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New Guidelines for Wind Turbine Gearboxes

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TECHNICAL PAPER

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[The statements and opinions contained herein are those of the author and should not be construed as an official action or opinion of the American Gear Manufacturers Association.]

Abstract

The American Gear Manufacturers Association in cooperation with the American Wind Energy Association has recently published AGMA/AWEA 921-A97, *Recommended Practices for Design and Specification of Gearboxes for Wind Turbine Generator Systems*. Much has been learned about the unique operation and severe loading of wind turbine gearboxes since the early 1980s. AGMA/AWEA 921-A97 provides guidelines that incorporate this knowledge to help ensure reliable gearboxes for wind turbine service. It gives valuable information to gear manufacturers, wind turbine designers, operators and manufacturers. The document provides information on wind turbine architecture, environmental considerations, gearbox loads, gearbox design, procurement specification, manufacturing, quality assurance, lubrication, operation and maintenance.

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American Gear Manufacturers Association
1500 King Street, Suite 201
Alexandria, Virginia, 22314

November, 1997

ISBN: 1-55589-702-9

NEW GUIDELINES FOR WIND TURBINE GEARBOXES

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INTRODUCTION

The wind turbine industry has been plagued with gearbox failures, which cause repair costs, legal expenses, lost energy production, and environmental pollution.

A wind turbine gearbox is considered failed if it:

- Jams and stops rotating.
- Breaks and allows the rotor to turn without turning the generator.
- Exceeds allowable sound level or vibration limit.
- Has excessive oil leakage.
- Requires excessive maintenance.

Failed gears, shafts, keys, bearings, and housings have caused jamming or breaking. Bending fatigue is usually the ultimate failure mode when gearboxes jam or break. However, bending fatigue is often a secondary failure mode initiated by other failure modes such as macropitting or scuffing. Some wind turbines were destroyed when gearboxes broke and allowed rotors to overspeed.

Strict sound regulations in the United States and Europe required shutdown of noisy turbines because failed gears or bearings caused excessive sound or vibration.

Failed shafts, seals, and housings caused excessive oil leakage and, in some cases, total

loss of lubricant and gearbox failure. Less severe leakage increased maintenance and costs. Soil contamination required costly cleanup.

Three years ago, a group of individuals dedicated to wind power recognized that many gearbox failures were due to a lack of understanding of the severity of the wind-turbine-operating environment. They sought to define this environment and improve communication between gear and wind turbine manufacturers so reliable gearboxes could be obtained.

Therefore, the American Gear Manufacturers Association (AGMA) and the American Wind Energy Association (AWEA) formed a committee of wind turbine manufacturers and operators, researchers, consultants, and gear and lubricant manufacturers.

The committee developed AGMA/AWEA 921-A97, "Recommended Practices for Design and Specification of Gearboxes for Wind Turbine Generator Systems." The document reflects latest knowledge about wind loads and failures, plus insights of gear and wind-turbine manufacturers and operators. It describes wind-turbine configurations, operating conditions, and environmental factors that affect gearbox life. It offers guidelines for defining wind loads, and specifying gears, bearings, operation, and maintenance. All of these guidelines focus on one goal: ensuring reliable wind-turbine gearboxes.