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INTERNATIONAL STANDARD

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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

FOREWORD.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references	8
3 Terms and definitions	9
4 Symbols and units	11
5 Preparation for performance test	14
5.1 Wind turbine and electrical connection	14
5.2 Test site	14
6 Test equipment.....	16
6.1 Electric power	16
6.2 Wind speed	16
6.3 Wind direction	17
6.4 Air density	17
6.5 Rotational speed and pitch angle.....	17
6.6 Blade condition	17
6.7 Wind turbine control system	17
6.8 Data acquisition system.....	18
7 Measurement procedure.....	18
7.1 General	18
7.2 Wind turbine operation	18
7.3 Data collection	18
7.4 Data rejection.....	19
7.5 Data correction.....	19
7.6 Database.....	19
8 Derived results	20
8.1 Data normalization	20
8.2 Determination of the measured power curve.....	21
8.3 Annual energy production (<i>AEP</i>)	21
8.4 Power coefficient.....	22
9 Reporting format.....	23
Annex A (normative) Assessment of obstacles at the test site.....	33
Annex B (normative) Assessment of terrain at the test site	36
Annex C (normative) Site calibration procedure	37
Annex D (normative) Evaluation of uncertainty in measurement.....	39
Annex E (informative) Theoretical basis for determining the uncertainty of measurement using the method of bins	41
Annex G (normative) Mounting of instruments on the meteorological mast.....	66
Annex H (normative) Power performance testing of small wind turbines.....	74
Annex I (normative) Classification of anemometry.....	77
Annex J (informative) Assessment of cup anemometry	79
Annex K (informative) In situ comparison of anemometers	88
Bibliography.....	90

Figure 1 – Requirements as to distance of the meteorological mast and maximum allowed measurement sectors.....	15
Figure 2 – Presentation of example database A and B: power performance test scatter plots sampled at 1 Hz (mean values averaged over 10 min).....	26
Figure 3 – Presentation of example measured power curve for databases A and B.....	27
Figure 4 – Presentation of example C_p curve for databases A and B.....	28
Figure 5 – Presentation of example site calibration (only the sectors 20° to 30°, 40° to 60°, 160° to 210° and 330° to 350° are valid sectors).....	29
Figure A.1 – Sectors to exclude due to wakes of neighbouring and operating wind turbines and significant obstacles	34
Figure A.2 – An example of sectors to exclude due to wakes of the wind turbine under test, a neighbouring and operating wind turbine and a significant obstacle.....	35
Figure B.1 – Illustration of area to be assessed, top view.....	36
Figure G.1 – Example of a top-mounted anemometer and requirements for mounting	66
Figure G.2 – Example of alternative top-mounted primary and control anemometers positioned side-by-side and wind vane and other instruments on the boom.....	67
Figure G.3 – Example of a top-mounted anemometer and mounting of control anemometer, wind vane and other sensors on a boom.....	68
Figure G.4 – Example of top-mounted primary and control anemometers positioned side-by-side, wind vane and other instruments on the boom	69
Figure G.5 – Iso-speed plot of local flow speed around a cylindrical mast, normalised by free-field wind speed (from the left); analysis by 2 dimensional Navier-Stokes computations	70
Figure G.6 – Centre-line relative wind speed as a function of distance R from the centre of a tubular mast and mast diameter d	70
Figure G.7 – Representation of a three-legged lattice mast showing the centre-line wind speed deficit, the actuator disc representation of the mast with the leg distance L and distance R from the centre of the mast to the point of observation.....	71
Figure G.8 – Iso-speed plot of local flow speed around a triangular lattice mast with a C_T of 0,5 normalised by free-field wind speed (from the left); analysis by 2 dimensional Navier-Stokes computation and actuator disc theory	72
Figure G.9 – Centre-line relative wind speed as a function of distance R from the centre of a triangular lattice mast of face width L for various C_T values.....	72
Figure J.1 – Measured angular response of a cup anemometer compared to cosine response.....	79
Figure J.2 – Wind tunnel torque measurements on a cup anemometer at 8 m/s	80
Figure J.3 – Example of bearing friction torque measurements	81
Figure J.4 – Distribution of vertical wind speed components assuming a fixed ratio between horizontal and vertical standard deviation in wind speed.....	82
Figure J.5 – Calculation of the total deviation with respect to the cosine response.....	83
Figure J.6 – Probability distributions for three different average angles of inflow.....	84
Figure J.7 – Total deviation from cosine response for three different average angles of inflow over horizontal turbulence intensity.....	84
Figure J.8 – Example of an anemometer that does not fulfil the slope criterion	85
Figure J.9 – Example of deviations of a Class 2.0A cup anemometer.....	87

