



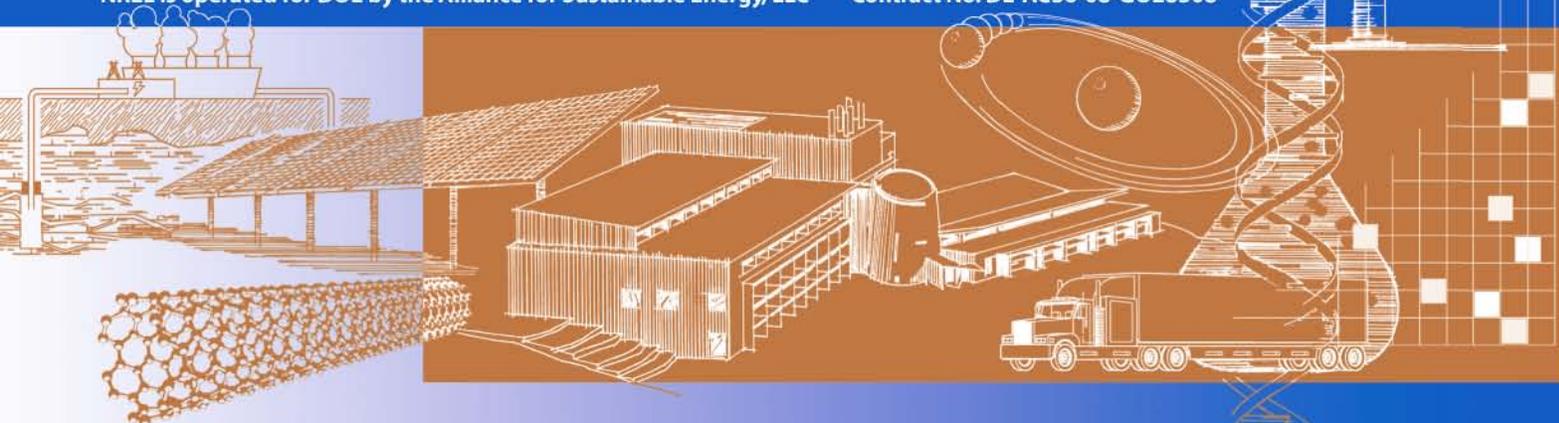
# Gearbox Reliability Collaborative: Gearbox Inspection Metadata

Kristin Munch and Mark McDade

*Technical Report*  
NREL/TP-500-49133  
September 2010

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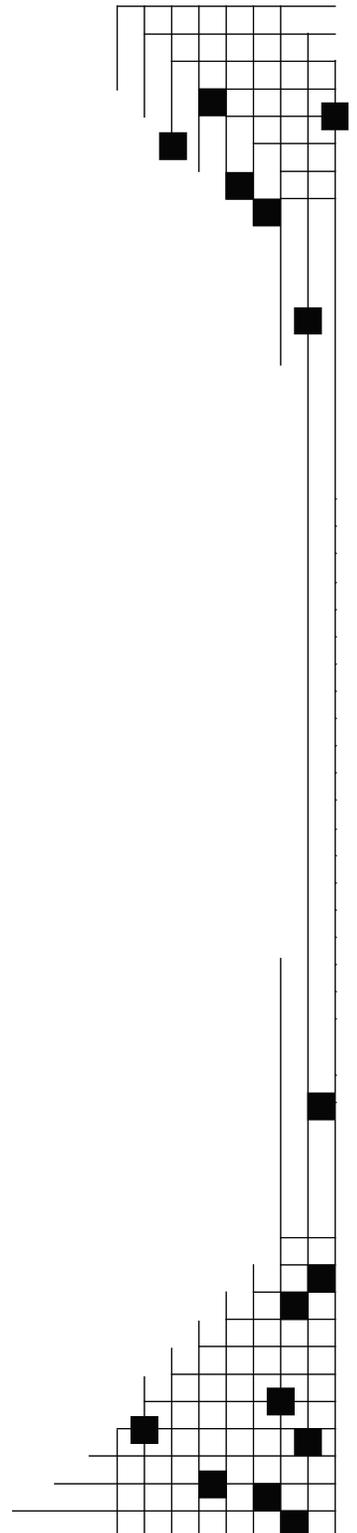


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Prepared under Task No(s). WE10.1132



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## **NREL/NWTC Gearbox Reliability Collaborative Database *GearFacts* Software**

The Gearbox Reliability Collaborative (GRC) is a U.S. Department of Energy (DOE)/National Renewable Energy Laboratory (NREL) project to identify and understand premature failure of components in wind turbine gearboxes. These failures are a leading source of unplanned expense in the operation of commercial wind turbines. Analysis and root cause correction of these failures is critical to enhancing the commercial viability of wind power as a sustainable energy source. A key component of the overall GRC effort is the creation of a database of gearbox failure history. To this end, NREL has developed a software application called *GearFacts* that will be distributed to Database Collaborative participants to capture failure information when gearboxes are rebuilt. This publication names and describes each field used in *GearFacts* and can be used as a reference to the software's design.

