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

SURFACE INTEGRITY INSTITUTE

# Stress Concentration Relief

## Preventing Fatigue Cracking from Stress Concentrations

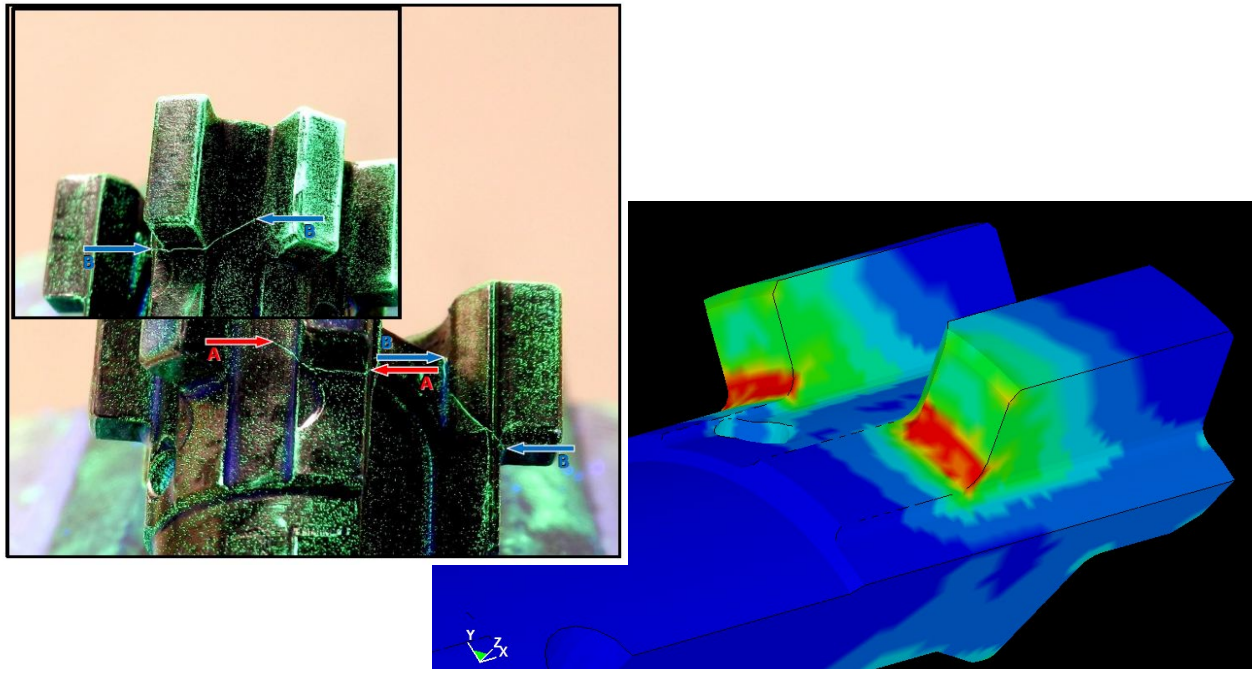
Supported by:

LAMBDA Technologies Group

# Detrimental Effects of Stress Concentrations

- Caused by geometrical features like fillet radius, sharp edge, etc.
- Exceptionally high local stresses compared to surrounding areas decrease component life
- Leads to unanticipated cracking and failures
- Stress concentration effects are further exacerbated by other coexisting damage conditions like corrosion pitting, FOD, unanticipated vibratory mode, etc.

**High Stress Concentration in Fillet Radius Region of Rifle Carbine Bolt**



**Consequences**

- Potential catastrophic failure
- Frequent inspection
- Frequent replacement of parts

