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Archiving Surface Integrity Research for the Development of New Applications and Economy of Design

Mitigation of Fretting Induced Failures

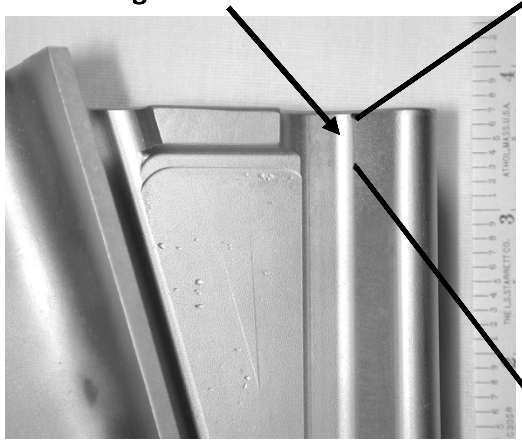
Preventing Fan/Compressor Blade Separation

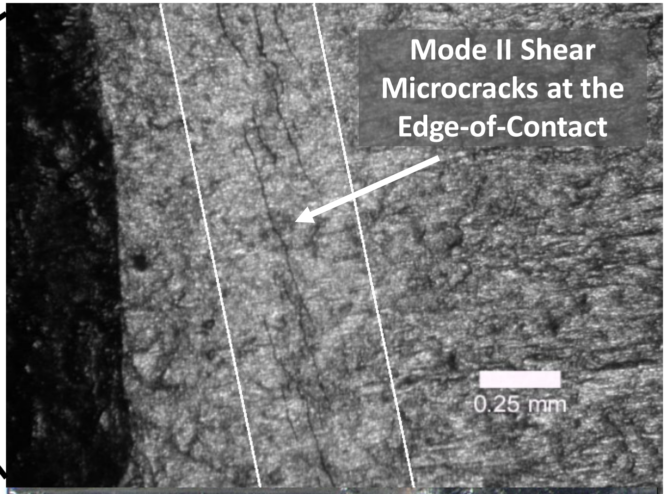
Supported by:

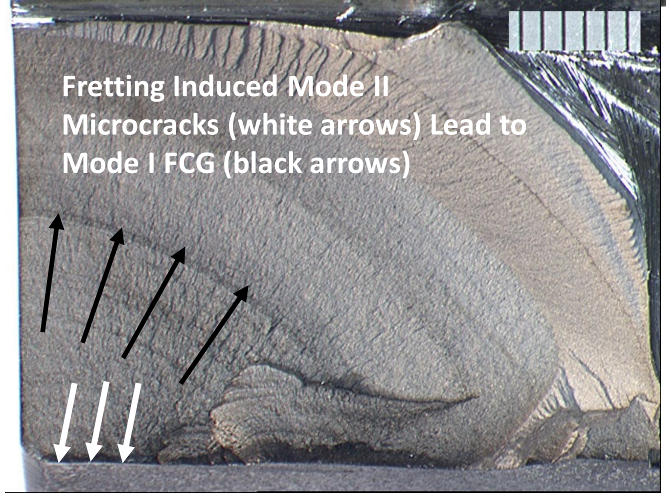
LAMBDA Technologies Group

Detrimental Effects of Fretting Damage

- Caused by low amplitude sliding on contact surfaces
- Typical sliding amplitude: tens of nanometers to tens of microns
- Appears as pits or grooves surrounded by debris
- At the periphery, microslip occurs due to high shear stresses, leading to shallow (depth <100 microns) Mode II Microcracks
- Microcracks transition to Mode I fatigue cracks leading to unanticipated catastrophic failure







Consequences

- Potential catastrophic failure
- Premature retirement of blades and rotors from service
- Frequent inspection

