

**Elektrituulikud. Osa 21: Elektrivõrguga ühendatud
elektrituulikute elektri kvaliteedi näitajate mõõtmine
ja hindamine**

Wind turbines Part 21: Measurement and assessment
of power quality characteristics of grid connected wind
turbines

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

Käesolev Eesti standard EVS-EN 61400-21:2008 sisaldab Euroopa standardi EN 61400-21:2008 ingliskeelset teksti.

Standard on kinnitatud Eesti Standardikeskuse 05.12.2008 käskkirjaga ja jõustub sellekohase teate avaldamisel EVS Teatajas.

Euroopa standardimisorganisatsioonide poolt rahvuslikele liikmetele Euroopa standardi teksti kättesaadavaks tegemise kuupäev on 07.11.2008.

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This Estonian standard EVS-EN 61400-21:2008 consists of the English text of the European standard EN 61400-21:2008.

This standard is ratified with the order of Estonian Centre for Standardisation dated 05.12.2008 and is endorsed with the notification published in the official bulletin of the Estonian national standardisation organisation.

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Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonilisse süsteemi või edastamine ükskõik millises vormis või millisel teel on keelatud ilma Eesti Standardikeskuse poolt antud kirjaliku loata.

Kui Teil on küsimusi standardite autorikaitse kohta, palun võtke ühendust Eesti Standardikeskusega:
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English version

**Wind turbines -
Part 21: Measurement and assessment
of power quality characteristics of grid connected wind turbines
(IEC 61400-21:2008)**

Eoliennes -
Partie 21: Mesurage et évaluation
des caractéristiques de qualité
de puissance des éoliennes
connectées au réseau
(CEI 61400-21:2008)

Windenergieanlagen -
Teil 21: Messung und Bewertung
der Netzverträglichkeit
von netzgekoppelten
Windenergieanlagen
(IEC 61400-21:2008)

This European Standard was approved by CENELEC on 2008-10-01. 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, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the 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

Foreword

The text of document 88/317/FDIS, future edition 2 of IEC 61400-21, prepared by IEC TC 88, Wind turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61400-21 on 2008-10-01.

This European Standard supersedes EN 61400-21:2002.

EN 61400-21:2008 includes the following new items with respect to EN 61400-21:2002:

- interharmonics and current distortions (< 9 kHz),
- response to voltage dips,
- active power ramp rate limitation and set-point control,
- reactive power capabilities and set-point control,
- grid protection and reconnection time after grid faults.

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) 2009-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2011-10-01

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61400-21:2008 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 61000-3-3	NOTE Harmonized as EN 61000-3-3:2008 (not modified).
IEC 61000-4-30	NOTE Harmonized as EN 61000-4-30:2003 (not modified).
IEC 61400-1	NOTE Harmonized as EN 61400-1:2005 (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 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 60044-1 (mod)	- ¹⁾	Instrument transformers - Part 1: Current transformers	EN 60044-1	1999 ²⁾
IEC 60044-2 (mod)	- ¹⁾	Instrument transformers - Part 2: Inductive voltage transformers	EN 60044-2	1999 ²⁾
IEC 60050-161	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Chapter 161: Electromagnetic compatibility	-	-
IEC 60050-415	- ¹⁾	International Electrotechnical Vocabulary (IEV) - Part 415: Wind turbine generator systems	-	-
IEC 61000-4-7	2002	Electromagnetic compatibility (EMC) - Part 4-7: Testing and measurement techniques - General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto	EN 61000-4-7	2002
IEC 61000-4-15	- ¹⁾	Electromagnetic compatibility (EMC) - Part 4-15: Testing and measurement techniques - Flickermeter - Functional and design specifications	EN 61000-4-15	1998 ²⁾
IEC 61400-12-1	- ¹⁾	Wind turbines - Part 12-1: Power performance measurements of electricity producing wind turbines	EN 61400-12-1	2006 ²⁾
IEC 61800-3	2004	Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods	EN 61800-3	2004
IEC 62008	- ¹⁾	Performance characteristics and calibration methods for digital data acquisition systems and relevant software	EN 62008	2005 ²⁾

¹⁾ Undated reference.

²⁾ Valid edition at date of issue.

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INTRODUCTION

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the presentation, testing and assessment of power quality characteristics of grid connected wind turbines (WTs). The power quality characteristics here include wind turbine specifications, voltage quality (emissions of flicker and harmonics), voltage drop response, power control (control of active and reactive power), grid protection and reconnection time.