*GearFacts* software will be used at the time of a rebuild to guide rebuilders in defining and entering gear and bearing failure details including a photographic record of failure mechanisms. The owner of the gearbox will be able to use any information they have entered to maintain their own rebuild records and to produce reports on their fleet of gearboxes. The research community will be able to use aggregated data from the database to develop statistics on gearbox failure mechanisms, failure timing and, in some cases, costs. The aggregated reporting system will be secured and 'sanitized' to remove identifying data which might convey ownership (or other proprietary) information. In addition, participants in the collaborative will be able to access and utilize data from the testing and analysis portions of the GRC.

For more information about the GRC and its background and proposed research agenda, please see "Improving Wind Turbine Gearbox Reliability" (NREL conference paper CP-500-41548), May 2007. You can access this paper at: <http://www.nrel.gov/docs/fy07osti/41548.pdf>.

## MetaData Collection Elements

The list below describes the metadata elements associated with a gearbox inspection in the Gearbox Reliability Collaborative.

Field name	Field description
Rebuilder name	Group or individual rebuilding gearbox.
rebuild site	Where rebuilt.
gearbox owner	
gearbox responsible contact	Owner contact.
Gearbox responsible contact phone	
Wind site name	
Wind site address 1	
Wind site address 2	
wind site city	
wind site state	
Wind site zip	
Wind site country	
Site turbulence intensity	Using standard nomenclature as available.
Site capacity factor	Actual generation over potential generation.
Operating power	Turbine rated output.
Gearbox install date	The date the gearbox was installed on this turbine.
Gearbox startup date	The date this gearbox first went into operation.
Gearbox shutdown date	The date this gearbox was shutdown due to fault.
Gearbox removal date	The date this gearbox was removed from the turbine.
Cumulative run time hours	The total amount of time this gearbox has run since last rebuild.
Turbine OK hours	SCADA data which may be unavailable during rebuild.
Production since new or rebuilt	Total production in kWh since new (or last rebuilt if not new).
Line loss stops	SCADA data which may be unavailable during rebuild.
Emergency stops	SCADA data which may be unavailable during rebuild.
Wind site comments	
Oil cooler installed	Is an oil cooler installed?
Max online filter size	in microns
Max offline filter size	in microns
Sample collection point	Where on gearbox was oil taken?
Sample collection date	The date the sample was collected, after the failure?
Has dessicant breather	Is a dessicant breather installed?
Lubricant comments	
Failure date	Date of the failure
How discovered	Short description of how the failure was discovered.

Unusual conditions	
SCADA data available	Is SCADA data available for this gearbox?
SCADA data output format	If SCADA data is available, what is its format?
Similar failed	The number of similar gearboxes that have failed on this site?
Similar running	The number of similar gearboxes that are running on this site?
Site terrain description	A short description of the terrain of this site.
Terrain surrounding turbine	A short description of the terrain around the turbine where this gearbox was installed.
Site climate	Desert, ocean, or inland.
Inspection comments	
Gearbox name	
Manufacturer	
Model	
New or rebuilt?	When last installed.
Rebuild location	If rebuilt, above - shop, tower, unknown?
Power rating	
Gear ratio	
Serial number	
{Image of the gearbox ID tag}	
Storage	Please indicate whether the gearbox was stored indoors or outdoors after removal from turbine.
Mount	Number of mount points.
Inspection date	
Lead investigator	
Assisting investigator	
Attached images	Images may be attached to any of the above areas and are critical to the usefulness of an incident report.
<b>Enter data for lubricant:</b>	
Manufacturer	Manufacturer of the lubricant used in this gearbox.
Type Grade	Type and grade of lubricant used in this gearbox.
Last change date	The date the lubricant was last changed
Lab analysis available	Is a lab analysis report available for this lubricant?
Analysis frequency	How frequently was the lubricant analyzed?
Lab used	The name of the lab that analyzed the lubricant.
Oil temperature control low set-point	Fahrenheit/centigrade
Oil temperature control high set-point	Fahrenheit/centigrade
<b>Enter for each gear:</b>	
Gear type	Helical/spur.
Teeth	The number of teeth on this gear.
Gear handedness	Left/right

Outside diameter	The outer diameter of the gear.
Face width	The face width of the teeth.
Whole depth of teeth	
Tooth thickness span	
Tooth thickness top land	
Gear comments	Comments concerning the inspection of this gear
Failure classification	Choose a classification category, and a sub-classification.
<b>Enter for each bearing:</b>	
Bearing type	
Bearing orientation	
Bearing set orientation	
Make	Maker of this bearing.
Country	Country of make of this bearing.
Inner race outside diameter	
Inner race inside diameter	
Outer race outside diameter	
Outer race inside diameter	
Width	
Number of rollers	
Roller profile	
Roller diameter	
Roller length	
Cage type	
Cage material	
Comments	Comments concerning the inspection of this bearing
Failure classification	Choose a classification category, and a sub-classification

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