Synthetic wind turbine gear oil
Developed with NUFLUX™ technology
Evonik specialists continually work to meet tomorrow’s demands today by developing forward-looking technologies and new formulations with sustainable solutions.

Providing solutions for wind turbines

Wind turbines are one of the most challenging applications for industrial lubrication. Harsh environmental conditions, varying loads and speeds and necessary lubricant compatibility all contribute to stressed wind turbine gearbox lubricants performance. The industry’s expectation of an increasing service life for gearboxes requires lubricants to exhibit exceptional durability and reliability in service.

The wind turbine gear oils (WTGO) used in wind farm service are a significant contributor to the overall operating cost of wind power generation, especially the attendant costs of replacement and quality monitoring. Consequently, they must offer innovative and sustainable solutions that not only extend performance, but also minimize costs.

Evonik has created Formulation 8175, a WTGO developed with NUFLUX™ technology, for critical OEM and owner/operator service requirements.
Evonik has developed this synthetic WTGO for use in a wide variety of gearbox systems. Formulated with NUFLUX™ technology, additional Evonik-formulated components as well as base fluids and additives from other suppliers, Formulation 8175 meets or exceeds the performance of existing synthetic WTGO lubricants, even under the most demanding conditions.

Evonik is bringing Formulation 8175 to market through selected lubricant formulators and marketers. These partners have the resources to provide wind farm operators with full-system protection for their turbine gearboxes. Formulation 8175 addresses modern wind turbine equipment challenges to deliver durability, energy efficiency and extended service life.

<table>
<thead>
<tr>
<th>COMPONENTS/PERFORMANCE</th>
<th>ISO CLASS 220</th>
<th>ISO CLASS 320</th>
<th>ISO CLASS 460</th>
<th>ISO CLASS 680</th>
</tr>
</thead>
<tbody>
<tr>
<td>VISCObASE® 11-522</td>
<td>37.0</td>
<td>45.1</td>
<td>51.5</td>
<td>58.5</td>
</tr>
<tr>
<td>NEXBASE® 3080</td>
<td>59.6</td>
<td>51.5</td>
<td>45.1</td>
<td>38.1</td>
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<tr>
<td>VISCOpLEX® 1-180</td>
<td>0.7</td>
<td>0.7</td>
<td>0.7</td>
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<tr>
<td>Additive package</td>
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<td>2.7</td>
<td>2.7</td>
<td>2.7</td>
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<tr>
<td>Kinematic viscosity at 40°C</td>
<td>223.0</td>
<td>319.6</td>
<td>464.5</td>
<td>687.9</td>
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<td>Kinematic viscosity at 100°C</td>
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<td>37.0</td>
<td>48.8</td>
<td>65.5</td>
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<tr>
<td>VI</td>
<td>161</td>
<td>165</td>
<td>165</td>
<td>167</td>
</tr>
<tr>
<td>Pour point</td>
<td>-39</td>
<td>-39</td>
<td>-36</td>
<td>-33</td>
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<tr>
<td>Kinematic viscosity at -10°C</td>
<td>7,058</td>
<td>11,815</td>
<td>19,239</td>
<td>33,394</td>
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<tr>
<td>Brookfield viscosity at -26°C</td>
<td>50,000</td>
<td>82,000</td>
<td>150,000</td>
<td>290,000</td>
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<tr>
<td>FZG failure load stage A/8.3/90</td>
<td>&gt;14</td>
<td>&gt;14</td>
<td>&gt;14</td>
<td>&gt;14</td>
</tr>
</tbody>
</table>

(1) Formulation 8175

Evonik’s VISCObASE® synthetic base fluid plays a critical role in the capabilities of Formulation 8175. VISCObASE® synthetic base fluids have been developed to retain protective film strength and good lubricity, even under the harshest operating conditions. Incorporating the best raw materials and proprietary manufacturing technology, VISCObASE® combines excellent additive solubility, lubricity and film strength in one base fluid molecule.