This part of IEC 61400 has been prepared with the anticipation that it would be applied by:

- the WT manufacturer striving to meet well-defined power quality characteristics;
- the WT purchaser in specifying such power quality characteristics;
- the WT operator who may be required to verify that stated, or required power quality characteristics are met;
- the WT planner or regulator who has to be able to accurately and fairly determine the impact of a WT on the voltage quality to ensure that the installation is designed so that voltage quality requirements are respected;
- the WT certification authority or component testing organization in evaluating the power quality characteristics of the wind turbine type;
- the planner or regulator of the electric network who has to be able to determine the grid connection required for a WT.

This part of IEC 61400 provides recommendations for preparing the measurements and assessment of power quality characteristics of grid connected WTs. This part of IEC 61400 will benefit those parties involved in the manufacture, installation planning, obtaining of permission, operation, utilization, testing and regulation of WTs. The measurement and analysis techniques recommended in this part of IEC 61400 should be applied by all parties to ensure that the continuing development and operation of WTs are carried out in an atmosphere of consistent and accurate communication.

This part of IEC 61400 presents measurement and analysis procedures expected to provide consistent results that can be replicated by others.

WIND TURBINES –

Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines

1 Scope

This part of IEC 61400 includes:

- definition and specification of the quantities to be determined for characterizing the power quality of a grid connected wind turbine;
- measurement procedures for quantifying the characteristics;
- procedures for assessing compliance with power quality requirements, including estimation of the power quality expected from the wind turbine type when deployed at a specific site, possibly in groups.

The measurement procedures are valid for single wind turbines with a three-phase grid connection. The measurement procedures are valid for any size of wind turbine, though this part of IEC 61400 only requires wind turbine types intended for PCC (Point of Common Coupling) at MV or HV to be tested and characterized as specified in this part of IEC 61400.

The measured characteristics are valid for the specific configuration and operational mode of the assessed wind turbine type only. Other configurations, including altered control parameters that cause the wind turbine to behave differently with respect to power quality, require separate assessment.

The measurement procedures are designed to be as non-site-specific as possible, so that power quality characteristics measured at for example a test site can be considered valid also at other sites.

The procedures for assessing compliance with power quality requirements are valid for wind turbines with PCC at MV or HV in power systems with fixed frequency within ± 1 Hz, and sufficient active and reactive power regulation capabilities. In other cases, the principles for assessing compliance with power quality requirements may still be used as a guidance.

This part of IEC 61400 is for testing of wind turbines, though it contains information that may also be useful for testing of wind farms.

NOTE This part of IEC 61400 uses the following terms for system voltage:

- low voltage (LV) refers to $U_n \leq 1$ kV;
- medium voltage (MV) refers to $1 \text{ kV} < U_n \leq 35$ kV;
- high voltage (HV) refers to $U_n > 35$ kV.

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 60044-1, *Instrument transformers – Part 1: Current transformers*

IEC 60044-2, *Instrument transformers – Part 2: Inductive voltage transformers*

IEC 60050-161, *International Electrotechnical Vocabulary – Part 161: Electromagnetic compatibility*

IEC 60050-415, *International Electrotechnical Vocabulary – Part 415: Wind turbine generator systems*

IEC 61000-4-7:2002, *Electromagnetic compatibility (EMC) – Part 4-7: Testing and measurement techniques – General guide on harmonics and interharmonics measurements and instrumentation, for power supply systems and equipment connected thereto*

IEC 61000-4-15, *Electromagnetic compatibility (EMC) – Part 4: Testing and measurement techniques – Section 15: Flickermeter – Functional and design specifications*

IEC 61400-12-1, *Wind turbines – Part 12-1: Power performance measurements of electricity producing wind turbines*

IEC 61800-3:2004, *Adjustable speed electrical power drive systems – Part 3: EMC requirements and specific test methods*

IEC 62008, *Performance characteristics and calibration methods for digital data acquisition systems and relevant software*

3 Terms and definitions

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

3.1

continuous operation (for wind turbines)

normal operation of the wind turbine excluding start-up and shutdown operations

3.2

cut-in wind speed (for wind turbines)

lowest wind speed at hub height at which the wind turbine starts to produce power

[IEV 415-03-05]

3.3

flicker coefficient for continuous operation (for wind turbines)

normalized measure of the flicker emission during continuous operation of the wind turbine:

$$c(\psi_k) = P_{st, fic} \times \frac{S_{k, fic}}{S_n}$$

where

$P_{st, fic}$ is the flicker emission from the wind turbine on the fictitious grid;

S_n is the rated apparent power of the wind turbine;

$S_{k, fic}$ is the short-circuit apparent power of the fictitious grid

NOTE The flicker coefficient for continuous operation is the same for a short-term (10 min) and long-term period (2 h).

3.4

flicker step factor (for wind turbines)

a normalized measure of the flicker emission due to a single switching operation of the wind turbine: