

**Wind turbines - Part 4: Design requirements for wind turbine gearboxes (IEC 61400-4:2012)**

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## NATIONAL FOREWORD

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Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation.
Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 22.03.2013.	Date of Availability of the European standard is 22.03.2013.
Standard on kättesaadav Eesti Standardikeskusest.	The standard is available from the Estonian Centre for Standardisation.

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ICS 27.180

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**Wind turbines -  
Part 4: Design requirements for wind turbine gearboxes  
(IEC 61400-4:2012)**

Eoliennes -  
Partie 4: Exigences de conception des  
boîtes de vitesses pour éoliennes  
(CEI 61400-4:2012)

Windenergieanlagen -  
Teil 4: Auslegungsanforderungen für  
Getriebe von Windenergieanlagen  
(IEC 61400-4:2012)

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European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**

## Foreword

The text of document 88/438/FDIS, future edition 1 of IEC 61400-4, prepared by IEC/TC 88 "Wind turbines" and ISO/TC 60 "Gears" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61400-4:2013.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2013-10-08
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2016-01-08

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## Endorsement notice

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In the official version, for Bibliography, the following notes have to be added for the standards indicated:

ISO/IEC 17025	NOTE Harmonized as EN ISO/IEC 17025.
ISO 2160	NOTE Harmonized as EN ISO 2160.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60050	series	International electrotechnical vocabulary	-	-
IEC 61400-1	2005	Wind turbines - Part 1: Design requirements	EN 61400-1	2005
IEC 61400-3	-	Wind turbines - Part 3: Design requirements for offshore wind turbines	EN 61400-3	-
IEC/TS 61400-13	2001	Wind turbine generator systems - Part 13: Measurement of mechanical loads	-	-
IEC 61400-22	2010	Wind turbines - Part 22: Conformity testing and certification	EN 61400-22	2011
ISO 76	-	Rolling bearings - Static load ratings	-	-
ISO 281	2007	Rolling bearings - Dynamic load ratings and rating life	-	-
ISO 683	series	Heat-treatable steels, alloy steels and free-cutting steels	-	-
ISO 1328-1	-	Cylindrical gears - ISO system of accuracy - Part 1: Definitions and allowable values of deviations relevant to corresponding flanks of gear teeth	-	-
ISO 4287	-	Geometrical Product Specifications (GPS) - Surface texture: Profile method - Terms, definitions and surface texture parameters	EN ISO 4287	-
ISO 4288	-	Geometrical Product Specifications (GPS) - Surface texture: Profile method - Rules and procedures for the assessment of surface texture	EN ISO 4288	-
ISO 4406	-	Hydraulic fluid power - Fluids - Method for coding the level of contamination by solid particles	-	-
ISO 5725-2	-	Accuracy (trueness and precision) of measurement methods and results - Part 2: Basic method for the determination of repeatability and reproducibility of a standard measurement method	-	-
ISO 6336	series	Calculation of load capacity of spur and helical-gears	-	-
ISO 6336-1	2006	Calculation of load capacity of spur and helical-gears - Part 1: Basic principles, introduction and general influence factors	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
ISO 6336-2	2006	Calculation of load capacity of spur and helical-gears - Part 2: Calculation of surface durability (pitting)		-
ISO 6336-3	2006	Calculation of load capacity of spur and helical-gears - Part 3: Calculation of tooth bending strength		-
ISO 6336-5	2003	Calculation of load capacity of spur and helical-gears - Part 5: Strength and quality of materials		-
ISO 6336-6	2006	Calculation of load capacity of spur and helical-gears - Part 6: Calculation of service life under variable load		-
ISO/TR 10064-3	-	Code of inspection practice - Part 3: Recommendations relative to gear blanks, shaft centre distance and parallelism of axes	-	-
ISO 12925-1	-	Lubricants, industrial oils and related products - (class L) - Family C (Gears) - Part 1: Specifications for lubricants for enclosed gear systems		-
ISO/TR 13593	-	Enclosed gear drives for industrial applications	-	-
ISO/TR 13989-1	-	Calculation of scuffing load capacity of cylindrical, bevel and hypoid gears - Part 1: Flash temperature method Hide details	-	-
ISO/TR 13989-2	-	Calculation of scuffing load capacity of cylindrical, bevel and hypoid gears - Part 2: Integral temperature method	-	-
ISO 14104	-	Gears - Surface temper etch inspection after grinding	-	-
ISO 14635-1	2000	Gears - FZG test procedures - Part 1: FZG test method A/8,3/90 for relative scuffing load-carrying capacity of oils	-	-
ISO 15243	2004	Rolling bearings - Damage and failures - Terms, characteristics and causes	-	-
ISO/TS 16281	2008	Rolling bearings - Methods for calculating the modified reference rating life for universally loaded bearings	-	-
AGMA 9005	-	Industrial Gear Lubrication	-	-
ANSI/AGMA 925-A02	-	Effect of lubrication on gear surface distress	-	-
ANSI/AGMA 6001-E10	-	Design and selection of components for enclosed gear drives	-	-
ANSI/AGMA 6123	-	Design manual for enclosed epicyclic gear drives	-	-
ASTM E1049-85	-	Standard practices for cycle counting in fatigue analysis	-	-
DIN 471	-	Circlips (retaining rings) for shafts: Normal type and heavy type	-	-

