



### ASME Wind Energy Tribology Committee

This organization is hosting a Wind Energy Conference as part of the next ASME/STLE Joint International Tribology Conference to be held in Memphis. An entire one-day session (Monday October 19) is devoted to Wind Energy. Presentations will be made by gearbox and bearing companies, major owner/operators, and Donaldson. For additional information, go to: <http://www.asmeconferences.org/ijtc09>.

Donaldson (Bill Needelman) is participating in the Conference in numerous ways, including:

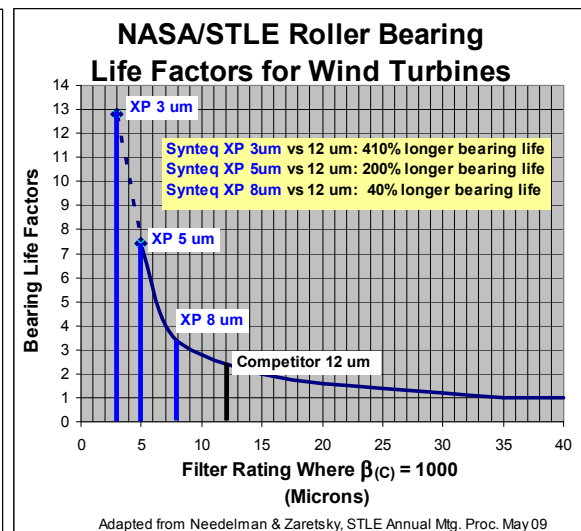
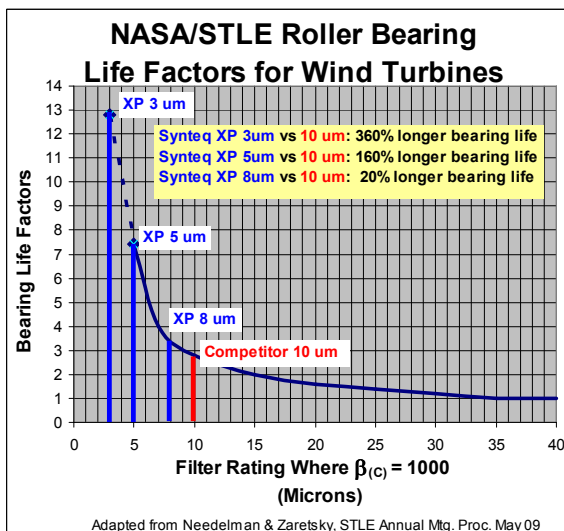
- 1) Co-authoring a technical paper with **Timken** (Michael Kotzalas, Chief Engineer of Product Design), titled “Minimizing Oil Contamination and Using Debris Resistant Bearings to Enhance Wind Turbine Gearbox Performance”. The paper discusses improvements in gearbox bearing performance and life achieved by reducing the harmful effects of oil contamination, and the advantages of using bearings resistant to oil contaminant debris.
- 2) Co-authoring a paper with **Columbia University** (Elon Terrell, Professor of Mechanical Engineering) on “Current and Future Tribological Challenges in Wind Turbine Power Systems”. The paper surveys problems (including oil contamination) that need to be solved to make wind turbine more reliable and efficient.
- 3) Arranging for papers from **International Authors**.
- 4) Presenting at the **ASME International Graduate Workshop on Wind Power**. This Workshop will be held the day before the Wind Energy Session, on Sunday October 18. The presentation, to an audience including Master and Ph.D. students, will be on “Oil Contamination in Wind Turbine Machinery - Problems & Solutions”.

### NREL (National Renewable Energy Laboratory)

Donaldson (Bill Needelman) has been invited to talk at the NREL Condition Monitoring Conference this October at the National Wind Center in Colorado. The talk is titled “Excellent Oil Cleanliness in Wind Turbine Gearboxes – Data from the Field”. The presentation will summarize oil analysis data on samples from operating turbines, and implications for longer gear and bearing life.

### NASA & STLE

At the recent STLE Annual Meeting held in Orlando in May, Donaldson (Bill Needelman) co-authored a paper with NASA (Erving Zaretsky, Chief Engineer, NASA Glenn Research Center), titled “Recalibrated Equations for Determining Effects of Oil Filtration on Rolling Bearing Life”. The paper quantified bearing life extensions achieved when upgrading to finer filters, rated using the modern filter rating,  $\beta_{X(C)} = 1000$ . Based on this paper the following two figures were generated. They quantify bearing life increases expected in wind turbine gearboxes when upgrading from older technology 10  $\mu\text{m}$  and 12  $\mu\text{m}$  filters to Donaldson new technology Synteq™ XP filters delivering  $\beta_{X(C)} = 1000$  performance at 8  $\mu\text{m}$ , 5  $\mu\text{m}$ , and 3  $\mu\text{m}$ .



### Legend

Bill Needelman: Chief Science Advisor  
Greg LaVallee: Principal Engineer

ASME: American Society of Mechanical Engineers  
STLE: Society of Tribology and Lubrication Engineers



### Field Test Case Study: Tracking of Gearbox ISO Codes for Synteq XP Filters

#### Equipment:

- GE 1.5MW wind turbines with Winergy gearboxes on a wind farm in the upper Midwest, which operates >200 turbines.

#### Gearbox Filter:

- Cartridge element is a popular size for gearboxes
- Photos of the ( $\beta_{sum}=1000$ ) cartridge element (right)

#### Background:

The gearbox operates over temperature ranges normally of 30-70 °C (86-158 °F), with a desired filter service interval of 6 months. This gearbox uses an ISO VG320 gear lube, based on a PAO (poly alpha olefin) synthetic lubricant. Normally the gear lube is sampled and analyzed prior to each filter change. The wind farm operator was interested in assessing the performance of several gear lube oils and the Donaldson Triboguard Synteq XP 8 um and 5 um versions of this cartridge element (DT1300R-11XP-45UM / DT1300R-6XP-45UM). Their main objective was the reduction of ISO codes to enable reduced maintenance expense and longer gearbox life. Prior to the installation of the Donaldson Triboguard elements, the gearboxes were drained and flushed thoroughly, before refilling with the new gear lube. After the installation of new Donaldson Triboguard elements and competitive elements on a total of seven turbines, the turbines were placed into service and monitored monthly as part of this field test. The same oil analysis laboratory tested all oil samples using the same preparation and protocol, so as to remove any excess variability.



#### Conclusions:

- A Donaldson Triboguard Synteq XP 8 um element has been in service for almost 9 months to date.
- Three of the Donaldson Triboguard Synteq XP 5 um elements have been in service nearly 6 months to date.
- One of the competitor's elements reached its maximum differential pressure point and was changed out after 6 months.
- The 5 um filters averaged 2 to 3 ISO codes cleaner than the competitive 10 um counterpart on the same turbines.
- The 5 um filters averaged 1 to 2 ISO codes cleaner than the 8 um elements on the same turbines.

#### Recommendations:

- Use 5 um main flow filtration with clean gear lube for reduced ISO codes and longer bearing life.

#### Analysis:

Two of the turbines ISO code and particle concentration histories are depicted here to indicate the performance change when adopting 5 um filtration. Gearbox particle concentrations can vary by turbine as witnessed by comparing turbines #4 and #5. More importantly, note

the dramatic drop in particle concentrations and ISO codes after the change to 5 um filtration. ISO codes in Turbine #5 fell from 18/16/13 to 17/14/11. Similar results are shown for Turbine #4. Vertical blue bars indicate filter change timing for each gearbox.

