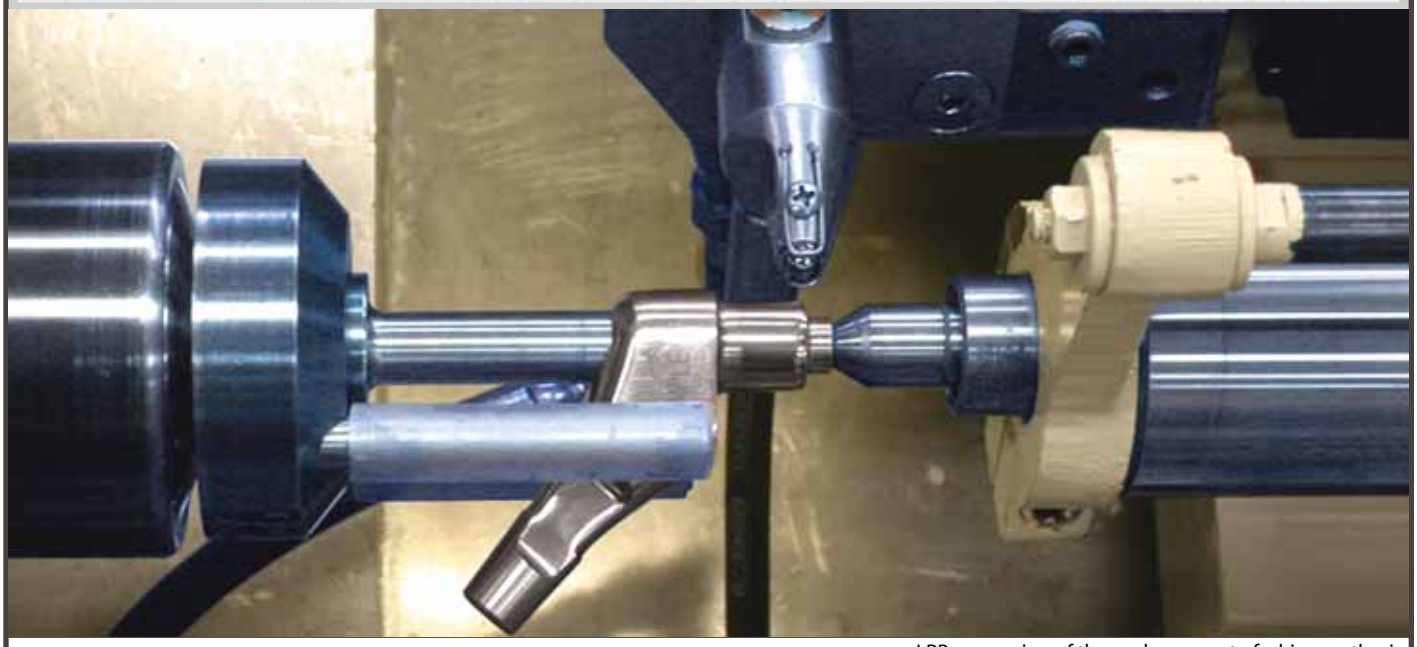
LAMBDA Technologies Group.

LPB® Application Note

IMPROVING COMPONENT LIFE AND PERFORMANCE

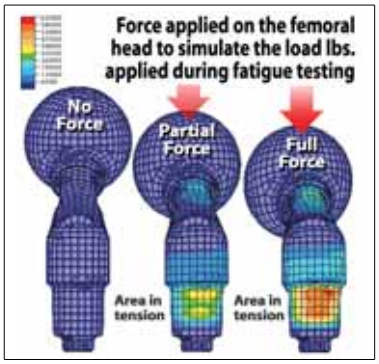
TOTAL HIP PROSTHESIS



LPB processing of the neck segment of a hip prosthesis

LPB Eliminates Fretting Failure in Hip Implants

300,000 hip replacement surgeries are performed in the United States each year. Modular hip prosthesis systems afford doctors the flexibility to choose properly sized components and treat a wide spectrum of patients. However, these replacements are vulnerable to fretting at their tapered connections. Every step taken by a patient represents a single loading and unloading cycle that accumulates over years of implantation. This damage can reduce the HCF life, and cause complete failure of the hip. LPB treatment of high stress areas in prosthetic hips increases the fatigue life and eliminates the occurrence of failure from fretting-induced fracture.



