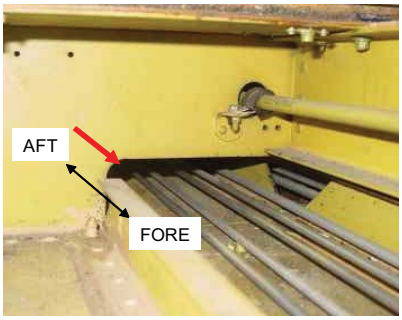
LAMBDA Technologies Group.

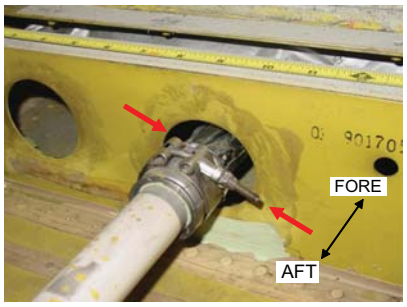
LPB® Application Note

IMPROVING COMPONENT LIFE AND PERFORMANCE

AIRCRAFT STRUCTURES

MITIGATING STRESS CONCENTRATIONS IN P-3 FLOOR BEAMS





Crack-prone areas

The US Navy and its foreign military sales partners are extending the service life of the P-3 Orion. Fleet aircraft are currently averaging approximately 24,000 flight hours, 16,500 hours past the designed service life. Full-scale pressurization testing showed that several forged floor beams are prone to fatigue damage due to stress concentrations from machined cutouts. Replacement of the components is impossible, so a program was implemented by NAVAIR to evaluate performance improvement by LPB. LPB treatment of P-3 Orion floor beams increases fatigue life and eliminates stress-related fractures.

- Improves Safety
- Eliminates the Need for Early Retirement
- Lowers Maintenance Costs
- Increases Time in Service

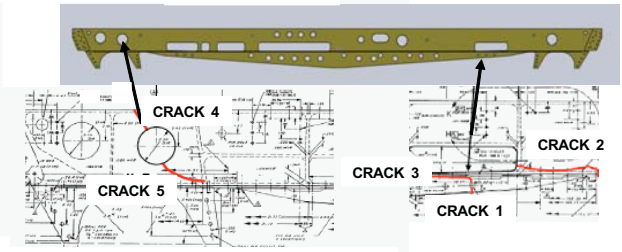
www.lambdatechs.com

Lambda Technologies ■ 3929 Virginia Avenue, Cincinnati, OH 45227
Tel (513) 561-0883 ■ Toll Free/U.S. (800) 883-0851 ■ Fax (513) 322-7186

LAMBDA Technologies Group.

Mitigating Stress Concentrations in P-3 Floor Beams

High stress concentrations in the P-3 floor beams can lead to premature cracking and decreased service life of the aircraft, adversely impacting crew safety and fleet readiness, as well as significantly increasing the total cost of ownership and operation. Applying designed compression from low plasticity burnishing solves these problems.

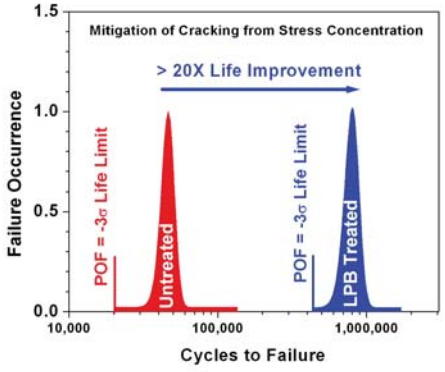


LPB Processing of a Simulated Part

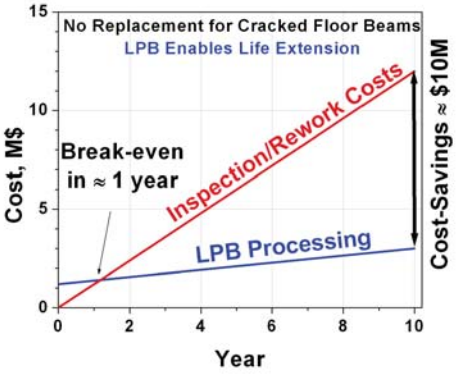
To demonstrate the life improvement from LPB treatment, fatigue testing was performed on two types of feature specimens that simulated the crack-prone areas of the floor beam. Stress concentration factors, k_t, were calculated with finite element analysis. Residual compression required to overcome the stress concentration was determined with Lambda's fatigue design method. Verification tests were conducted to the event of component fracture or until a "run-out" life of 10 million cycles was attained.

LPB treatment improves fatigue life exceeding 20 times compared to the as-manufactured condition. This corresponds to a safe service life of roughly 2.25 million flight hours. Improved fatigue performance allows increased inspection intervals and providing an estimated cost savings of 10 million dollars.

LIFE IMPROVEMENT



COST SAVINGS



References:

- G. Kauffman, T. Nguyen, D. Hornbach, P. Prevéy. "Life Extension of the P-3 Aircraft by Robotic Applications of LPB." Aircraft, Airworthiness and Sustainment 2011. http://www.meetingdata.utcdayton.com/agenda/airworthiness/2011/proceedings/presentations/P4619.pdf. San Diego, CA, April 18-21, 2011.
- P. Prevéy, D. Hornbach, J. Scheel. "The Effect of Surface Enhancement on the Corrosion Properties, Fatigue Strength, and Degradation of Aircraft Aluminum," http://web.nace.org/Departments/Store/Product.aspx?ID=ef1f6fac-515c-df11-a321-005056ac759b. NACE Corrosion 2010.

http://www.lambdatechs.com/publications/all-technical-papers.html

Accreditation:

- ISO/IEC 17025 Accredited Laboratory
- ISO 9001:2008 Certified
- FAA Accepted

For more information on Lambda, LPB® or to read complete papers, please visit www.LambdaTechs.com

www.lambdatechs.com

Lambda Technologies ■ 3929 Virginia Avenue, Cincinnati, OH 45227
Tel (513) 561-0883 ■ Toll Free/U.S. (800) 883-0851 ■ Fax (513) 322-7186