Tuuleturbiin-generaatorsüsteemid. Osa 1: Ohutusnõuded

Wind turbines Part 1: Design requirements

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61400-1:2005 sisaldab Euroopa standardi EN 61400-1:2005 ingliskeelset teksti. Käesolev dokument on jõustatud 19.12.2005 ja selle kohta on avaldatud teade Eesti standardiorganisatsiooni ametlikus väljaandes. Standard on kättesaadav Eesti standardiorganisatsioonist.	This Estonian standard EVS-EN 61400-1:2005 consists of the English text of the European standard EN 61400-1:2005. This document is endorsed on 19.12.2005 with the notification being published in the official publication of the Estonian national standardisation organisation. The standard is available from Estonian standardisation organisation.

Käsitlusala: Specifies essential design requirements to ensure the engineering integrity of wind turbines. Provides an appropriate level of protection against damage from all hazards during the planned lifetime. Is concerned with all subsystems of wind turbines such as control and protection mechanisms, internal electrical systems, mechanical systems and support structures. Applies to wind turbines of all sizes. See IEC 61400-2 for small wind turbines.	**Scope:** Specifies essential design requirements to ensure the engineering integrity of wind turbines. Provides an appropriate level of protection against damage from all hazards during the planned lifetime. Is concerned with all subsystems of wind turbines such as control and protection mechanisms, internal electrical systems, mechanical systems and support structures. Applies to wind turbines of all sizes. See IEC 61400-2 for small wind turbines.

ICS 27.180

Võtmesõnad: draft, safety requirements, wind turbine generator systems

EUROPEAN STANDARD **EN 61400-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM November 2005

ICS 27.180 Supersedes EN 61400-1:2004

English version

Wind turbines
Part 1: Design requirements
(IEC 61400-1:2005)

Eoliennes
Partie 1: Exigences de conception
(CEI 61400-1:2005)

Windenergieanlagen
Teil 1: Auslegungsanforderungen
(IEC 61400-1:2005)

This European Standard was approved by CENELEC on 2005-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland and United Kingdom.

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61400-1:2005 E

Foreword

The text of document 88/228/FDIS, future edition 3 of IEC 61400-1, prepared by IEC TC 88, Wind turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61400-1 on 2005-10-01.

This European Standard supersedes EN 61400-1:2004.

The main changes with respect to EN 61400-1:2004 are listed below:

– the title has been changed to “Design requirements” in order to reflect that the standard presents safety requirements rather than requirements for safety or protection of personnel;

– wind turbine class designations have been adjusted and now refer to reference wind speed and expected value of turbulence intensities only;

– turbulence models have been expanded and include an extreme turbulence model;

– gust models have been adjusted and simplified;

– design load cases have been rearranged and amended;

– the inclusion of turbulence simulations in the load calculations is emphasized and a scheme for extreme load extrapolation has been specified;

– the partial safety factors for loads have been adjusted and simplified;

– the partial safety factors for materials have been amended and specified in terms of material types and component classes;

– the requirements for the control and protection system have been amended and clarified in terms of functional characteristics;

– a new clause on assessment of structural and electrical compatibility has been introduced with detailed requirements for assessment, including information on complex terrain, earthquakes and wind farm wake effects.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2006-07-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2006-11-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61400-1:2005 was approved by CENELEC as a European Standard without any modification.

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

IEC 60034	NOTE	Harmonized in EN 60034 series (not modified).
IEC 60038	NOTE	Harmonized as HD 472 S1:1989 (modified).
IEC 60146	NOTE	Harmonized in EN 60146 series (not modified).
IEC 60173	NOTE	Harmonized as HD 27 S1:1978 (not modified).
IEC 60227	NOTE	The HD 21 series is related to, but not directly equivalent with the IEC 60227 series.
IEC 60245	NOTE	The HD 22 series is related to, but not directly equivalent with the IEC 60245 series.
IEC 60269	NOTE	Harmonized in EN/HD 60269 series (modified).
IEC 60439	NOTE	Harmonized in EN 60439 series (not modified).
IEC 60446	NOTE	Harmonized as EN 60446:1999 (not modified).
IEC 60529	NOTE	Harmonized as EN 60529:1991 (not modified).
IEC 60898	NOTE	Harmonized in EN 60898 series (modified).
IEC 61310-1	NOTE	Harmonized as EN 61310-1:1995 (not modified).
IEC 61310-2	NOTE	Harmonized as EN 61310-2:1995 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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