Table 1 – Example of presentation of a measured power curve for database A	30
Table 2 – Example of presentation of a measured power curve for database B	31
Table 3 – Example of presentation of estimated annual energy production (database A).....	32
Table 4 – Example of presentation of estimated annual energy production (database B).....	32
Table B.1 – Test site requirements: topographical variations	36
Table D.1 – List of uncertainty components	40
Table E.1 – Expanded uncertainties	43
Table E.2 – List of categories B and A uncertainties	45
Table E.3 – Uncertainties from site calibration	53
Table E.4 – Sensitivity factors (database A).....	54
Table E.5 – Sensitivity factors (database B).....	55
Table E.6 – Category B uncertainties (database A).....	56
Table E.7 – Category B uncertainties (database B).....	57
Table F.1 – Example of evaluation of anemometer calibration uncertainty.....	62
Table G.1 – Estimation method for C_T for various types of lattice tower.....	73
Table H.1 – Battery bank voltage settings	76
Table I.1 – Influence parameter ranges (based on 10 min averages) of Classes A and B.....	78

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND TURBINES –

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 turbines.

This standard cancels and replaces IEC 61400-12 published in 1998. This first edition of IEC 61400-12-1 constitutes a technical revision. IEC 61400-12-2 and IEC 61400-12-3 are additions to IEC 61400-12-1.

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

FDIS	Report on voting
88/244/FDIS	88/251/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.

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IEC 61400-12 consists of the following parts, under the general title *Wind turbines*:

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

Part 12-2: Verification of power performance of individual wind turbines (under consideration)

Part 12-3: Wind farm power performance testing (under consideration)

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 standard may be issued at a later date.

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 wind turbine manufacturer striving to meet well-defined power performance requirements and/or a possible declaration system;
- a wind turbine purchaser in specifying such performance requirements;
- a wind turbine operator who may be required to verify that stated, or required, power performance specifications are met for new or refurbished units;
- a wind turbine planner or regulator who must 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 standard provides guidance in the measurement, analysis, and reporting of power performance testing for wind turbines. The standard 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 environmental concerns. This standard 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, and from the chosen criteria for data selection. 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 standard prescribes the use of cup anemometers to measure the wind speed. This instrument is robust and has long been regarded as suitable for this kind of test. Even though suitable wind tunnel calibration procedures are adhered to, the field flow conditions associated with the fluctuating wind vector, both in magnitude and direction, will cause different instruments to potentially perform differently.

Tools and procedures to classify cup anemometers are given in Annexes I and J. However there will always be a possibility that the result of the test can be influenced by the selection of the wind speed instrument. Special care should therefore be taken in the selection of the instruments chosen to measure the wind speed.

WIND TURBINES –

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

1 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 turbines at specific locations, but equally the methodology can be used to make generic comparisons between different turbine models or different turbine settings.

The wind turbine power performance characteristics are determined by the measured power curve and the estimated annual energy production (*AEP*). The measured power curve is determined by collecting simultaneous measurements of wind speed and 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.

The standard 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.

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 60044-1:1996, *Instrument transformers – Part 1: Current transformers*
Amendment 1 (2000)
Amendment 2 (2002)¹

IEC 60688:1992, *Electrical measuring transducers for converting a.c. electrical quantities to analogue or digital signals*
Amendment 1 (1997)
Amendment 2 (2001)²

IEC 61400-2:1996, *Wind turbine generator systems – Part 1: Safety of small wind turbines*

ISO 2533:1975, *Standard atmosphere*

ISO Guide to the expression of uncertainty in measurement, 1995, ISBN 92-67-10188-9

¹ There exists a consolidated edition 1.2 (2003) that includes edition 1 and its amendments 1 and 2.