Sisaldab värvilisi lehekülgi
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Wind power generation systems - Part 12-1: Power performance measurement of electricity producing wind turbines

EESTI STANDARDI EESSÕNA | NATIONAL FOREWORD

EESTI STANDARDI EESSÕNA	NATIONAL FOREWORD
See Eesti standard EVS-EN 61400-12-1:2017 sisaldab Euroopa standardi EN 61400-12-1:2017 ja selle paranduste AC:2019, AC:2020 ja AC:2021 ingliskeelset teksti.	This Estonian standard EVS-EN 61400-12-1:2017 consists of the English text of the European standard EN 61400-12-1:2017 and its and its corrigenda AC:2019, AC:2010 and AC:2021.
Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas. Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 02.06.2017.	This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation. Date of Availability of the European standard is 02.06.2017.
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ICS 27.180

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 61400-12-1

June 2017

ICS 27.180

Supersedes EN 61400-12-1:2006

English Version

Wind power generation systems - Part 12-1: Power performance measurement of electricity producing wind turbines (IEC 61400-12-1:2017)

Systèmes de génération d'énergie éolienne - Partie 12-1: Mesures de performance de puissance des éoliennes de production d'électricité (IEC 61400-12-1:2017)

Windenergieanlagen - Teil 12-1: Messung des Leistungsverhaltens einer Windenergieanlage (IEC 61400-12-1:2017)

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

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Ref. No. EN 61400-12-1:2017 E

European foreword

The text of document 88/610/FDIS, future edition 2 of IEC 61400-12-1, prepared by IEC TC 88 "Wind turbines" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61400-12-1:2017.

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)	2018-01-07
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2020-04-07

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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:

IEC 61400-1:2005	NOTE	Harmonized as EN 61400-1:2005.
IEC 61400-1:2005/AMD1:2010	NOTE	Harmonized as EN 61400-1:2005/A1:2010.
IEC 61400-2:2013	NOTE	Harmonized as EN 61400-2:2013.
IEC 61400-12-2	NOTE	Harmonized as EN 61400-12-2.

IEC 61400-12-1

Edition 2.0 2017-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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Wind energy generation systems –
Part 12-1: Power performance measurements of electricity producing wind turbines

Systèmes de génération d'énergie éolienne –
Partie 12-1: Mesures de performance de puissance des éoliennes de production d'électricité

IEC 61400-12-1:2017-03(en-fr)

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IEC 61400-12-1

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ICS 27.180

ISBN 978-2-8322-3823-3

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WIND ENERGY GENERATION SYSTEMS –

Part 12-1: Power performance measurements of electricity producing wind turbines

FOREWORD

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International Standard IEC 61400-12-1 has been prepared by IEC technical committee 88: Wind energy generation systems.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

a) new definition of wind speed,
b) inclusion of wind shear and wind veer,
c) revision of air density correction,
d) revision of site calibration,
e) revision to definition of power curve,
f) interpolation to bin centre method,
g) revision of obstacle model,

h) clarification of topography requirements,
i) new annex on mast induced flow distortion,
j) revision to anemometer classifications,
k) inclusion of ultrasonic anemometers,
l) cold climate annex added,
m) database A changed to special database,
n) revision of uncertainty annex,
o) inclusion of remote sensing.

IEC 61400-12-2 is an addition to IEC 61400-12-1.

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

FDIS	Report on voting
88/610/FDIS	88/617/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.

A list of all parts in the IEC 61400, published under the general title *Wind energy generation systems*, can be found on the IEC website.

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

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

The committee recognizes that this revision represents a significant increase in complexity and perhaps greater difficulty to implement. However, it represents the committee's best attempt to address issues introduced by larger wind turbines operating in significant wind shear and complex terrain. The committee recommends that the new techniques introduced be validated immediately by test laboratories through inter-lab proficiency testing. The committee recommends a Review Report be written within three years of the release of this document which includes recommendations, clarifications and simplifications that will improve the practical implementation of this standard. If necessary a revision should be proposed at the same time to incorporate these recommendations, clarifications and simplifications.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website 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.

The contents of the corrigenda of September 2019 and March 2020 have been included in this copy.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency, accuracy and reproducibility in the measurement and analysis of power performance by wind turbines. The standard has been prepared with the anticipation that it would be applied by:

a) a wind turbine manufacturer striving to meet well-defined power performance requirements and/or a possible declaration system;

b) a wind turbine purchaser in specifying such performance requirements;

c) a wind turbine operator who may be required to verify that stated, or required, power performance specifications are met for new or refurbished units;

d) a wind turbine planner or regulator who shall be able to accurately and fairly define power performance characteristics of wind turbines in response to regulations or permit requirements for new or modified installations.

This document provides guidance in the measurement, analysis, and reporting of power performance testing for wind turbines. The document will benefit those parties involved in the manufacture, installation planning and permitting, operation, utilization, and regulation of wind turbines. The technically accurate measurement and analysis techniques recommended in this standard should be applied by all parties to ensure that continuing development and operation of wind turbines is carried out in an atmosphere of consistent and accurate communication relative to wind turbine performance. This document presents measurement and reporting procedures expected to provide accurate results that can be replicated by others. Meanwhile, a user of the standard should be aware of differences that arise from large variations in wind shear and turbulence. Therefore, a user should consider the influence of these differences and the data selection criteria in relation to the purpose of the test before contracting the power performance measurements.