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

Publication	Year	Title	EN/HD	Year
IEC 60204-1	1997	Safety of machinery - Electrical equipment of machines Part 1: General requirements	EN 60204-1 + corr. September	1997 1998
IEC 60204-11	2000	Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV	EN 60204-11	2000
IEC 60364 (mod)	Series	Electrical installations of buildings	EN 60364 HD 60364 HD 384	Series Series Series
IEC 60721-2-1	1982	Classification of environmental conditions Part 2: Environmental conditions appearing in nature - Temperature and humidity	HD 478.2.1 S1 [1)]	1989
IEC 61000-6-1 (mod)	1997	Electromagnetic compatibility (EMC) Part 6-1: Generic standards - Immunity for residential, commercial and light-industrial environments	EN 61000-6-1	2001
IEC 61000-6-2 (mod)	1999	Part 6-2: Generic standards - Immunity for industrial environments	EN 61000-6-2 [2)]	2001
IEC 61000-6-4 (mod)	1997	Part 6-4: Generic standards - Emission standard for industrial environments	EN 61000-6-4	2001
IEC 61024-1	1990	Protection of structures against lightning Part 1: General principles	-	-
IEC 61312-1	1995	Protection against lightning electromagnetic impulse Part 1: General principles	-	-
IEC 61400-21	2001	Wind turbine generator systems Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines	EN 61400-21	2002

[1)] HD 478.2.1 S1 includes A1:1987 to IEC 60721-2-1:1982.

[2)] EN 61000-6-2:2001 is superseded by EN 61000-6-2:2005, which is based on IEC 61000-6-2:2005.

Publication	Year	Title	EN/HD	Year
IEC/TR 61400-24	2002	Part 24: Lightning protection	-	-
ISO 76	1987	Rolling bearings - Static load ratings	-	-
ISO 281	1990	Rolling bearings - Dynamic load ratings and rating life	-	-
ISO 2394	1998	General principles on reliability for structures	-	-
ISO 2533	1975	Standard atmosphere	-	-
ISO 4354	1997	Wind actions on structures	-	-
ISO 6336-1	1996	Calculation of load capacity of spur and helical gears Part 1: Basic principles, introduction and general influence factors	-	-
ISO 9001	2000	Quality management systems - Requirements	EN ISO 9001	2000

INTERNATIONAL STANDARD

IEC 61400-1

Third edition
2005-08

Wind turbines –

Part 1:
Design requirements

Reference number
IEC 61400-1:2005(E)

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

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INTERNATIONAL STANDARD

IEC 61400-1

Third edition
2005-08

Wind turbines –

Part 1: Design requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND TURBINES –

Part 1: Design requirements

FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61400-1 has been prepared by IEC technical committee 88: Wind turbines.

This third edition cancels and replaces the second edition published in 1999. It constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

– the title has been changed to "Design requirements" in order to reflect that the standard presents safety requirements rather than requirements for safety or protection of personnel;
– wind turbine class designations have been adjusted and now refer to reference wind speed and expected value of turbulence intensities only;
– turbulence models have been expanded and include an extreme turbulence model;
– gust models have been adjusted and simplified;

– design load cases have been rearranged and amended;
– the inclusion of turbulence simulations in the load calculations is emphasised and a scheme for extreme load extrapolation has been specified;
– the partial safety factors for loads have been adjusted and simplified;
– the partial safety factors for materials have been amended and specified in terms of material types and component classes;
– the requirements for the control and protection system have been amended and clarified in terms of functional characteristics;
– a new clause on assessment of structural and electrical compatibility has been introduced with detailed requirements for assessment, including information on complex terrain, earthquakes and wind farm wake effects.

