

Gear Failure Analysis

Macropitting

Background Information, Definitions

- Gear data: 19 tooth, 1Dp, 20 PA, 8.5 HA, 4340 through hardened pinion (400 BHN), 33" tooth width
- Contact fatigue - localized stress state resulting from curved surfaces contacting under a normal load.
- Fatigue cracks initiate at the surface or at the shallow depth.
- Alternating subsurface shear stress
- Subsurface plastic strain builds up with cycles – cracks propagate in a direction roughly parallel to the tooth surface before turning to the surface
- Pits are formed
- GSC – Geometric Stress Concentration

Tooth Contact Pattern

- Wear, macropitting and spalling, concentrated on the left side of the tooth
 - Bearing position misalignment (housing)
 - Tooth lead error (pinion and gear)
 - Gear runout to shaft's bearing journals
 - Shaft bending and torsional deflection



Wear shifted to the left side of the tooth width

Macropitting

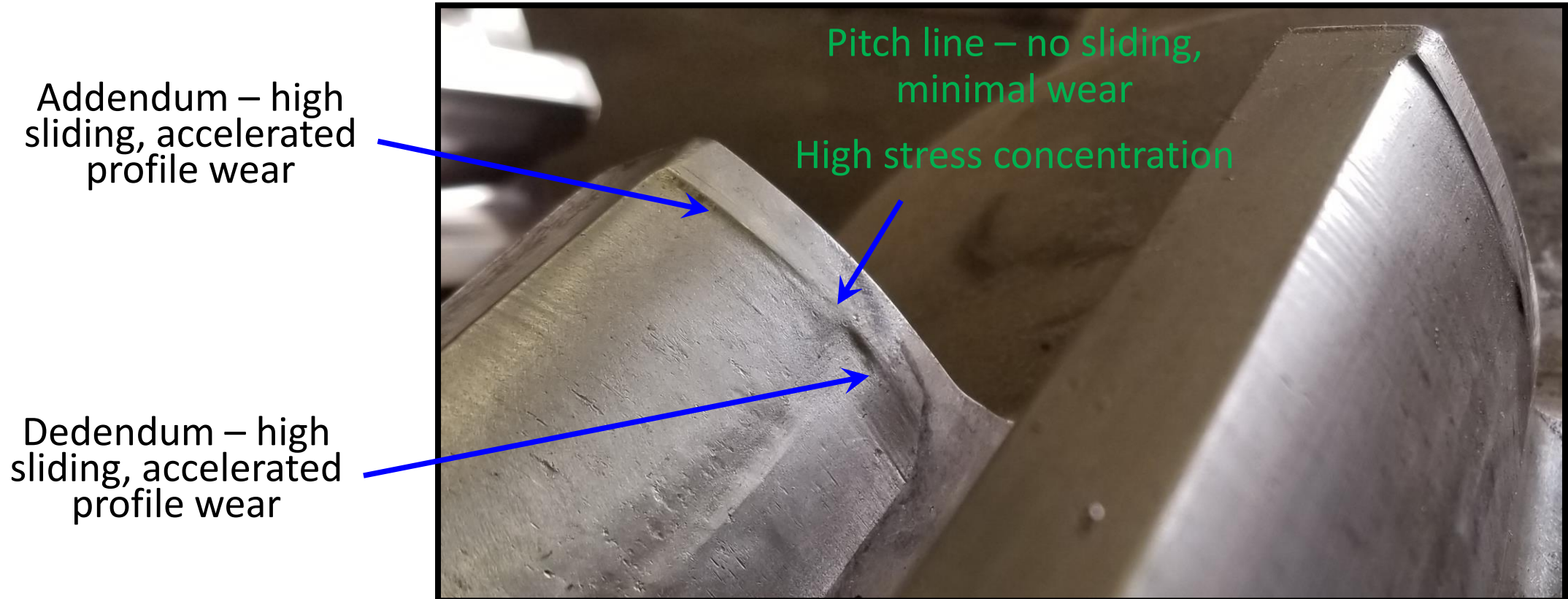
Macropitting concentrated at pitchline



Pitting at the pitchline propagates into the addendum - spalling

Tooth Profile Wear

- Addendum and dedendum wear



Root Cause

- Shaft misalignment – uneven tooth loading and reduced contact pattern
- Improper, inadequate tooth profile modifications – addendum and dedendum accelerated wear
 - Profile wears due to relative sliding (material, hardness, heat treat, load, lubrication)
 - Progressive involute profile destruction
- These conditions generate GSC (Geometric Stress Concentration) at the pitchline promoting macropitting
- Pitting at the pitchline propagates into the addendum area – spalling