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
DIN 472	-	Circlips (retaining rings) for bores: Normal type and heavy type	-	-
DIN 743	2000	Shafts and axles, calculations of load capacity, Parts 1,2, 3	-	-
DIN 3990-4	-	Calculation of load capacity of cylindrical gears: calculation of scuffing load capacity	-	-
DIN 6885-2	-	Parallel Key Geometries	-	-
DIN 6892	-	Mitnehmervverbindungen ohne Anzug – Passfedern – Berechnung und Gestaltung	-	-
DIN 7190	-	Interference fits – Calculation and design rules-	-	-
DIN 51517-3	-	Lubricants: Lubricating oils – Part 3: Lubricating oils CLP; Minimum requirements	-	-
-	-	Founding - Ultrasonic examination - Part 3: Spheroidal graphite cast iron castings	EN 12680-3	2003

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## WIND TURBINES –

### Part 4: Design requirements for wind turbine gearboxes

#### 1 Scope

This part of the IEC 61400 series is applicable to enclosed speed increasing gearboxes for horizontal axis wind turbine drivetrains with a power rating in excess of 500 kW. This standard applies to wind turbines installed onshore or offshore.

This International Standard provides guidance on the analysis of the wind turbine loads in relation to the design of the gear and gearbox elements.

The gearing elements covered by this standard include such gears as spur, helical or double helical and their combinations in parallel and epicyclic arrangements in the main power path. This standard does not apply to power take off gears (PTO).

The standard is based on gearbox designs using rolling element bearings. Use of plain bearings is permissible under this standard, but the use and rating of them is not covered.

Also included is guidance on the engineering of shafts, shaft hub interfaces, bearings and the gear case structure in the development of a fully integrated design that meets the rigours of the operating conditions.

Lubrication of the transmission is covered along with prototype and production testing. Finally, guidance is provided on the operation and maintenance of the gearbox.

#### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary*  
Available at <<http://www.electropedia.org>>

IEC 61400-1:2005, *Wind turbines – Part 1: Design requirements*

IEC 61400-3, *Wind turbines – Part 3: Design requirements for offshore wind turbines*

IEC/TS 61400-13:2001, *Wind turbine generator systems – Part 13: Measurement of mechanical loads*

IEC 61400-22:2010, *Wind turbines – Part 22: Conformity testing and certification*

ISO 76, *Rolling bearings – Static load ratings*

ISO 281:2007, *Rolling bearings – Dynamic load ratings and rating life*

ISO 683 (all parts), *Heat-treatable steels, alloy steels and free-cutting steels*

ISO 1328-1, *Cylindrical gears – ISO system of accuracy – Part 1: Definitions and allowable values of deviations relevant to corresponding flanks of gear teeth*

ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – terms, definitions and surface texture parameters*

ISO 4288, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – rules and procedures for the assessment of surface texture*

