only pitch links should be used for idle track, and then use outboard tab to adjust 100/35 test condition (refer to IL 206L-99-64 for proper Tab Bender use).

When track at idle and 100/35 is within acceptable limit, switch RADS to "flight" mode.

3

**3.** Take vibration reading on forward flight. Be aware of the following information, which should be considered as guidance as aerodynamic effects may slightly vary depending on factors such as altitude, temperature or aircraft configuration.

a) One individual adjustment will affect all flight conditions (ex: hover, climb, high speed, descent, etc.) but to a different level.

b) Lateral unbalance is fairly consistent over any flight condition and is normally easily reduced by addition of rotor weights and/or blade sweep. (NOTE: Sweeping forward of initial alignment is not permitted)

c) Outboard tab is normally used when vertical vibration significantly increases with speed.

d) Inboard tabs provide capability to move the location of the vertical vibration closer to the working axis of the outboard tab (B1–B2, refer to chart). The outboard tab should be used simultaneously to compensate vertical vibration following an inboard tab move. See example on page 5.

e) Pitch links are mostly used for idle tracking purpose, and can be used thereafter to reduce in-flight vertical preferably for lower speed and let down corrections.

f) During troubleshooting, we recommend to evaluate the effect of each move.

g) Consistency between flights is required. Two consecutive sets of readings should demonstrate very similar results. Otherwise, several checks must be performed prior to continuing rotor track and balance such as M/R head, loose strap fitting, etc.

h) Bell recommends using the hub weights prior to sweeping when possible in order to keep the alignment integrity.

i) RADS software offers many options during track and balance. Operators should become familiar with these options as it may diminish the number of flights by finding a more appropriate move than the initial suggested one. You may choose to have only one suggested move, or as an example, to have only the outboard tab option available for use. You can therefore adapt it to your personal situation and get a perfect hover with an acceptable high speed if your operations are mostly sling loading, or the opposite if the aircraft is operated for executive ferry flights.

**To conclude**, a properly balanced rotor will increase parts life and provide better comfort inside the cabin. Product Support Engineering is always available to help owners/operators fully understand their track and balance exercise and to reduce aircraft vibrations to the minimum.

**The following is an example for using the "Vertical 100 knots" chart at right.**

Vibration data obtained at 100 knots: 0.3 IPS at 330 degrees.

*Recommended move should be:*

Inboard tabs: 6 degrees target up and blank down with

Outboard tab: 2 ¾ degrees target down or blank up

*Explanation:*

The 6 degrees of inboard tabs should bring you approximately to 1.0 IPS at 240 degrees, which permits you to come back toward the center of the chart using the outboard tab axis. This is what the 2 ¾ degrees will do. Doing inboard and outboard tabs simultaneously should consequently bring you directly from 0.3 IPS at 330 to approximately 0.0 IPS.

When the data obtained is relatively close to the outboard tab axis (B1–B2) (outside of the shaded area), the use of inboard tabs is not necessary.

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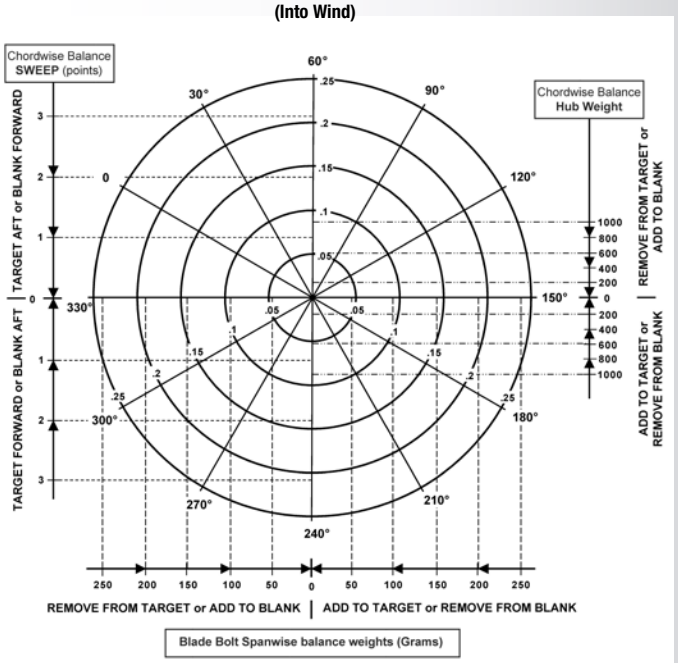
*For any additional information, please do not hesitate to contact Bell Helicopter Product Support Engineering.*

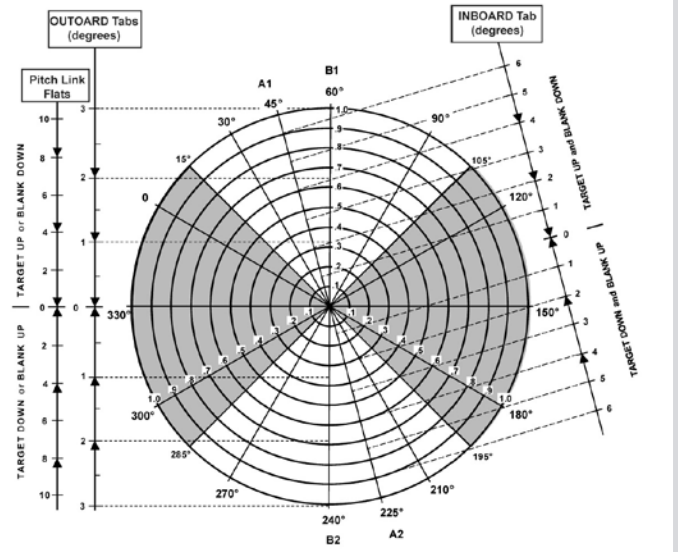
**206L SERIES** **LATERAL HOVER** **MAIN ROTOR**
**(Into Wind)**




CHORDWISE BALANCE–HUB WEIGHTS
206-011-157-101 : 100 grams
206-011-157-103 : 50 grams
206-011-157-105 : 25 grams

Scale: 0.05 IPS per division

**206L SERIES** **VERTICAL** **MAIN ROTOR**
**100 KNOTS**
**(1/rev)**




Scale: 0.1 IPS per division

| Move line direction | Tabs | Adjustment |
|---|---|---|
| A1 to A2 | Inboard | Target up AND Blank down |
| A2 to A1 | Inboard | Target down AND Blank up |
| B1 to B2 | Outboard | Target up OR Bank down |
| B2 to B1 | Outboard | Target down OR Blank up |

Note: Inboard tabs provide capability to move the location of the vertical vibration closer to the working axis of the outboard tab (B1–B2). The outboard tab should be used simultaneously to compensate vertical vibration following an inboard tab move.

# Bringing Technical Training to You: The Bell Training Academy's Remote Maintenance Courses

by John Griffith, *Supervisor, Light and Intermediate Technical Training, Bell Training Academy*

In today's highly competitive world, helicopter maintainers are looking for any advantage they can get—Bell Helicopter is committed to bring training near the top of the list. In the past, employers would have to make sizeable investments in time and travel expense to send their technicians to training courses – those days are now gone.

The Bell Training Academy (BTA) is announcing a concept called Remote Maintenance Training in an effort to satisfy customers' technical training requirements much closer to home. Remote maintenance training courses have been specifically designed to offer remote courses in areas of the world with a high concentration of Bell aircraft. Customers will benefit from this localized, tailored approach through reduced travel expenses, minimized "off the job time" for trainees, and enhanced access to the BTA's renowned instructor staff.

These classes are open to any personnel that desire to attend and enrollment is fast and easy! Go to the Bell Training web site at www.bellhelicopter.com/en/training. After logging in, select the aircraft model for the training you wish to receive and you will see a listing of all the courses for that model. The Bell Training Academy is dedicated to providing the highest quality helicopter training in the industry and now, anywhere in the world. For more information on remote maintenance training courses, or if you would like to host a remote training course at your facility, contact BTA administration at btaadmin@bellhelicopter.textron.com.

**The following schedule outlines the 2010 and early 2011 Remote Maintenance Training:**

| Location | Course | Date |
|---|---|---|
| Sao Paulo, Brazil | 407 Field Maintenance | Oct 2010 |
| | 206 Series Field Maintenance | Oct 2010 |
| Calgary, Alberta, Canada | 212 Field Maintenance | 29 Nov–17 Dec 2010 |
| | 205 Field Maintenance | 14 Feb–4 Mar 2011 |
| | T-53 Line Maintenance | 7 Mar–11 Mar 2011 |
| | 206 B/L Electrical Maintenance | 24–28 Jan 2011 |
| | 212 Electrical Maintenance | 31 Jan–4 Feb 2011 |
| | 205 Electrical Maintenance | 7–11 Feb 2011 |
| Singapore | 206 Series Field Maintenance | Feb 2011 |
| | 407 Field Maintenance | Mar 2011 |

# Bell Training Academy Joins the FAA Safety Team

The mission of the FAA Safety Team (FAASTeam) is to improve the nation's aviation safety record by conveying safety principles and practices through training, outreach, and education. Critical to the success of this effort is active participation from operators, maintenance facilities, and manufacturers. The Bell Training Academy (BTA) Technical Training Department recently joined forces with the FAA Safety Team (FAASTeam) to help improve safety outreach to helicopter maintainers. Manager of Technical Training, Charles Fisher, will serve as Bell's FAASTeam representative for the Technical Training Staff, joining existing BTA FAASTeam members John Williams and Richard Forns.

As part of this critical effort, Bell instructors are actively promoting the notion that aviation accidents can be reduced by improving the attitude, knowledge, and skills of technicians. Technical instructors are engaged in the process of risk management by attending FAASTeam safety education events and workshops to broaden their knowledge as aviation maintenance technicians.

In one of the more visible commitments to the FAASTeam, Bell instructors have also been enrolled in the William (Bill) O'Brien Aviation Maintenance Technician (AMT) Awards Program which focuses on training and knowledge of aviation maintenance accidents, regulatory issues, and incident causal factors. Several instructors have already achieved the Gold Award of Excellence after obtaining more than 80 hours of maintenance training and satisfactory completion of college level courses related to aviation safety, human factors, management, or quality control. Participation in the AMT Program provides Bell's technical staff the opportunity to share their knowledge and professional experience to customers around the world.

Located at Alliance Airport in Fort Worth, Texas, the Bell Training Academy takes pride in delivering the finest helicopter training in the world with highly skilled professional pilot and technical instructors. Training at the BTA incorporates the latest technological advancements into its aviation training programs and continues to invest in the development of new, industry-leading initiatives to promote helicopter safety.

