



Technical Topic

Micropitting Can Lead to Macro Problems

What is micropitting?

Micropitting is a surface fatigue phenomenon mainly observed in gears but can also occur in rolling element bearings. Micropitting causes destructive wear that can occur within the first few hours of operation. If left uncontrolled, significant equipment failures may occur. While many factors can contribute to the generation of micropitting, surface roughness and lubricant selection are key factors. Micropitting is not a new phenomenon. It has become much more prominent as gearbox design has evolved with the use of case hardened or carburized gears. Gearbox technology has achieved significant reductions in gearbox size while increasing power throughput capability. This has required all design components, including the gear oil, to improve their performance capabilities.

What problems can micropitting lead to?

Micropitting on gears may lead to problems with gears, bearings and seals. The main problem caused by micropitting in gears is the wearing of the gear tooth. This wear changes the shape of the gear tooth. When micropitting wear occurs on gears, the gear tooth shape is altered and this concentrates the load over a smaller area and affects the accuracy of the gears as they move through mesh. Illustrated by **Figure A**, this can lead to vibrations, noise, misalignment and an increased chance of fatigue failure. Micropitting can also lead to significant gear tooth wear called macropitting, as illustrated in **Figure B**, which shows a series of macropits emanating from a micropitted area of a gear tooth.

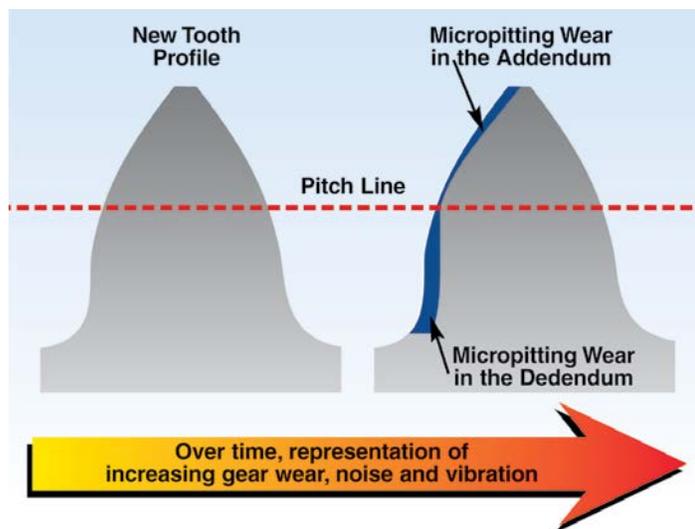


Figure A: Gear tooth wear progression through micropitting

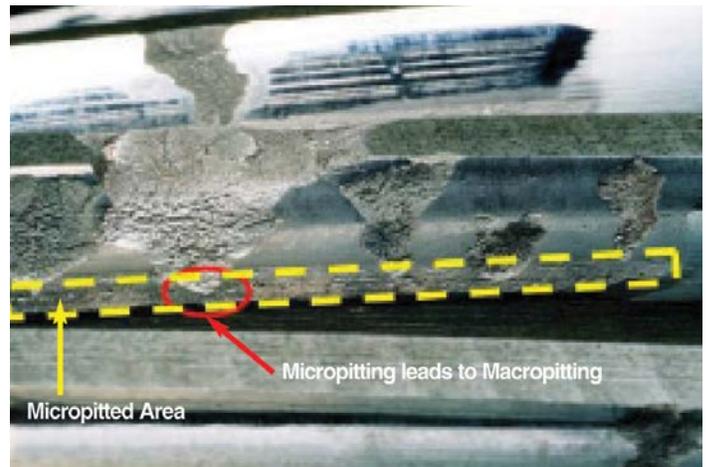


Figure B: Micropitting leading to macropitting

When gears wear, the wear metal becomes a contaminant in the oil. As these particles are circulated in a gearbox, they can become impacted on gear and bearing surfaces. Known as “debris dents”, they can alter the surface on bearing rolling elements and races that, in turn, can lead to spalling. **Figure C** shows the arrow head of a spall starting at a debris dent.