- Fewer Follow-up Surgeries
- Increase in Fatigue Life Allows Active Use
- Does Not Alter Material or Design
- CNC Tool Control for Easy Integration
- FDA Approved

Lambda provides complete process development and can deliver a custom production solution to fit your needs.

www.lambdatechs.com

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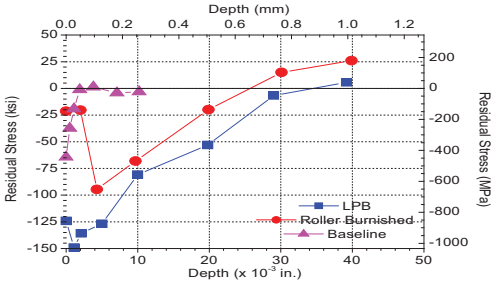
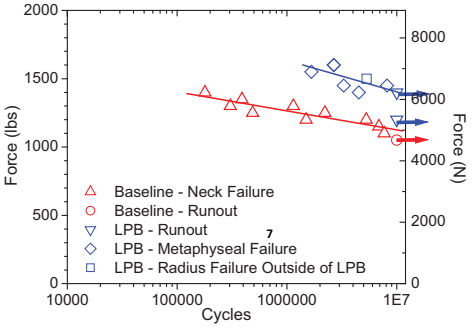
Mitigating Fretting in Hip Implants

To determine LPB parameters, a finite element model of the neck segment was used to show the in-service applied stresses. Loads and boundary conditions were applied to simulate those experienced in service. Applied stress data from the FEM and fractography results derived from fatigue tested components was used to determine where to place the beneficial compressive residual stresses. X-ray diffraction residual stress measurements were made on the tapered region of the neck segment in as-machined and LPB treated hip implants to determine depth of compression. LPB provided a very deep, stable layer of high compression.



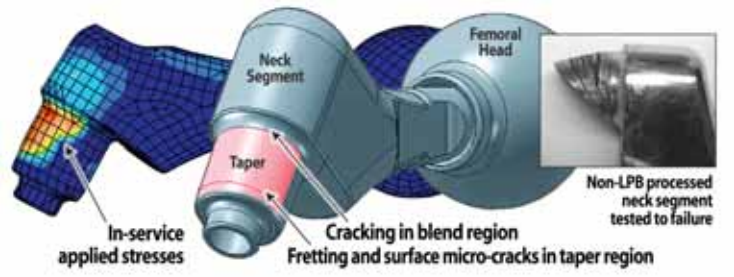
X-ray diffraction residual stress vs. depth profiles on the outside diameter of the tapered neck showing deeper and higher compression for the LPB processed specimen



HCF results indicating LPB produces a nominal 40% increase in fatigue strength at 10^7 cycles

Fatigue testing was essential to validate that fretting failure mitigation and the high cycle fatigue goals were met. The smallest size components were tested to maximize the applied stresses and thereby simulate the worst-case implant construct. Testing showed that LPB processing of the neck taper increased the fatigue strength by almost 40% and eliminated the occurrence of fretting-induced fracture.

LPB provides many benefits to medical implants compared to other surface treatment options. LPB achieves deep, high magnitude compression. The procedure requires no special coatings, uses only a single cycle for treatment and the implants do not need to be moved from one machine to another. Since LPB tooling is designed to fit on existing CNC machinery, the entire process can be seamlessly and affordably integrated into manufacturing.



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

References:

- D. Hornbach, E. Loftus, and P. Prevey, "Application of Low Plasticity Burnishing (LPB) to Improve the Fatigue Performance of Ti-6Al-4V Femoral Hip Stems." Proceedings of Symposium on Fatigue and Fracture of Medical Metallic Materials and Devices. Dallas, Texas, Nov. 10, 2005.

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

Accreditation:

- ISO/IEC 17025 Accredited Laboratory
- ISO 9001:2008 Certified
- FDA Approved

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

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