For instance, the VISCObASE® ISO 320 wind turbine gear oil Formulation 8175 was tested extensively and successfully on the FZG gear test rig, a widely recognized bench test predictor of field performance.
Highest level of gear protection and superior efficiency

- Formulation 8175 reached the highest level of protection from micropitting (load stage 10) at both 60°C and 90°C in the FVA micropitting test.
- In the FZG scuffing test, Formulation 8175 passed through load stage 14 at single and double speed.
- Besides providing gear protection from fatigue and wear, tests also revealed that Formulation 8175 ran at lower temperatures than both mineral oil and PAO/ester formulations.

Screening in the FZG rig shows wind turbine gear oil Formulation 8175 provides lower torque losses than mineral oil and PAO/ester alternatives.

As gearbox durability improves across the industry, energy efficiency will become more important in technically advanced operations.
Excellent bearing protection

In-service bearing performance is predicted by industry recognized tests, including the DIN 51819-3 FE8 bearing test. This test evaluates a lubricant’s ability to ensure protection under mixed friction conditions using a cylindrical roller thrust bearing. Standard conditions employed in this test are an 80 kN axial load and a speed of 7.5 rpm for 80 hours; a wear limit of 30 mg roller weight loss is requested in industry standards such as the DIN 51517-3.

Formulation 8175 demonstrated excellent performance in the test:

<table>
<thead>
<tr>
<th>DIN 51819-3 FE8 bearing test results</th>
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<tr>
<td></td>
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<tr>
<td><strong>Formulation 8175 @ 80 kN</strong></td>
</tr>
<tr>
<td>Roller wear [mg]</td>
</tr>
<tr>
<td>Cage wear</td>
</tr>
</tbody>
</table>

Testing of Formulation 8175 by Schaeffler/FAG, a leading global bearing manufacturer, included its demanding four-step-test, a test series recognized as a benchmark for wind turbine applications. As a result of this evaluation, Schaeffler/FAG certified Formulation 8175 for use in wind turbine gearboxes.

Approval status of Formulation 8175

Meets and exceeds industry standards:
- DIN 51517-3
- ANSI/AGMA 9005-E02
- IEC 61400-4
- Schaeffler/FAG
- Moventas
- Winergy (Field Trial)
- Siemens MD (Rev. 15)
Benefits of Formulation 8175 in WT operations:

- Meets and surpasses critical industry technical requirements
- Developed from NUFLUX™ technology, Evonik’s solution for advanced industrial lubricants
- Formulated with Evonik’s VISCObASE®, a fully-synthetic, high-viscosity base stock
- Robust global supply chain position for business continuity assurance
- Provides a needed alternative lubricant offering to the wind power industry
- Offers highly competitive cost position for a synthetic formulation
- Supported by Evonik’s global technical organization

About Evonik

Evonik is a leading global specialty chemicals company. Its activities focus on the key megatrends of resource efficiency, health, nutrition and globalization. Around 80 percent of sales come from leading market positions. Evonik benefits specifically from its innovative strength and integrated technology platforms. Evonik is active in more than 100 countries around the world. In 2014, roughly 33,000 employees generated sales of $17.7 billion (USD) and an operating result (adjusted EBITDA) of $2.6 billion (USD).

As part of Evonik’s Resource Efficiency segment, the Oil Additives business line is a leading global supplier of high-performance lubricant, fuel and refinery chemicals. Long established as an essential partner to both the major global oil companies and regional lubricant marketers, Evonik’s sales and technical specialists are located close to its customers and backed up by state-of-the-art regional technology centers. Evonik is committed to providing tailor-made, optimum performance solutions that meet the latest industry standards.

With a worldwide network of manufacturing facilities, Evonik’s global supply chain provides a reliable flow of customized products and services to valued customers around the world.

Evonik has leveraged its extensive technical and research resources, ideally situated in Germany, to work closely with original equipment manufacturers of gearboxes and wind turbine systems.

Scan the QR code to watch the video, or visit evonik.com/oil-additives to learn more about NUFLUX™ technology and Formulation 8175.
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