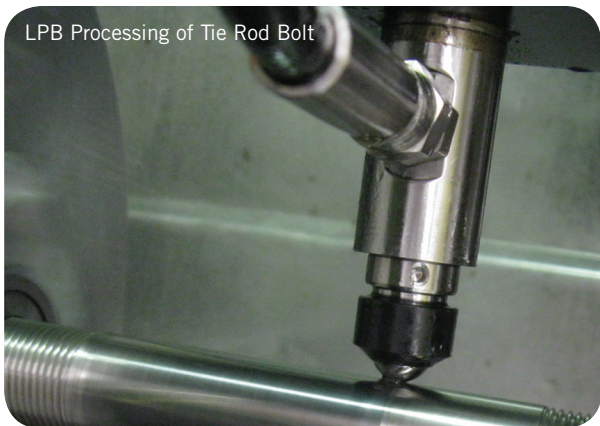
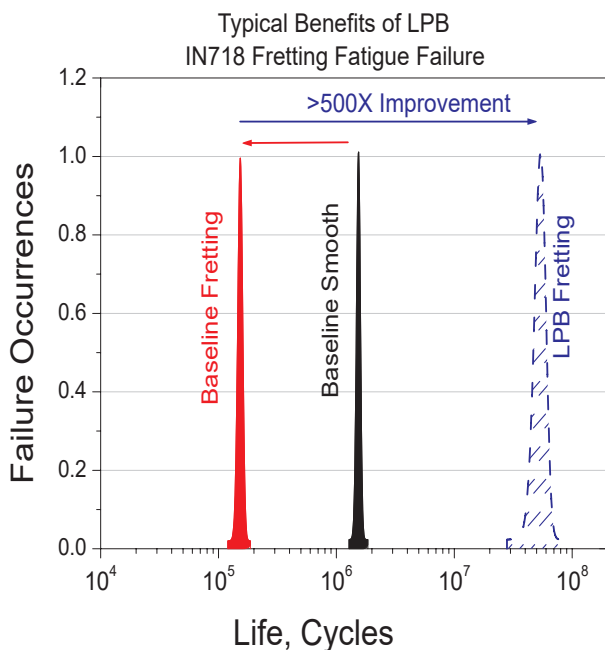


Turbines are the backbone of power generation, producing over 80% of the world's electricity. Tie rod bolts that connect gas turbine stages can be susceptible to fretting fatigue at the edge contacts between the turbine rotors and the tie rod landings. Oxide particles can become embedded in the tie rod surfaces at these locations, creating local stress concentrations. Shallow shear cracks formed at the edge of fretting zones can initiate fatigue cracking, potentially leading to failure of untreated tie rod bolts within the first few years of service. To address this, plant operators perform frequent inspections of the tie rod bolts, replacing any that have signs of damage. This requires a substantial amount of down time that can severely impact both operating efficiency and cost of power generation.



**SOLUTION:** Low plasticity burnishing (LPB<sup>®</sup>) of the gas turbine tie rod bolts provides a cost effective solution. Lambda developed optimum LPB process conditions through initial trials. Fatigue tests were conducted on LPB treated and untreated rods with simulated conditions of fretting and embedded oxide particles. The fatigue strength of the tie rod material deteriorated by a factor of five in the untreated rods. LPB treatment resulted in over six-fold improvement in fatigue strength, even with oxide damage and fretting. Additional combined thermal-mechanical tests for years of thermal exposure with nominal operating stresses proved that the LPB induced compressive residual stresses remained stable during operation. This confirmed that the benefits of LPB treatment would allow the tie rod bolts to resist fretting fatigue for the duration of the designed life of the gas turbines they hold together.



**IMPACT:** With LPB treatment, tie rod bolts can remain in service for the entire design life of the turbines. Over forty (40) ship sets of tie rod bolts have been LPB treated and placed in service in the last five years. At a cost of up to \$400,000 for materials alone each time a set of tie rod bolts needs to be replaced, LPB has provided a cost savings of approximately \$16 million to date. Adding the cost of taking the gas turbines out of service for repairs, estimated at \$1 million per shutdown, yields over \$40 million in savings so far with LPB.

To learn more about how LPB can extend the life of your component, contact Lambda Technologies at 1-800-883-0851 or visit our website at [www.lambdatechs.com](http://www.lambdatechs.com).