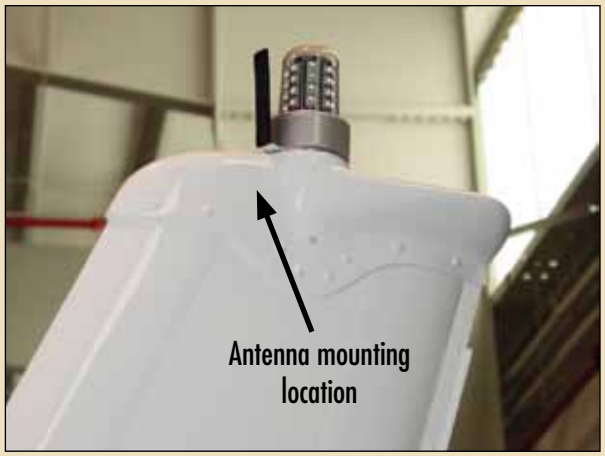
The Academy provides comprehensive training courses on Bell products. For a complete schedule of all courses, call 1-800-368-2355, visit www.bellhelicopter.com/en/training or contact the Bell Helicopter Training Academy Administration directly at BTAAdmin@bellhelicopter.textron.com.

# Aeronautical Accessories Now Offering Vertical Fin Antenna Mounts for Bell 407, 206B, and 206L Series

Aeronautical Accessories Inc. has developed new Vertical Fin Antenna Mounts for Bell 407, 206B, and 206L Series applications. The new cap includes several benefits including:

- Less weight than OEM collision light (approximately 1 pound less)
- Provides ample area for installation of a variety of antennas including GPS and satellite
- Improved signal reception – out from underneath the main rotor blades into "clean air"
- Replaces existing vertical fin fairing assembly and includes new LED anti-collision light Contains provisions for optional anti-collision light to be installed on belly of aircraft
- Easy installation using existing ship wiring, retaining the same mounting location for an anti-collision light

The Vertical Fin Antenna Mount is supplemental type certificate (STC) approved for Bell 407, 206B, and 206L series and is available for immediate shipment from Aeronautical Accessories at 1-800-251-7094.




*407 Vertical Fin Antenna Cap with LED anti-collision light (see arrow for antenna mounting location)*

# Blue Epoxy Coating

by Craig Mair, *Product Support Engineering—Medium Aircraft Group Supervisor*

## Operators from around the world have often asked:

***"What is the blue coating on this part, what are the damage limits and how do I repair it when damaged?"***

Blue epoxy coating or "blue coat" as it is commonly referred to, is used in multiple applications on all Bell Helicopter aircraft. Some typical applications are for a protective coating against fretting corrosion, general corrosion, or as an electrical barrier. The primary use is to prevent fretting and fretting corrosion between expensive steel, stainless steel and titanium components used in rotor system and drive train applications.

*The primary use is to prevent fretting and fretting corrosion between expensive steel, stainless steel and titanium components used in rotor system and drive train applications.*

The blue coat process is a rather complicated and tedious process with exact machining requirements. During the process the part is sandblasted in the areas to be coated, followed by a thorough cleaning. Areas not to be coated are masked. Within four hours of being prepared, the part is heated to a specified temperature and immersed into a "fluidized" bed of dry blue coat compound. The heat and immersion cycle bakes on layers of blue coat. After immersion, the part is cured at a specified temperature and time period. After cure and cooling, the masking is removed and the hardened blue coat machined or ground to the required dimensions per the blueprint.

As stated, blue coat is used primarily between two or more parts that are susceptible to fretting. In the case of the Bell 412, multiple components are blue coated on the main rotor head as this application uses a number of expensive metal components. For instance, the center section of the main rotor head driven by the mast incorporates three primary parts - the upper and lower cone seat and the spline plate. All three of these parts are blue coated on the outside diameters at the mating surfaces between themselves and the two titanium yokes. Since fretting movement between these parts cannot be entirely prevented, the blue coat acts as a sacrificial layer and prevents metal on metal fretting that would ultimately scrap out the parts in a short period of time.

During overhaul, blue coated components are inspected for condition. Blue coat that is worn but not chipped or missing is acceptable and the part may remain in service. Chipped or missing blue coat in small patches may be acceptable and field repairable, depending on the part and application. Generally blue coat loss of up to 10 percent of the surface area may be locally repaired by applying a thin layer of EA934 NA adhesive to the exposed surface. Allow the epoxy to cure for 24 hours and sand epoxy to contour with 180 grit paper. If there is any doubt on part serviceability, contact Product Support Engineering. For components with more than 10 percent of the bluecoat missing, the part needs to be sent to an authorized facility that is capable of recoating and re-machining the part. Operators have the choice of sending the parts to Bell Helicopter or a Customer Service Facility that has recoating capabilities. For more information contact Bell Helicopter Product Support Engineering at 450-437-6201.

SkyBOOKS AVIATION MANAGEMENT SOLUTIONS A TEXTRON COMPANY

# The Dos and Don'ts of the FAA Form 337

By Elizabeth Howard, Training Manager, *SkyBOOKS*

Alterations can become a concern without proper documentation and referencing. A Supplemental Type Certificate (STC) can be required when a modification becomes necessary for the Type Certificate (TC). You must have the approved STC before the new equipment is installed. As you know, an FAA Form 337 is required for the alteration. The FAA Form 337, Major Repair and Alteration for Airframe, Powerplant, Propeller, or Appliance serves two purposes. One is to provide owners and operators a record of major repairs and major alterations indicating details and approval. The other purpose is to provide the FAA with a copy for the aircraft records.