The text of this standard is based on the following documents:

FDIS	Report on voting
88/228/FDIS	88/232/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 61400 consists of the following parts under the general title *Wind turbine generator systems:*

Part 1: Design requirements
Part 2: Design requirements for small wind turbines
Part 11: Acoustic noise measurement techniques
Part 12: Wind turbine power performance testing
Part 13: Measurement of mechanical loads
Part 14: Declaration of apparent sound power level and tonality values
Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines
Part 23: Full-scale structural testing of rotor blades
Part 24: Lightning protection

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This part of IEC 61400 outlines minimum design requirements for wind turbines and is not intended for use as a complete design specification or instruction manual.

Any of the requirements of this standard may be altered if it can be suitably demonstrated that the safety of the system is not compromised. This provision, however, does not apply to the classification and the associated definitions of external conditions in Clause 6.Compliance with this standard does not relieve any person, organization, or corporation from the responsibility of observing other applicable regulations.

The standard is not intended to give requirements for wind turbines installed offshore, in particular for the support structure. A future document dealing with offshore installations is under consideration.

WIND TURBINES –

Part 1: Design requirements

1 Scope

This part of IEC 61400 specifies essential design requirements to ensure the engineering integrity of wind turbines. Its purpose is to provide an appropriate level of protection against damage from all hazards during the planned lifetime.

This standard is concerned with all subsystems of wind turbines such as control and protection mechanisms, internal electrical systems, mechanical systems and support structures.

This standard applies to wind turbines of all sizes. For small wind turbines IEC 61400-2 may be applied.

This standard should be used together with the appropriate IEC and ISO standards mentioned in Clause 2.

2 Normative references

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

IEC 60204-1:1997, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60204-11:2000, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V a.c. or 1 500 V d.c. and not exceeding 36 kV*

IEC 60364 (all parts), *Electrical installations of buildings*

IEC 60721-2-1:1982, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature. Temperature and humidity*

IEC 61000-6-1:1997, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 1: Immunity for residential, commercial and light-industrial environments*

IEC 61000-6-2:1999, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 2: Immunity for industrial environments 15*

IEC 61000-6-4:1997, *Electromagnetic compatibility (EMC) – Part 6: Generic standards – Section 4: Emission standard for industrial environments*

IEC 61024-1:1990, *Protection of structures against lightning – Part 1: General principles*

IEC 61312-1:1995, *Protection against lightning electromagnetic impulse – Part 1: General principle*

IEC 61400-21:2001, *Wind turbine generator systems – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines*

IEC 61400-24: 2002, *Wind turbine generator systems – Part 24: Lightning protection*

ISO 76:1987, *Rolling bearings – Static load ratings*

ISO 281:1990, *Rolling bearings – Dynamic load ratings and rating life*

ISO 2394:1998, *General principles on reliability for structures*

ISO 2533:1975, *Standard Atmosphere*

ISO 4354:1997, *Wind actions on structures*

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

ISO 9001:2000, *Quality management systems – Requirements*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
annual average
mean value of a set of measured data of sufficient size and duration to serve as an estimate of the expected value of the quantity. The averaging time interval should be a whole number of years to average out non-stationary effects such as seasonality

3.2
annual average wind speed
V_{ave}
wind speed averaged according to the definition of annual average

3.3
auto-reclosing cycle
event with a time period, varying from approximately 0,01 s to a few seconds, during which a breaker released after a grid fault is automatically reclosed and the line is reconnected to the network

3.4
blocking (wind turbines)
use of a mechanical pin or other device (other than the ordinary mechanical brake) that cannot be released accidentally to prevent movement, for instance of the rotor shaft or yaw mechanism

3.5
brake (wind turbines)
device capable of reducing the rotor speed or stopping rotation

NOTE The brake may operate on, for example, aerodynamic, mechanical or electrical principles.

3.6
characteristic value
value having a prescribed probability of not being attained (i.e. an exceedance probability of less than or equal to a prescribed amount)