SURFACE INTEGRITY INSTITUTE

# Common Treatments

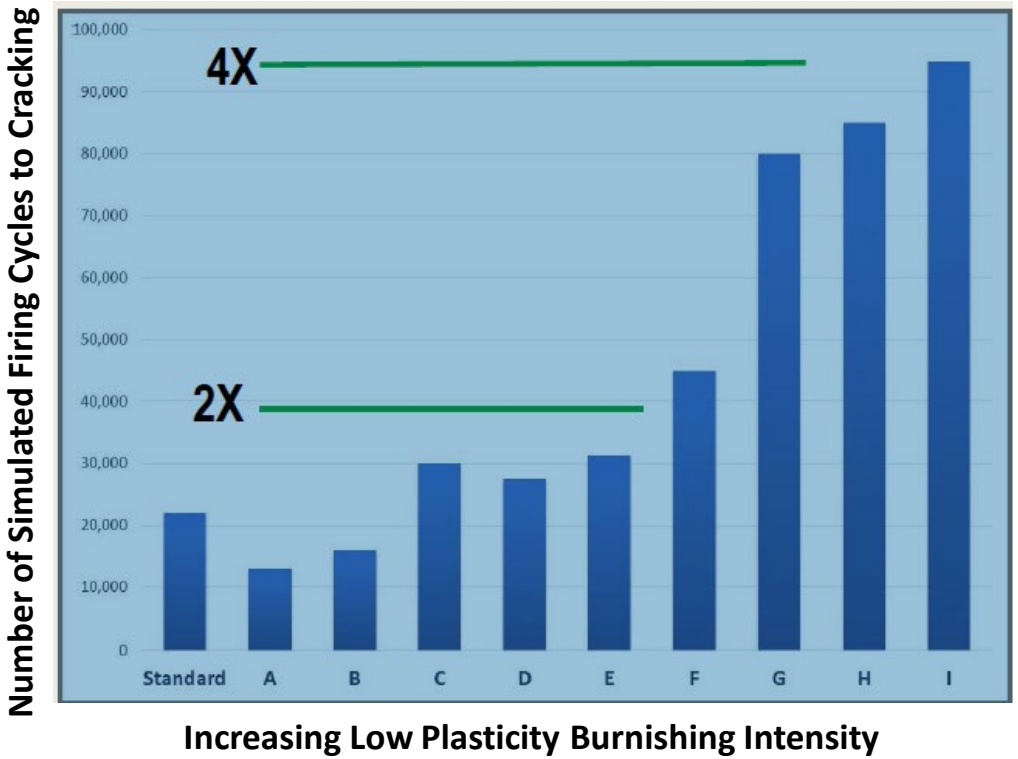
- Redesigning the component to minimize the stress concentration – changing design is cost-prohibitive
- Frequent inspection for fatigue cracking damage – very difficult for components with low damage tolerance; limitations on frequency of inspection; inspection may be difficult once the part is installed
- Changing material with better fatigue cracking resistance – material itself and additional qualifying process is cost-prohibitive
- Replace parts frequently – Increases total ownership costs

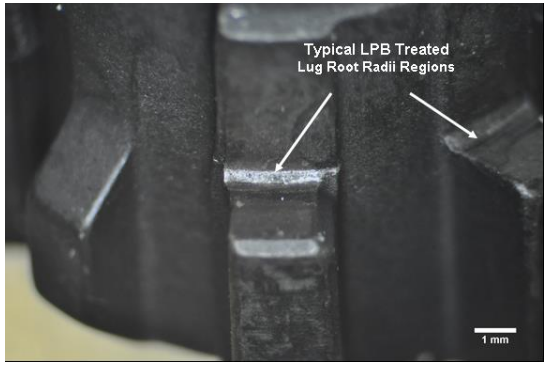
**These treatment methods aim to minimize the effects of stress concentrations with varying degrees of success**

SURFACE INTEGRITY INSTITUTE

# Designed Compression

## Fatigue Testing of Carbine Bolts




- Designed compression improved life by up to 4X over baseline carbine bolts in laboratory fatigue tests
- Over 10X life improvement has been reported in treated carbine bolts in service

## Successful Applications

- Rifle Bolts
- IBRs/Blisks
- Mining Equipment
- Turbine Blades
- Canon Barrels
- Fuselage

## Benefits

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

SURFACE INTEGRITY INSTITUTE

**Increase Time in Service with Designed Compression**
**A Cost-Effective Solution to Relieve Stress Concentrations**