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American National Standard

Standard for Design and Specifications of Gearboxes for Wind Turbines

ANSI/AGMA/AWEA 6006–A03

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Approved January 9, 2004

ABSTRACT

This standard is intended to apply to wind turbine gearboxes. It provides information for specifying, selecting, designing, manufacturing, procuring, operating and maintaining reliable speed increasing gearboxes for wind turbine generator system service.

Annex information is supplied on: wind turbine architecture, wind turbine load description, quality assurance, operation and maintenance, minimum purchaser gearbox manufacturer ordering data, lubrication selection and monitoring, determination of an application factor from a load spectrum using the equivalent torque, and bearing stress calculations.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of ANSI/AGMA/AWEA 6006–A03, *Standard for Design and Specification of Gearboxes for Wind Turbines*.]

The operation and loading of a wind turbine speed increasing gearbox is unlike most other gear applications. The intent of this standard is to describe the differences. Much of the information is based on field experience. This standard is a tool whereby wind turbine and gearbox manufacturers can communicate and understand each other's needs in developing a gearbox specification for wind turbine applications. The annexes present informative discussion of various issues specific to wind turbine applications and gear design.

A combined committee of AWEA and AGMA members representing wind turbine manufacturers, operators, researchers, consultants, and gear, bearing and lubricant manufacturers were responsible for the drafting and development of this standard.

The committee first met in 1993 to develop AGMA/AWEA 921–A97, *Recommended Practices for Design and Specification of Gearboxes for Wind Turbine Generator Systems.* The AGMA Information Sheet was approved by the AGMA/AWEA Wind Turbine Gear Committee on October 25, 1996 and by the AGMA Technical Division Executive Committee on October 28, 1996. This standard supersedes AGMA/AWEA 921–A97.

The first draft of ANSI/AGMA/AWEA 6006–A03 was made in March, 2000. It was approved by the AGMA membership in October, 2003. It was approved as an American National Standard on January 9, 2004.

Suggestions for improvement of this standard will be welcome. They should be sent to the American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314.

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American National Standard –

Standard for Design and Specification of Gearboxes for Wind Turbines

1 Scope

This standard applies to gearboxes for wind turbines with power capacities ranging from 40 kW to 2 MW. It applies to all parallel axis, one stage epicyclic, and combined one stage epicyclic and parallel shaft enclosed gearboxes. The provisions made in this standard are based on field experience with wind turbines having the above power capacities and configurations.

Guidelines of this standard may be applied to higher capacity wind turbines provided the specifications are appropriately modified to accommodate the characteristics of higher capacity wind turbines.

Life requirements apply to wind turbines with a minimum design lifetime of 20 years.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents indicated below.

AGMA 901–A92, *A Rational Procedure for Preliminary Design of Minimum Volume Gears*

AGMA 913–A98, *Method for Specifying the Geometry of Spur and Helical Gears*

AGMA 925–A03, *Effect of Lubrication on Gear Surface Distress*

AMS 2301, *Aircraft quality steel cleanliness, magnetic particle inspection procedure*

ANSI Y12.3–1968, *Letter symbols for quantities used in mechanics of solids*

ANSI/AGMA 1012–F90, *Gear Nomenclature, Definitions of Terms with Symbols*

ANSI/AGMA 2101–C95, *Fundamental Rating Factors and Calculation Methods for Involute Spur and Helical Gear Teeth*

ANSI/AGMA 6000–B96, *Specification for Measurement of Linear Vibration on Gear Units*

ANSI/AGMA 6001–D97, *Design and Selection of Components for Enclosed Gear Drives*

ANSI/AGMA 6025–D98, *Sound for Enclosed Helical, Herringbone, and Spiral Bevel Gear Drives*

ANSI/AGMA 6110–F97, *Standard for Spur, Helical, Herringbone and Bevel Enclosed Drives*

ANSI/AGMA 6123–A88, *Design Manual for Enclosed Epicyclic Metric Module Gear Drives*

ANSI/AGMA 9005–E02, *Industrial Gear Lubrication*

ANSI/AGMA/ISO 1328–1, *Cylindrical Gears – ISO System Of Accuracy – Part 1: Definitions and Allowable Values of Deviations Relevant to Corresponding Flanks of Gear Teeth*

ASTM A534, *Standard specification for carburizing steels for anti–friction bearings*

Det Norske Veritas Classification AS, Classification Notes No. 41.2, *Calculation of Gear Rating for Marine Transmissions,* July 1993

DIN ISO 281 Bbl. 4:2003, *Dynamische Tragzahl und nominelle Lebensdauer – Verfahren zur Berechnung der modifizierten Referenzlebensdauer für allgemein belastete Wälzlager (Dynamic load ratings and life – Method for calculation of the modified reference rating life for generally loaded rolling bearings)*[1)]

DIN 743:2000, *Tragfähigkeitsberechnung von Wellen und Achsen (Calculation of load capacity of shafts and axles)*

[1)] English translation available as ISO TC 4/SC 8 N254a