SLOVENSKI STANDARD

SIST EN 61400-11:2003

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Sistemi generatorjev vetrne turbine – 11. del: Tehnike merjenja hrupa (IEC 61400-11:2002)

Wind turbine generator systems - Part 11: Acoustic noise measurement techniques

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SIST EN 61400-11:2003(en)

EUROPEAN STANDARD **EN 61400-11**

NORME EUROPÉENNE

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ICS 27.180 Supersedes EN 61400-11:1998

English version

Wind turbine generator systems
Part 11: Acoustic noise measurement techniques
(IEC 61400-11:2002)

Aérogénérateurs
Partie 11: Techniques de mesure
du bruit acoustique
(CEI 61400-11:2002)

Windenergieanlagen
Teil 11: Schallmessverfahren
(IEC 61400-11:2002)

This European Standard was approved by CENELEC on 2003-03-18. 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, Czech Republic, Denmark, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Luxembourg, Malta, Netherlands, Norway, Portugal, Slovakia, 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

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Foreword

The text of document 88/166/FDIS, future edition 2 of IEC 61400-11, prepared by IEC TC 88, Wind turbines, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61400-11 on 2003-03-18.

This European Standard supersedes EN 61400-11:1998.

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) 2003-12-01

– latest date by which the national standards conflicting with the EN have to be withdrawn (dow) -

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annex ZA is normative and annexes A to D are informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61400-11:2002 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

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

Publication	Year	Title	EN/HD	Year
IEC 60386	1972	Method of measurement of speed fluctuations in sound recording and reproducing equipment	-	-
IEC 60651	1979	Sound level meters	EN 60651	1994
IEC 60688	1992	Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals	EN 60688	1992
IEC 60804	2000	Integrating-averaging sound level meters	EN 60804	2000
IEC 60942	1997	Electroacoustics - Sound calibrators	EN 60942 [1)]	1998
IEC 61260	1995	Electroacoustics - Octave-band and fractional-octave-band filters	EN 61260	1995
IEC 61400-12	1998	Wind turbine generator systems Part 12: Wind turbine power performance testing	EN 61400-12	1998

1) EN 60942 is superseded by EN 60942:2003, which is based on IEC 60942:2003.

INTERNATIONAL STANDARD

IEC 61400-11

Second edition
2002-12

Wind turbine generator systems –

Part 11:
Acoustic noise measurement techniques

Aérogénérateurs –

Partie 11:
Techniques de mesure du bruit acoustique

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND TURBINE GENERATOR SYSTEMS –

Part 11: Acoustic noise measurement techniques

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
2) The formal decisions or agreements of the IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical specifications, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61400-11 has been prepared by IEC technical committee 88: Wind turbine systems.

This second edition of IEC 61400-11 cancels and replaces the first edition published in 1998 and constitutes a technical revision.

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

FDIS	Report on voting
88/166/FDIS	88/171/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.

The committee has decided that the contents of this publication will remain unchanged until 2004. At this date, the publication will be

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

INTRODUCTION

The purpose of this part of IEC 61400 is to provide a uniform methodology that will ensure consistency and accuracy in the measurement and analysis of acoustical emissions by wind turbine generator systems. The standard has been prepared with the anticipation that it would be applied by:

- the wind turbine manufacturer striving to meet well defined acoustic emission performance requirements and/or a possible declaration system;
- the wind turbine purchaser in specifying such performance requirements;
- the wind turbine operator who may be required to verify that stated, or required, acoustic performance specifications are met for new or refurbished units;
- the wind turbine planner or regulator who must be able to accurately and fairly define acoustical emission characteristics of a wind turbine in response to environmental regulations or permit requirements for new or modified installations.

This standard provides guidance in the measurement, analysis and reporting of complex acoustic emissions from wind turbine generator systems. The standard will benefit those parties involved in the manufacture, installation, planning and permitting, operation, utilization, and regulation of wind turbines. The measurement and analysis techniques recommended in this document should be applied by all parties to insure that continuing development and operation of wind turbines is carried out in an atmosphere of consistent and accurate communication relative to environmental concerns. This standard presents measurement and reporting procedures expected to provide accurate results that can be replicated by others.

WIND TURBINE GENERATOR SYSTEMS –

Part 11: Acoustic noise measurement techniques

1 Scope

This part of IEC 61400 presents measurement procedures that enable noise emissions of a wind turbine to be characterised. This involves using measurement methods appropriate to noise emission assessment at locations close to the machine, in order to avoid errors due to sound propagation, but far enough away to allow for the finite source size. The procedures described are different in some respects from those that would be adopted for noise assessment in community noise studies. They are intended to facilitate characterisation of wind turbine noise with respect to a range of wind speeds and directions. Standardisation of measurement procedures will also facilitate comparisons between different wind turbines.

The procedures present methodologies that will enable the noise emissions of a single wind turbine to be characterised in a consistent and accurate manner. These procedures include the following:

- location of acoustic measurement positions;
- requirements for the acquisition of acoustic, meteorological, and associated wind turbine operational data;
- analysis of the data obtained and the content for the data report; and
- definition of specific acoustic emission parameters, and associated descriptors which are used for making environmental assessments.

The standard is not restricted to wind turbines of a particular size or type. The procedures described in this standard allow for the thorough description of the noise emission from a wind turbine. If, in some cases, less comprehensive measurements are needed, such measurements are made according to the relevant parts of this standard.

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 60386:1972, *Method of measurement of speed fluctuations in sound recording and reproducing equipment*

IEC 60651:1979, *Sound level meters*

IEC 60688:1992, *Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals*

IEC 60804:2000, *Integrating-averaging sound level meters*

IEC 60942:1997, *Electroacoustics – Sound calibrators*

IEC 61260:1995, *Electroacoustics – Octave-band and fractional-octave-band filters*

IEC 61400-12:1998, *Wind turbine generator systems – Part 12: Wind turbine power performance testing*

3 Definitions

For the purposes of this standard, the following definitions apply:

3.1
apparent sound power level
L_{WA} (in dB re. 1 pW)
the A-weighted sound power level re. 1 pW of a point source at the rotor centre with the same emission in the downwind direction as the wind turbine being measured, L_{WA} is determined at each wind speed integer from 6 to 10 m/s

3.2
audibility criterion
L_a (in dB re. 20 µPa)
a frequency dependent criterion curve determined from listening tests, and reflecting the subjective response of a 'typical' listener to tones of different frequencies

3.3
A-weighted or C-weighted sound pressure levels
L_A or L_C, respectively (in dB re. 20 µPa)
sound pressure levels measured with the A or C frequency weighting networks specified in IEC 60651

3.4
directivity
Δ_i (in dB)
the difference between the A-weighted sound pressure levels measured at measurement positions 2, 3, and 4 and those measured at the reference position 1 from the turbine corrected to the same distance from the wind turbine rotor centre

3.5
inclination angle
ϕ (in °)
the angle between the plane of the microphone board and a line from the microphone to the rotor centre

3.6
reference distance
R_0 (in m)
the nominal horizontal distance from the centre of the base of the wind turbine to each of the prescribed microphone positions

3.7
reference height
z_{ref} (in m)
a height of 10 m used for converting wind speed to reference conditions

3.8
reference roughness length
z_{0ref} (in m)
a roughness length of 0,05 m used for converting wind speed to reference conditions

3.9
sound pressure level
L_p (in dB re. 20 µPa)
10 times the $\log_{10}$ of the ratio of the mean-square sound pressure to the square of the reference sound pressure of 20 µPa