## 337 Dos

✔ According to Advisory Circular 43.9-1F Instructions for completing the FAA form 337, the 337 should be completed by the person who performs or supervises a major repair or alteration.

✔ Use the AC Form 8050-3, Certificate of Aircraft Registration, to complete the FAA form 337.

✔ Enter the descriptive details in the detail block. Descriptions should include:

- What is wrong? Exact location? What caused it? Is this the only problem or is there other damage?
- What will be done, repair or replace?
- Are you modifying the structure or duplicating existing structure? If duplicating, what are the basic parameters being duplicated, material, rivet type and size, rivet spacing and edge distance.

✔ Drawings should include:

- Station number
- Sheet material
- Rivet type and size
- Original rivet spacing
- Repairs –Should be able to fabricate parts or assemble repair in the shop without reference to descriptive text or aircraft.

✔ The Form must be duplicated so that the FAA receives a duplicate and the original is given to the aircraft owner to be maintained with the aircraft records.

## 337 Don'ts

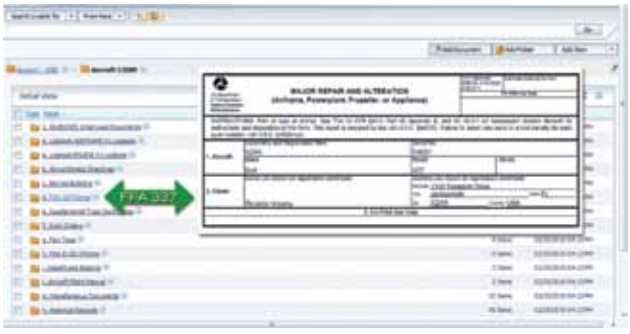
✖ Do not assume that the STC is approved. You would never assume an aircraft is ready for power. You would verify the aircraft's condition by reviewing the logbook. You should also never assume documents have been approved by the FAA before installing new equipment. FAA forms and other documents should be made just as readily available as the aircraft log book. Make sure all applicable documents are available for those who need them. **The best record keeping practice is to save the documents in an organized online program so that it is searchable and available for all users at any time.**

✖ Do not refer to Metallic Materials Properties Development and Standardization (MMPDS) unless the handbook was actually used. Instead refer to the original structure's material, thickness, and rivet spacing.

✖ Do not write a detailed description of the work performed when it would be best shown on a diagram.

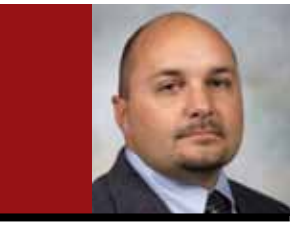
✖ Do not leave any details to assumption. FAA maintenance inspectors often discover forms with incomplete maintenance descriptions.

✖ Do NOT lose the FAA Form 337! Keep an online duplicate of the originally signed documents for reference and future use. The form will need to be retrieved if you are audited by the FAA.



✖ Do not forget about the next step. FAA Form 337 is required for any Major Repair & Alteration without established Technical Data. The work will require Instructions for Continued Airworthiness (ICA) if new airworthiness limitations or additional maintenance exist. **Do not forget to incorporate Instructions for Continued Airworthiness into your continuous maintenance program.**

*For more helpful tips and record keeping information, contact SkyBOOKS at 866.929.8700 or email sales@skybooks.com.*



# "Sundown"

## Of the United States Marine Corps HH/UH-1N Fleet

by Chad Heiman, *Senior Project Engineer, Military Technical Support*

As the U.S. Marine Corps begins to take delivery of new UH-1Y aircraft, the HH-1N and UH-1N aircraft are beginning the decommissioning phase, known as "Sundown" to the current military operators. Most of these aircraft will be preserved and placed in military reserve; however, many of them will begin a new life in the Surplus Military arena. They will be owned and operated by Department of State, Sheriff and Fire departments around the United States… and possibly the world.

While the UH-1N and Bell 212 Commercial aircraft closely resemble each other, there are many differences: engine package, main drive shaft , main transmission, tail rotor drive system , and main rotor hub and blade assembly, just to name a few. These combat proven aircraft have been well maintained by Naval Air Systems Command (NAVAIR) Engineering and their Marine Corps operators. These aircraft have been upgraded with multiple military air frames changes, power plant changes, and dynamic component changes over the years to allow for better performance and longevity. Simply put, the aircraft chosen for continued service in the FAA "Restricted" category will provide a great solution for local and state government agencies needing medium-lift helicopter capability.

Bell Helicopter Military Technical Support/Product Support Engineering (MTS/PSE) will continue to provide 24/7 technical and logistical assistance to the operators of the subject aircraft, military or surplus. Please note that the HH-1N is a U.S. Navy designation for the Search and Rescue configured UH-1N. The HH-1N is not recognized by Bell Helicopter Design Engineering and therefore does not have a production model, and is not listed in the Application Data of Bell engineering Drawings, Reports, or any other engineering document.

For normal requests and aircraft on ground (AOG) requests during business hours (7:00 am -3:30 pm M-F, CST), MTS/PSE can be contacted via email at: MTS-Medium@bellhelicopter.textron.com. For after-hours (3:30 pm – 7:00 am and weekends, CST) AOG assistance, the "duty" Product Support Engineer can be reached at 817-280-7200.

The Flight/Maintenance/Parts Manuals, engineering drawings, and modification documents for these aircraft are owned and maintained by NAVAIR. Due to ITAR regulations and Restricted Disclosure, Bell Helicopter is not at liberty to provide copies or revisions of these publications to surplus operators. However, we can assist with clarification of technical data/procedures within the manuals, discrepancy reporting, tooling, ground support equipment, etc. Please note, our assistance is limited to the Bell Helicopter "as delivered" engineering and last known aircraft configuration.

**There are two resources available for requesting NAVAIR publications, engineering drawings and documents:**

**1. United States/Canada Joint Qualified Contractor Program**

Technical data may be requested under the United States /Canada Joint Qualified Contractor Program, per the Department of Defense Directive (DoDD) 5230.25, Withholding of Unclassified Technical Data from Public Disclosure.

To purchase NAVAIR publications and engineering drawings under this program, a current, signed, certified DD Form 2345, "Militarily Critical Technical Data Agreement" must accompany the request. This certification is obtained through the Defense Logistics Information Service (DLIS). If data has been purchased in the past, an active certification may still exist. For further information please contact DLIS:

**United States/Canada Joint Certification Office Defense Logistics Information Service**
74 Washington Avenue North, Suite 7
Battle Creek, Michigan 49017-3084
Commercial: 1-800-352-3572, 616-961-7431/4358
Web address: www.dlis.dla.mil/jcp

Upon receipt of certification from DLIS, forward a copy to Naval Air Technical Data and Engineering Services Command (NATEC) along with the following information:

For NAVAIR publication requests provide the publication number(s) and title(s); or part number of the components for which publication is needed. For engineering drawing requests, provide the engineering drawing number(s), manufacturer cage code number(s), and the revision level if known. Also include a mailing address, email address, phone number and a point of contact.

The request and certification can be sent via email to: nani_qualifiedcontractor@navy.mil , faxed to 619-545-2722, or mailed to the Department of the Navy address below.

**2. FREEDOM OF INFORMATION ACT (FOIA)**

Technical data can be requested under the Freedom of Information Act (FOIA), per SECNAVINST 5720.42, Department of the Navy Freedom of Information Act (FOIA) Program. Per the SECNAV instruction, the minimum requirements of a FOIA request are as follows:

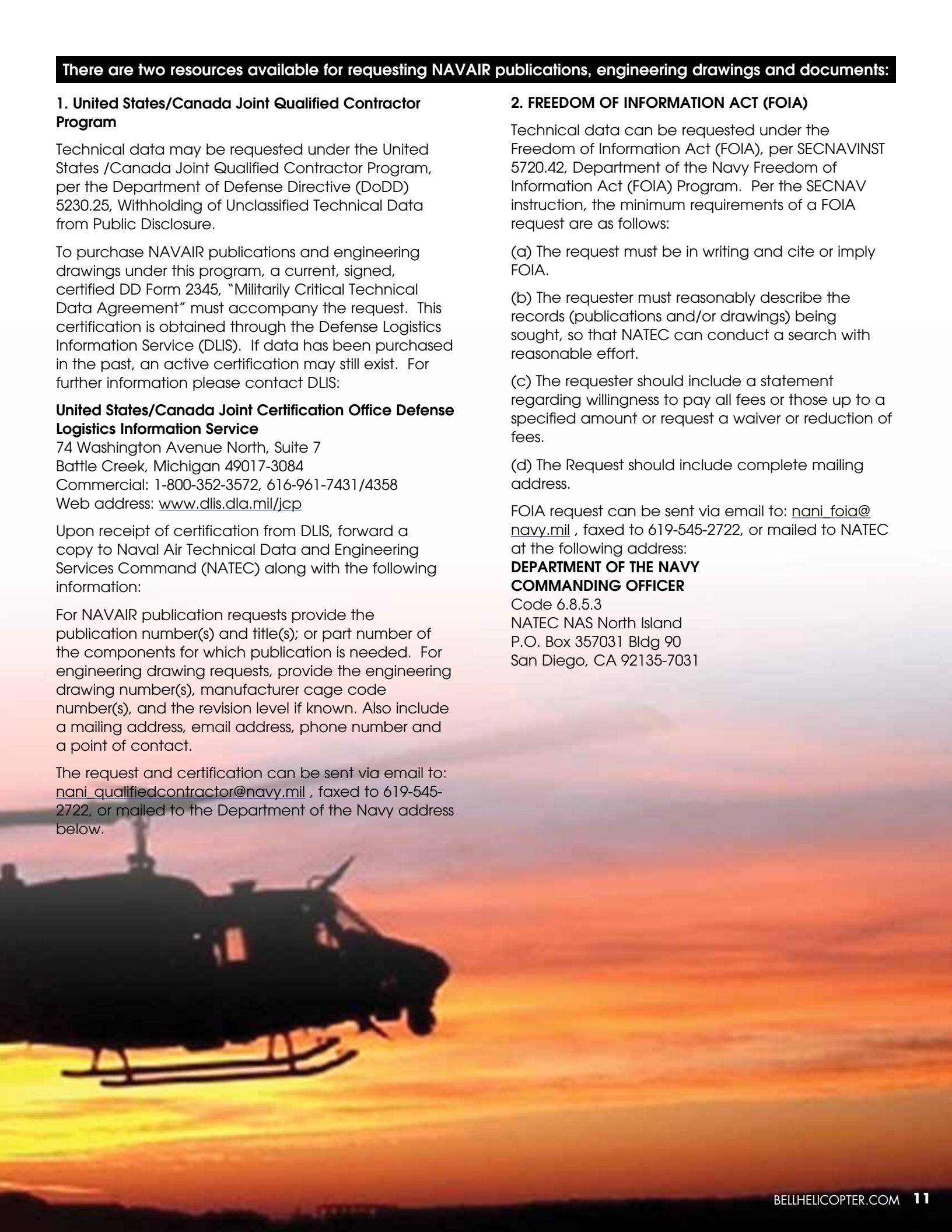
(a) The request must be in writing and cite or imply FOIA.

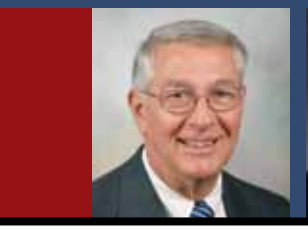
(b) The requester must reasonably describe the records (publications and/or drawings) being sought, so that NATEC can conduct a search with reasonable effort.

(c) The requester should include a statement regarding willingness to pay all fees or those up to a specified amount or request a waiver or reduction of fees.

(d) The Request should include complete mailing address.

FOIA request can be sent via email to: nani_foia@navy.mil , faxed to 619-545-2722, or mailed to NATEC at the following address:
**DEPARTMENT OF THE NAVY**
**COMMANDING OFFICER**
Code 6.8.5.3
NATEC NAS North Island
P.O. Box 357031 Bldg 90
San Diego, CA 92135-7031





# Bell 407 Feathering

by Jim McCollough, *Technical Fellow—Experimen*

In January 2010, Bell Helicopter Customer Support Managers from all over the world and Engineering leaders met in Fort Worth, Texas to talk about Bell Helicopter customers' experiences with various models. One of the items discussed was the wide variance in lives of Bell 407 Main Rotor (M/R) Elastomeric Lead-Lag bearings, commonly referred to as feathering bearings.

Bell 407 M/R feathering motion is accomplished via torsional motion transmitted through the 407-310-101-101 (shear) and 407-310-102-103 (feather) bearings. These are elastomeric bearings with on-condition replacement lives. The feathering bearings transmit rotor centrifugal force and in-plane and out-of-plane shear forces to the yoke.

The 407 M/R feathering bearing is a mature design with roots dating to the early 1980s with the introduction of the 406 Soft-in-plane Flexbeam Rotor System. The rotor, originally developed for commercial application, first saw service on the OH-58D for the U.S. Army. After about 15 years of successful military operation, the design loads and motions spectrum for the bearing were adjusted for the heavier and faster Bell 407. As service history began to accumulate, the design was again modified to the current configuration, which features better corrosion inhibiting coatings on the major metal parts of the bearing. Figure 1 (elastomeric feathering bearing) shows the original 407 feathering bearing and Figure 2 (feathering bearing installed in hub assembly) shows where the bearing is located in the hub assembly. The black elastomer material can easily be seen between the thin steel shims.

*Figure 1. Elasatomeric feathering bearing*

*Figure 2. Feathering bearing installed in hub assembly*

Anecdotal data indicated that some operators get more than 5,000 flight hours out of their bearings, while other operators find themselves replacing bearings after less than 1,000 hours. Real data was difficult to find because these are not time-life parts, so tracking component time is not required. The authors were asked to look into this matter and to consider two questions: 1) What can be done to increase component lives and reduce direct operating cost (DOC) with the existing bearing designs, and 2) What, if any, design changes can be made to improve these bearings?

Existing bearing replacement data were examined to look for a common denominator for low M/R elastomeric bearing lives. Were the issues related to cold weather, hot weather, high altitude, inconsistent interpretation of inspection criteria, or something else? While there were several operators with helicopters that had reduced bearing lives, initially no common factors stood out.

Representatives from Lord Corporation, the manufacturer of the elastomeric bearings, met in Fort Worth to discuss the issue with Bell's engineering team. A follow-up meeting was held between Bell, Lord and Edwards and Associates in Piney Flats, Tennessee to brainstorm a solution to increasing the elastomeric bearing lives. Many good ideas were discussed, but the question of why some bearings fail so much earlier than others remained.

During a meeting with the Director of Maintenance from a company that had experienced frequent early bearing replacements, in-depth discussions focused on operational mission characteristics i.e. typical weight, c.g., flight segment length, airspeed, altitude, temperature, etc. This discussion caused the investigative team to carefully consider operational differences as a common denominator for reduced bearing lives.

Examination of failed bearings showed the elastomeric material failed due to fatigue damage evidenced by tears in the elastomeric material between the steel shims. These tears are frequently detected by crumbing, where small pieces of elastomeric material work their way from the inside of the bearing to the surface. The inspection procedure is to measure the depth of the tear and if the depth exceeds the Maintenance Manual limit, the bearing must be replaced. Measuring the depth of a tear is not an exact science. Bearings have been returned to Lord that were still serviceable. This indicates that a better inspection procedure could prevent premature removal of serviceable parts, which was one take-away from this investigation and will be discussed in greater detail below.