ISO 4406, *Hydraulic fluid power – Fluids– Method for coding the level of contamination by solid particles*

ISO 5725-2, *Accuracy (trueness and precision) of measurement methods and results – Part 2: Basic methods for the determination of repeatability and reproducibility of a standard measurement method*

ISO 6336 (all parts), *Calculation of load capacity of spur and helical gears*

ISO 6336-1:2006, *Calculation of load capacity of spur and helical gears – Part 1: Basic principles, introduction and general influence factors*

ISO 6336-2:2006, *Calculation of load capacity of spur and helical gears – Part 2: Calculation of surface durability (pitting)*

ISO 6336-3:2006, *Calculation of load capacity of spur and helical gears – Part 3: Calculation of tooth bending strength*

ISO 6336-5:2003, *Calculation of load capacity of spur and helical gears – Part 5: Strength and quality of materials*

ISO 6336-6:2006, *Calculation of load capacity of spur and helical gears – Part 6: Calculation of service life under variable load*

ISO/TR 10064-3, *Cylindrical gears – Code of inspection practice – Part 3: Recommendations relative to gear blanks, shaft centre distance and parallelism of axes*

ISO 12925-1, *Lubricants, industrial oils and related products (class L). Family C (Gears) – Part 1: Specifications for lubricants for enclosed gear systems*

ISO/TR 13593, *Enclosed gear drives for industrial applications*

ISO/TR 13989-1, *Calculation of scuffing load capacity of cylindrical, bevel and hypoid gears – Part 1: Flash temperature method*

ISO/TR 13989-2, *Calculation of scuffing load capacity of cylindrical, bevel and hypoid gears – Part 2: Integral temperature method*

ISO 14104, *Gears – Surface temper etch inspection after grinding*

ISO 14635-1:2000, *Gears – FZG test procedures – Part 1: FZG test method A/8,3/90 for relative scuffing load-carrying capacity of oils*

ISO 15243:2004, *Rolling bearings – Damage and failures – Terms, characteristics and causes*

ISO/TS 16281:2008, *Rolling bearings – Methods for calculating the modified reference rating life for universally loaded bearings*

AGMA 9005, *Industrial Gear Lubrication*

ANSI/AGMA 925-A02, *Effect of lubrication on gear surface distress*

ANSI/AGMA 6001-E10, *Design and selection of components for enclosed gear drives*

ANSI/AGMA 6123, *Design manual for enclosed epicyclic gear drives*

ASTM E1049-85, *Standard practices for cycle counting in fatigue analysis*

DIN 471, *Circlips (retaining rings) for shafts: Normal type and heavy type*

DIN 472, *Circlips (retaining rings) for bores: Normal type and heavy type*

DIN 743:2000, *Shafts and axles, calculations of load capacity, Parts 1, 2, 3*

DIN 3990-4, *Calculation of load capacity of cylindrical gears: calculation of scuffing load capacity*

DIN 6885-2, *Parallel Key Geometries*

DIN 6892, *Mitnehmerverbindungen ohne Anzug – Passfedern – Berechnung und Gestaltung* (available in German only)

DIN 7190, *Interference fits – Calculation and design rules*

DIN 51517-3, *Lubricants: Lubricating oils – Part 3: Lubricating oils CLP; Minimum requirements*

EN 12680-3:2003, *Ultrasonic examination. Spheroidal graphite cast iron castings*

### **3 Terms, definitions and conventions**

#### **3.1 Terms and definitions**

For the purposes of this document, the terms and definitions given in IEC 61400-1:2005 and IEC 60050-415 as well as the following apply.

NOTE The definitions in this standard take precedence.

##### **3.1.1**

##### **bearing manufacturer**

legal entity supplying bearings for the wind turbine gearbox, and who is responsible for the design and the application engineering of the bearing

Note 1 to entry: Typically, the bearing supplier will also manufacture the bearing.

##### **3.1.2**

##### **certification body**

entity that conducts certification of conformity of the wind turbine gearbox in accordance with IEC 61400-22

##### **3.1.3**

##### **characteristic load**

load value having a prescribed probability of not being exceeded