

“To support our customers, we validated and quantified the life extension improvements we designed to solve the original issues with the ring gear with Sentient Science’s robust third party modeling system.”

Joseph Reisinger
Vice President Product Management
Broadwind Energy



Challenge

We sought to quantify the life extension benefit of new DriveMAX™ gear replacements and enhancements for our wind turbine gearbox customers.

Solution

We partnered with Sentient Science to use DigitalClone modeling to analyze the material, heat treatment, and geometric changes to their upgraded DriveMAX™ ring gear life and compare the failure rate to the original specification.

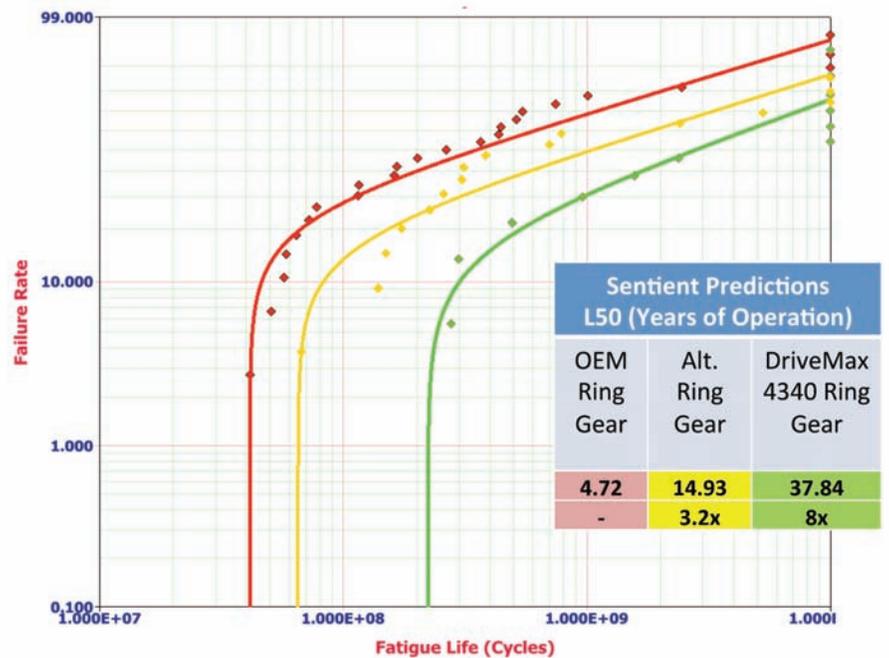
Results

Our DriveMAX™ ring gear was shown to have an **8x extended life** compared to the original ring gear specifications under the same loading conditions. This comparison is shown on the graph to the right.

Wind Gearing Case Study

DriveMAX™ Ring Gear is shown to have extended fatigue life compared to the original ring gear specification through Sentient Science third-party analysis and DigitalClone comparison.

Fatigue Life Predictions – Load Case 1 – Max. Contact Stress: 11371.2MPa



Ring Gear #1
Process: machine cut teeth, contour induction harden teeth, finish machine & finish grind teeth.

Ring Gear #2
Process: machine cut teeth, carburize & harden, finish machine & finish grind teeth.

DriveMAX Ring Gear #3
Process: machine cut teeth, heat treat, grind teeth, contour induction harden, finish machine and finish grind teeth.

Wind Gearing Case Study

Challenge



Today, many wind turbine operators make gearbox purchasing decisions based on price. With new decision support tools, these operators can now make that decision on price and quantified life extension to maximize the value of their wind gearbox fleets.

Wind owner-operators make decisions focused on price because they do not have the tools and data necessary for properly assessing and comparing the future reliability and life of gearboxes. When a company issues a Request for Proposal (RFP) for a gearbox replacement, suppliers are compared based on an analysis of historical and engineering assessments to determine future reliability. However, traditional tools for engineering assessments cannot accurately predict how gearboxes, bearings and gears will perform during future operations in a wind turbine. They do not account for material microstructure, surface finish, or lubricant and cannot predict non-classical failure modes such as surface-initiated fatigue. In fact, these tools suggested wind turbine gearboxes would last 20 years, but in reality, gearboxes began to fail as early as 3-5 years of life.

This presented a challenge to new market entrants who were looking to remanufacture and upgrade gearboxes to extend wind turbine life. These new solutions to improve life and performance could not prove themselves and quantify their benefits compared to alternatives without building years of operational data. Since any life extension benefits of the solutions couldn't be qualified, they couldn't be effectively valued in a business case and sold in a large enough sample size. This became a chicken or the egg problem. In 2015, we decided to partner with Sentient Science so we could better quantify life-extension enhancements made through DriveMAX™ to the gearing elements used in the remanufacturing of an OEM gearbox for 1.5MW turbine equipment.

Solution

We approached Sentient Science to use their state-of-the-art DigitalClone modeling capability to compare and validate the upgraded DriveMAX™ ring gear life. With the outputs of the lifting model, we could quantify how the DriveMAX™ improvements at the component level of a gearbox remanufacture design could extend future turbine life. And ultimately, we could better understand any warranty risk and have a **third-party assessment** of life extension and how to value our DriveMAX™ solution to the marketplace.

Results

The results of the analysis substantiated that **Brad Foote's DriveMAX™** ring gear provides **8 times design life** of the OEM and over twice the life expectancy of a competitor's gear. Therefore, it can be shown that the **DriveMAX™** ring gear's increased useful life can **protect operators from future failure maintenance expenses and lost production from turbine down-time.**

We are proud of the results from the project with Sentient Science and are sharing these amazing results with customers and wind turbine owner-operators. These findings demonstrate Broad Foote's DriveMAX™ remanufacturing expertise and commitment to provide customers with gearboxes that **dramatically maximize life cycle.**