A key element of power performance testing is the measurement of wind speed. This document prescribes the use of cup or sonic anemometers or remote sensing devices (RSD) in conjunction with anemometers to measure wind. Even though suitable procedures for calibration/validation and classification are adhered to, the nature of the measurement principle of these devices may potentially cause them to perform differently. These instruments are robust and have been regarded as suitable for this kind of test with the limitation of some of them to certain classes of terrain.

Recognising that, as wind turbines become ever larger, a wind speed measured at a single height is increasingly unlikely to accurately represent the wind speed through the entire turbine rotor, this standard introduces an additional definition of wind speed. Whereas previously wind speed was defined as that measured at hub height only, this may now be supplemented with a so called Rotor Equivalent Wind Speed (REWS) defined by an arithmetic combination of simultaneous measurements of wind speed at a number of heights spanning the complete rotor diameter between lower tip and upper tip. The power curves defined by hub height wind speed and REWS are not the same and so the hub height wind speed power curve is always presented for comparison whenever a REWS power curve is measured. As a consequence of this difference in wind speed definition, the annual energy production (*AEP*) derived from the combination of a measured power curve with a wind speed distribution uses an identical definition of wind speed in both the power curve and the wind speed distribution.

Procedures to classify cup anemometers and ultrasonic anemometers are given in Annexes I and J. Procedures to classify remote sensing devices are given in Annex L. Special care should be taken in the selection of the instruments chosen to measure the wind speed because it can influence the result of the test.

WIND ENERGY GENERATION SYSTEMS –

Part 12-1: Power performance measurements of electricity producing wind turbines

Scope

This part of IEC 61400 specifies a procedure for measuring the power performance characteristics of a single wind turbine and applies to the testing of wind turbines of all types and sizes connected to the electrical power network. In addition, this standard describes a procedure to be used to determine the power performance characteristics of small wind turbines (as defined in IEC 61400-2) when connected to either the electric power network or a battery bank. The procedure can be used for performance evaluation of specific wind turbines at specific locations, but equally the methodology can be used to make generic comparisons between different wind turbine models or different wind turbine settings when site-specific conditions and data filtering influences are taken into account.

The wind turbine power performance characteristics are determined by the measured power curve and the estimated annual energy production (AEP). The measured power curve, defined as the relationship between the wind speed and the wind turbine power output, is determined by collecting simultaneous measurements of meteorological variables (including wind speed), as well as wind turbine signals (including power output) at the test site for a period that is long enough to establish a statistically significant database over a range of wind speeds and under varying wind and atmospheric conditions. The AEP is calculated by applying the measured power curve to reference wind speed frequency distributions, assuming 100 % availability.

This document describes a measurement methodology that requires the measured power curve and derived energy production figures to be supplemented by an assessment of uncertainty sources and their combined effects.

Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60688:2012, *Electrical measuring transducers for converting A.C. and D.C. electrical quantities to analogue or digital signals*

IEC 61400-12-2:2013, *Wind turbines – Part 12-2: Power performance of electricity-producing wind turbines based on nacelle anemometry*

IEC 61869-1:2007, *Instrument transformers – Part 1: General requirements*

IEC 61869-2:2012*, Instrument transformers – Part 2: Additional requirements for current transformers*

IEC 61869-3:2011*, Instrument transformers – Part 3: Additional requirements for inductive voltage transformers*

ISO/IEC GUIDE 98-3:2008*, Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement (GUM:1995)*

ISO/IEC 17025:2005, *General requirements for the competence of testing and calibration laboratories*

ISO/IEC 17043:2010, *Conformity assessment – General requirements for proficiency testing*

ISO 2533:1975, *Standard atmosphere*

ISO 3966:2008, *Measurement of fluid flow in closed conduits – Velocity area method using Pitot static tubes*

Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
accuracy
closeness of the agreement between the result of a measurement and a true value of the measurand

3.2
annual energy production
AEP
estimate of the total energy production of a wind turbine during a one-year period by applying the measured power curve to different reference wind speed frequency distributions at hub height, assuming 100 % availability

3.3
atmospheric stability
a measure of tendency of the wind to encourage or suppress vertical mixing

Note 1 to entry: Stable atmosphere is characterized by a high temperature gradient with altitude, high wind shear, possible wind veer and low turbulence relative to unstable conditions. Neutral and unstable atmosphere generally result in lower temperature gradients and low wind shear.

3.4
complex terrain
terrain surrounding the test site that features significant variations in topography and terrain obstacles (refer to 3.18) that may cause flow distortion

3.5
cut-in wind speed
the lowest wind speed at which a wind turbine will begin to produce power

3.6
cut-out wind speed
the wind speed at which a wind turbine cuts out from the grid due to high wind speed

3.7
data set
a collection of data sampled over a continuous period