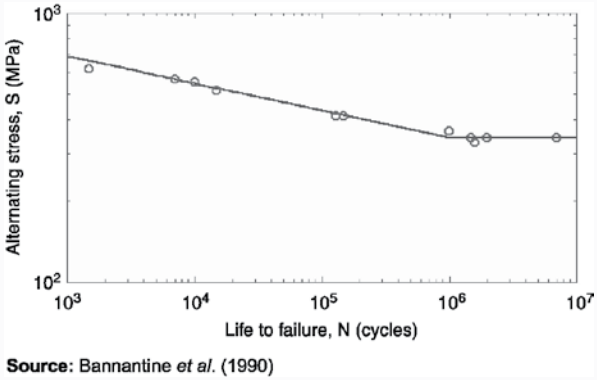
It is important to understand fatigue failures. Parts that are subjected to repeated loads have fatigue characteristics that are typically expressed in terms of a stress versus number of cycles, or S/N, curve.

Consider a tongue depressor clamped to a table and canilevered over the table edge like a diving board. There is some bending load that could be applied that would break the depressor the first time it is applied. There is a

# Bearing Update

*tal Flight Test and Customer Requirements* **and** Jim Braswell, *Technical Fellow—Rotor Systems*

slightly smaller load that would cause the tongue depressor to fail after ten load applications, a lesser load could be applied 100 times, a slightly smaller load would cause a fracture after a thousand loading cycles, etc. The S/N curve in Figure 3 (typical S/N curve) below is for steel, but it shows characteristics typical of S/N curves.




**Source:** Bannantine *et al.* (1990)

*Figure 3. Typical S/N curve*

As is depicted for steel, the load which may be applied for a million cycles may also be applied for 10 million cycles without breaking the part (the S/N curve goes horizontal at a million cycles). A steel part can continue for an infinite number of cycles at this strain level and never break. This strain level is called the material's endurance limit (EL). If the strain applied to a part is always equal to or less than the material's EL the part will not fail. However if a strain greater than the EL is applied, even infrequently, the part will be damaged to some degree. This is called fatigue damage and it is cumulative. When a part fails due to repeated load applications, we call it a fatigue failure.

The strain applied to the elastomeric material in the M/R bearings is primarily due to torsion. M/R bearings go through a strain cycle every rotor revolution. On a 407, that is 24,780 cycles per flight hour, or a million cycles in just over 40 flight hours. One portion of the bearing strain is due to collective pitch, which produces a steady strain. Cyclic pitch, which is added to collective pitch, produces oscillatory strain. The highest bearing strain levels occur when flying fast with an aft center of gravity at higher density altitudes.

Once it is realized that bearing lives are strongly influenced by operational characteristics, it is important to carefully consider potential operating strategies to reduce elastomeric bearing strain. Obviously, aircraft must fly at an altitude sufficient for terrain clearance, and the air temperature is what it is. However, operators have some latitude in the way the helicopter is loaded and the airspeed flown.

If a helicopter has a baggage compartment extender installed, careful loading is required to keep heavier items as far forward as possible. Installation of heavy equipment such as oxygen bottles in the baggage compartment moves the aircraft c.g. aft. Improved bearing lives may be realized by simply reconfiguring a 407 to move the c.g. as far forward as possible while maintaining the helicopter within the allowable maintenance manual empty weight c.g. envelope.

A slight reduction in cruise airspeed (reduced forward cyclic) will also improve M/R bearing lives. One operator noted a significant reduction in M/R elastomeric bearing lives shortly after reconfiguring their fleet from particle separator engine inlets to inlet barrier filters (IBF). The IBF is more efficient than the particle separator, which allows the engine to produce more power at the same MGT. With more power available during cruise flight the result will be slightly greater cruise airspeed, which requires more forward cyclic, resulting in higher bearing strain. Increased power available is great for improved hover and take-off performance but has the potential to reduce bearing lives during cruise flight at aft c.g. When operating hot/high with an aft center of gravity even a slight reduction in cruise speed will reduce strain and improve the elastomeric bearing lives.

Reconfiguring an aircraft to move the center of gravity forward and reducing power and airspeed during cruise flight for a heavy helicopter operating in hot/high conditions is not an ideal solution, but it is a way to reduce DOC and aircraft maintenance down time with today's bearings.

While the foregoing discussion focused on potential operational adjustments that could be made to improve bearing lives, Bell engineering is working with Lord to investigate new elastomeric materials with potentially better fatigue characteristics. Newer materials and processes for producing more robust components have emerged since the 407 bearings were designed in the mid 1990s. Lord and Bell will be meeting to discuss proposed design changes and the way forward to introduce improved bearings to the fleet. Lord engineers are also working independently to develop improved inspection procedures and methods to communicate more clearly how to inspect bearings for wear and tear.

Increasing 407 M/R elastomeric bearing lives and subsequent reduction of aircraft maintenance down time and DOC is a high priority task that is being worked from several perspectives. Operational changes to load the helicopter to a more forward center of gravity and to slightly reduce cruise airspeed when flying at high density altitude will increase existing bearings lives by reducing bearing strain levels. Clarification of inspection criteria should result in fewer rejections of serviceable bearings. The long term solution lies with potential design changes to use newer bearing materials.

# Legacy Spares Management Organization Update

by Peter Rue, *Director Legacy Spares*

In the Q1 2010 issue of RotorBreeze, the Legacy Spares Management (LSM) organization was introduced and its charter to provide focused priority for "Legacy" Commercial Spares explained. The LSM team continues to focus on streamlining processes for this value stream and improving responsiveness and reducing cost for Bell customers. This article will provide additional insight into how LSM parts are identified and share initial results from early 2010 actions.

