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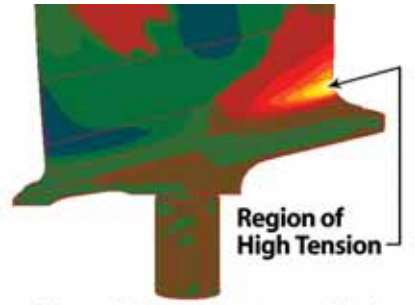
LPB® Application Note

IMPROVING COMPONENT LIFE AND PERFORMANCE

ENGINE COMPONENTS

LPB processing of a turbine vane

IMPROVING HCF AND FOD TOLERANCE IN TITANIUM VANES



Vane axial stress due to combined bending and torsion in engine service.

Low Plasticity Burnishing (LPB®) improves foreign object damage (FOD) tolerance and high cycle fatigue endurance limits while completely mitigating cracking along the trailing edge of the Ti-6Al-4V Alloy F402 First Stage Low Pressure Compressor (LPC1) Vane used in the U.S. Marine Corps V/STOL tactical strike aircraft.

- Reduces Inspection Times
- Increases Time in Service
- Decreases Maintenance and Replacement Costs
- Increases Safety for Military Personnel

LPB improves the service life of the F402 LPC1 vane by imparting through-thickness residual compression. This counters the applied tensile stresses in the component, increasing the vane's damage tolerance and eliminating fatigue cracking. LPB offers a significant reduction in the cost of aircraft ownership and improved fleet readiness.

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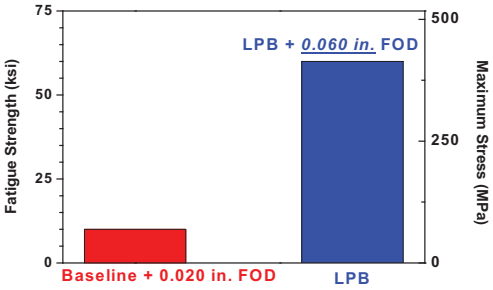
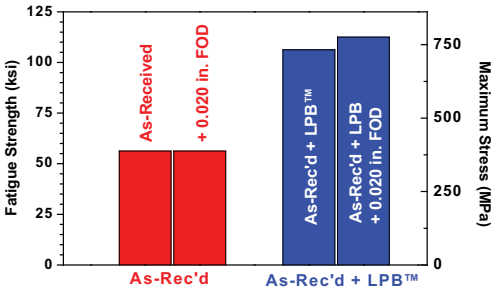
Mitigating HCF & FOD in Engine Components

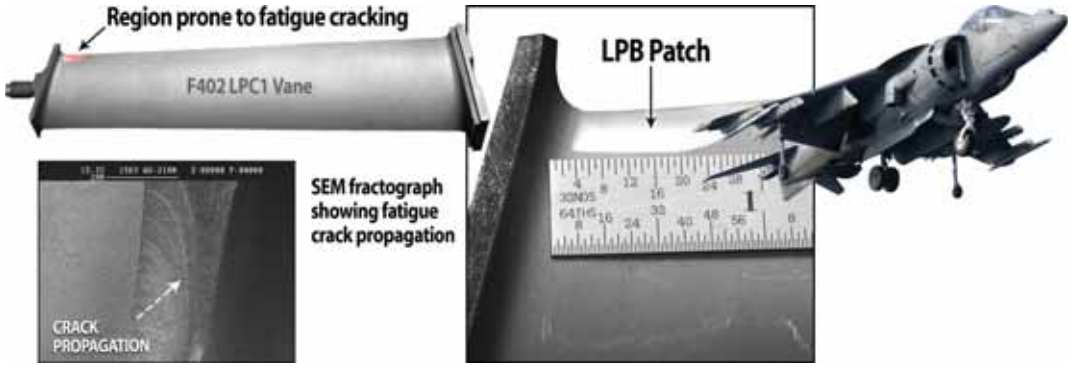
High cycle fatigue testing was performed to evaluate the effectiveness of treating the trailing edge of first stage F402 vanes with LPB. Both actual vanes and specially fabricated vane edge specimens were used throughout the testing process. FOD was simulated with controlled depth EDM notches. Residual stress and cold work distributions were measured using x-ray diffraction to confirm the depth of compression and process parameters.





LPB processing of fielded vanes, with a current trailing edge damage tolerance of 0.002 in., resulted in a ten-fold increase in FOD tolerance. LPB applied in the critical high stress area on the trailing edge doubled the fatigue strength. FOD up to 0.060 in. was tolerated in the vane edge feature specimens with a fatigue strength of 60 ksi. The test results were corroborated with linear elastic fracture mechanics modeling for the residual stress level and FOD sizes investigated.

As the military fleets age, aircraft are being required to stay in service for much longer than their initial design life. The costs of repair, inspection and replacement of critical parts is rising dramatically and the need to keep planes in service is growing. With LPB, rotating engine components can last years beyond their expected lifetimes, increasing time in service and decreasing the frequency of downtime due to maintenance, repair and inspection.



To learn how LPB can increase the life of your engines, please visit www.LambdaTechs.com or contact Kim Bellamy at (513) 561-0883.

References:

- R. Ravindranath, N. Jayaraman, and P. Prevey, "Effect of Surface Treatments on HCF Performance and FOD Tolerance of a Ti-6Al-4V Vane." Proceedings of the 8th National Turbine Engine High Cycle Fatigue (HCF) Conference. Monterey, California, April 14-16, 2003.

http://www.lambdatechs.com/publications/publications.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

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