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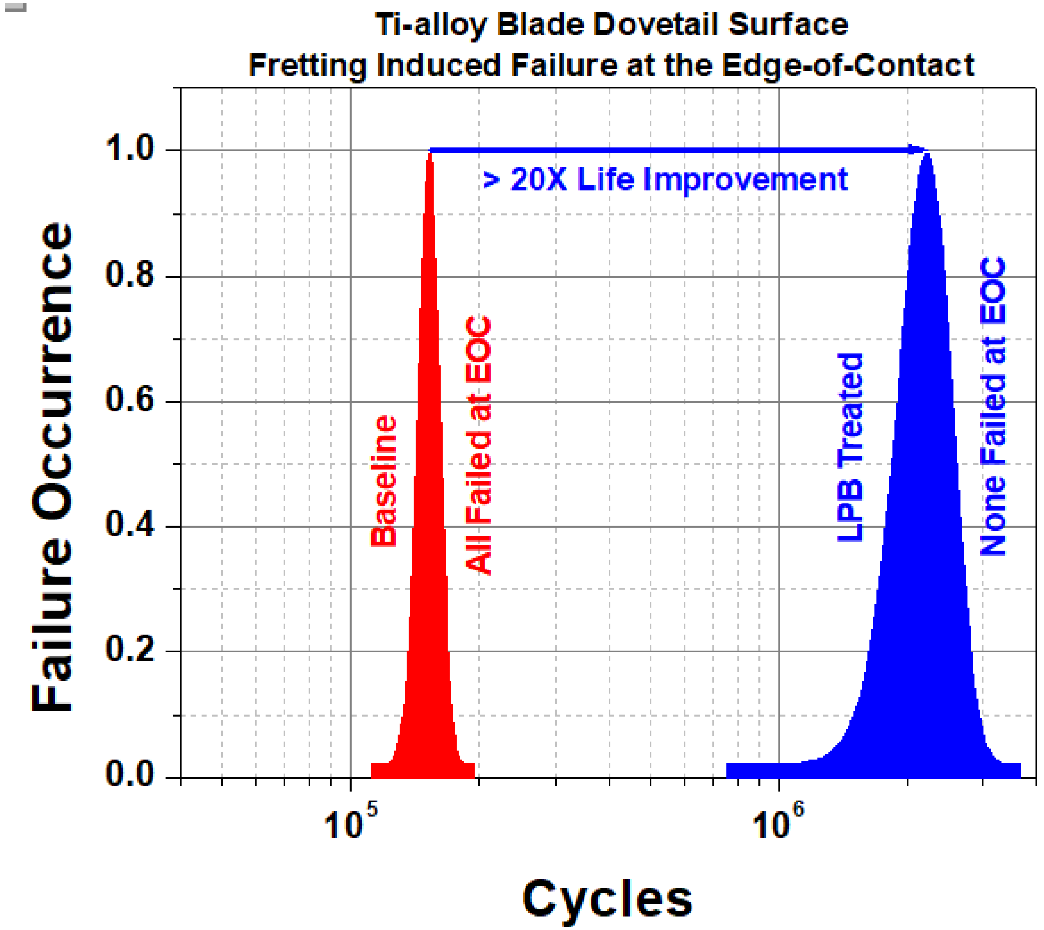
Common Treatments

- Alter the contact surface geometry to minimize/eliminate edge-of-contact (EOC) shear stresses – changing component design could be cost-prohibitive
- Minimize/eliminate sliding amplitude – very difficult for components subjected to vibratory stress conditions
- Use of hard coatings like Co-WC – local breakdown of coatings would exacerbate the problem
- Modify the coefficient of friction on the contact surface: use of lubricants like MoS_2 is common in blade dovetail contact surfaces – local breakdown of lubricant would exacerbate the problem
- Use of soft coatings like Cu-Ni-In coatings – local breakdown of coatings would exacerbate the problem

These treatments address only the symptoms of the problem and should not be considered a permanent solution.

Designed Compression



Successful Applications

- F402 LPC1 Disk Post Contact Faces
- F402 LPC1 Blade Dovetail Contact Faces
- F404 Fan Blade Dovetail contact faces
- F124 Fan Blade Stages 1, 2 and 3
- CFM56-7B HPC1 Blade
- Siemens Tie-rod Bolts
- Medical Implants

Benefits

- Extend Component Life
- No Material Replacement
- No Redesign
- Improve Damage Tolerance
- Reduce Risk of Failure
- Improve Cost Savings

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Improve Safety with Designed Compression
A Cost-Effective Solution to Mitigate Fretting Fatigue