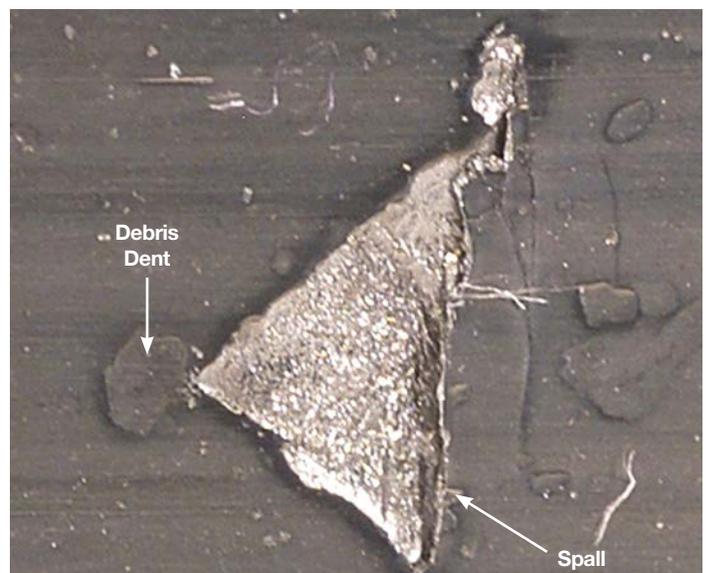


Figure C: Debris dent leading to macropit

Through debris denting and subsequent fatigue failures, the metal particles created from micropitting can shorten the life expectancy of the associated bearings used in a gear box. Based on current bearing life theory and data developed by ExxonMobil scientists, the hard debris particles generated by micropitting on gear teeth could potentially decrease the life of a bearing by more than 20%. Even with filtration, much of the debris denting and related damage is caused before the wear particles can be removed from the oil. In addition, this debris can cause abrasive damage to seals, leading to leaks and contamination ingress.

How do I identify micropitting?

Individual micropits are not visible to the unaided eye, however, many micropits normally appear together resulting in a dull matted area. On gear teeth, the tooth surface often must be illuminated from various angles to observe micropitting. It is best to use intense direct lighting rather than diffuse fluorescent lighting. **Figure D** shows an example of a gear tooth with micropitting.

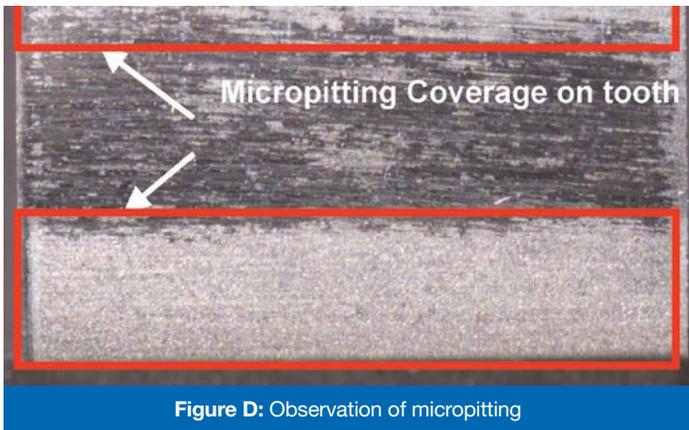


Figure D: Observation of micropitting

How can I stop micropitting?

To control micropitting, end users can use gears and bearings with very smooth or “super-finished” surfaces, change equipment operating conditions or select a lubricant designed to inhibit micropitting. Typically, the use of super-finished gearbox components is reserved for only the most critical of industrial operations. Changing operating conditions is often not a possibility. However, focusing on lubricant oil viscosity and lubricant formulation are a practical approach.

The selection of the appropriate viscosity grade is the first, and most important, step in choosing a lubricant for any application. Simply increasing the ISO viscosity grade of the oil is not necessarily preferred. Rather, selecting an oil with a higher viscosity index (VI), lower traction coefficient, or both should be considered. The higher VI can provide a thicker lubricant film under operating conditions. The lower traction coefficient can help to reduce surface fatigue. Because of the high VI and low traction coefficient, moving to a synthetic gear oil like the Mobil SHC Gear Series can help control micropitting.

In addition to viscosity and traction, the additive chemistry in finished lubricants can have a dramatic effect on micropitting performance. For instance, it has been shown through industrial standard micropitting test methods that certain additives, especially conventional extreme pressure (EP) additives, can have a negative effect on micropitting performance. Choosing an oil like the Mobil SHC Gear Series or Mobilgear 600 XP Series that is specifically designed to give micropitting protection, may help reduce the risk of micropitting.

Micropitting is clearly a major concern, especially for modern gear systems. However, it is important to choose a lubricating oil which does not address micropitting at the expense of other properties. The oil must protect against micropitting while still giving good wear and scuffing protection, good water separation, foam control and corrosion protection while maintaining compatibility with common seal materials. Lubricants like Mobil SHC Gear Series and Mobilgear 600 XP Series have been designed to protect against micropitting while helping to balance the formulations for long oil life and equipment durability so users can increase their productivity potential.

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