The LSM organization uses a streamlined commercial-oriented process. All of the parts in the LSM scope must be designated as either commercial items or a commercial off-the-shelf item by Bell's Commercial Item Determination (CID) Board. This means that LSM parts not only have to be offered for sale to commercial customers per the Federal Acquisition Regulations (FAR), but they must have a level of demonstrated sales to approved commercial customers within the last 10 years. This ensures that our commercialized process is compliant with the FAR. As this process matures, the LSM team will continue to look for ways to improve how "in scope" and "out of scope" parts are determined.

In 2010, LSM has continued to expand buying capacity through the transition of all CID commercially approved buy parts from both Fort Worth and Mirabel Procurement operations. Through June, the LSM demand control team that is led by Ernest Loper has successfully transitioned approximately 4,800 Fort Worth part numbers to the LSM team. For the remainder of the year, LSM is coordinating the transition for 4,700 additional part numbers from Mirabel. In addition to working with the CID board on commercial determinations, the demand control team acts as the liaison between all Fort Worth functional organizations and the Cessna transactional buying team. This team helps resolve a wide range of issues from demand order quantity reconciliation, updated planning and engineering, to supplier delivery and quality issues.

The LSM buying team at Cessna, led by Steven Rygg, has expanded its capability to handle increasing volume as these parts are transitioned to LSM buying responsibility. This buying team brings together a very agile and advanced workforce that has experience across many disciplines including purchasing, information technology, new product and service implementation, six sigma and supplier integration. These areas of knowledge and skill are integrated in a working team environment that is highly interactive and proactive in meeting customer expectations.

The LSM transition team under the leadership of Carter Biggs has the responsibility for establishing a differentiated legacy spares supply base focused on supporting out-of-production spare parts along with reducing inherited supply base to a more manageable number. This team collaborates with the Bell manufacturing centers to identify make parts to be transitioned and combines them with other LSM purchased parts to provide leverage for supplier quoting and contracting. During the first wave initiated in 2009, this team established five new LSM sheet metal and machine parts suppliers while contracting over 300 part numbers. Wave 2 activity has resulted in six new contracts for sheet metal and machined parts while adding only two new suppliers and impacting another 400 part numbers. Other Wave 2 activity has included quoting standards and hardware commodity parts resulting in contracting activity on another 1,000 plus part numbers. Activity started in May 2010 on Wave 3 to evaluate additional opportunities for the end of the year. One of the key benefits of higher volume contracting is the reduction of transactions required for placing parts on purchase orders for our company.

As the LSM organization continues to work through these transitions, the team remains committed to listening to the voice of the customer and will work to improve current processes and explore new ways to enhance value to Bell Helicopter customers.

# Bell Simulators

by Ashley Moore, *Communications Coordinator, Engineering*

Bell Helicopter has been building state of the art flight training simulators as a prime contractor for the military since 1998. Since this time, 18 simulator systems have been installed at military bases across the United States for the U.S. Marine Corps and U.S. Air Force —providing safety of flight and mission training for Bell's H-1 and V-22 military customers.

Bell Aircrew Training Devices team lead, Rod Beechey, says "the customer plays a significant role during concept development, design and final acceptance (of these flight training devices). We lean heavily on our government customer, pilots, instructors and Naval Air Systems Command (NAVAIR) to help tailor the design to meet their needs."

The simulators give pilots "sensation of flight" through modernized visual systems, motion systems, precision aerodynamics models and other advanced capabilities. Bell Helicopter has teamed with subcontractor Flight Safety International (FSI), combining Bell's aircraft expertise and systems integration knowledge with FSI's cutting edge commercial-off-the-shelf simulation technologies.

Student pilots are provided a safe simulation environment, where 50 percent of all training specific to the H-1 or V-22 aircraft is completed from on the ground. Simulator instructors provide trainees with one-on-one instruction using a military defined training syllabus for the specific aircraft type. Training is given to new students and experienced pilots, providing beginner and refresher sessions to keep aircraft skills current.

Training capacity goes far beyond routine avionics "switch-and-button" familiarization. Students learn aircraft emergency procedures with simulated system-wide aircraft failures. Engine failures, auto-rotations with severe wind turbulence and loss of tail rotor are examples of these replicated situations.

"Bell has a vested interest in providing training not only for normal operational profiles, but to train students on the extremes of aircraft capabilities particularly in the areas of avionics systems and aircraft aerodynamics performance. At the end of training, a student will know what the aircraft can and cannot do while provided for in a safe environment," says Beechey.

FSI's visual system uses powerful cutting-edge high-contrast visual projectors projected on a 24-foot spherical dome. With advanced simulator technologies, instructors can instantly playback a student's flight response and point out ways to improve, including student reaction and response time in information overload stress situations. One simulator advantage — giving on–the-ground instructional training that would be dangerous and otherwise impossible to do in an aircraft.

"These simulators will save lives," says Major General Thomas L. Conant in a recent H-1 full flight simulator dedication ceremony at the Camp Pendleton Marine Corp Air Station (MCAS), a California base that received two new simulators in May.

The simulators are "interoperable" to other training simulators — a feature that is said to be the future of training. H-1 and V-22 trainers are currently linked with other simulators systems at local base locations. This means that pilots can "fly together" in friend and foe tactical missions – adding value to training and a cost and time savings benefit for the military. Plans are in place to expand across the United States and at global U.S. military bases in the future.

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