

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Wind energy generation systems –
Part 50: Wind measurement – Overview**

**Systèmes de génération d'énergie éolienne –
Partie 50: Mesurage du vent – Vue d'ensemble**



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2022 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC - webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Wind energy generation systems –
Part 50: Wind measurement – Overview**

**Systèmes de génération d'énergie éolienne –
Partie 50: Mesurage du vent – Vue d'ensemble**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 27.180

ISBN 978-2-8322-5600-8

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Symbols, units and abbreviated terms	7
5 Wind measurement overview	8
6 Interfaces between standards	9
Bibliography.....	12
Figure 1 – Overview of relationship between standards in the IEC 61400-12 and IEC 61400-50 series	10
Table 1 – IEC 61400 series parts which make reference to wind measurements previously defined in IEC 61400-12-1	11

a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WIND ENERGY GENERATION SYSTEMS –**Part 50: Wind measurement – Overview****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.
- 2) The formal decisions or agreements of 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 IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 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.

IEC 61400-50 has been prepared by IEC technical committee 88: Wind energy generation systems. It is an International Standard.

This first edition of IEC 61400-50 is part of a structural revision that cancels and replaces the performance standards IEC 61400-12-1:2017 and IEC 61400-12-2:2013. The structural revision contains no technical changes with respect to IEC 61400-12-1:2017 and IEC 61400-12-2:2013, but the parts that relate to wind measurements, measurement of site calibration and assessment of obstacle and terrain have been extracted into separate standards.

The purpose of the re-structure was to allow the future management and revision of the power performance standards to be carried out more efficiently in terms of time and cost and to provide a more logical division of the wind measurement requirements into a series of separate standards which could be referred to by other use-case standards in the IEC 61400 series and subsequently maintained and developed by appropriate experts.

The text of this International Standard is based on the following documents:

Draft	Report on voting
88/827/CDV	88/863/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

IMPORTANT – The "colour inside" logo on the cover page of this document 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 the IEC 61400-50 series of standards is to provide uniform methodologies and requirements that will ensure consistency, accuracy and reproducibility in the measurement of the wind. In creating the IEC 61400-50 series of standards, a distinction is now made between the method of measurement of the wind and the various "use-cases" in other parts of IEC 61400 in which those wind measurements are applied (e.g. power performance, noise measurement, load measurement, resource assessment). It is anticipated that the IEC 61400-50 series of standards will be applied by:

- a) wind turbine manufacturers testing prototype or serial production turbines with the aim of determining or verifying aspects of the turbine specification where the measured wind is a necessary input (e.g. power performance, noise, structural loads);
- b) wind measurement equipment manufacturers providing instruments, meteorological masts and mounting hardware to the wind industry;
- c) organizations and laboratories providing wind measurement instrumentation calibration services;
- d) technical consultants delivering wind measurement services to wind turbine manufacturers, wind farm developers and operators, etc.;
- e) wind turbine operators who need to verify that stated or required specifications are met and which require wind measurements as an input;
- f) other committees developing standards in the IEC 61400 series which make reference to the specification of equipment and methods to be used in the measurement of the wind.

This series of related standards provides guidance in the wind measurement methods, equipment, classification, calibration and uncertainty assessment that can be used in the delivery of various use-case tests. The standards will benefit those parties involved in the manufacture, installation planning and permitting, operation, utilization, and regulation of wind turbines. The technically accurate measurement techniques recommended in these standards 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 measurement. These standards present measurement, classification and calibration procedures expected to provide accurate results that can be replicated by others. Meanwhile, a user of these standards needs to be aware that not all wind measurement methods specified in these standards are applicable to all use-cases. The use-case standards (e.g. power performance) define which wind measurement methods and equipment are allowable and in which circumstances. Furthermore, the use-case standards may define further restrictions on the wind measurements (e.g. height of measurement). Therefore, a user should consider the most appropriate wind measurement method and standard in relation to the use-case to which the wind measurements are to be put before procuring the wind measurements.

The separated standards in the wind measurement series comprise:

- a) IEC 61400-50, *Wind energy generation systems – Part 50: Wind measurement – Overview*
- b) IEC 61400-50-1, *Wind energy generation systems – Part 50-1: Wind measurement – Application of meteorological mast, nacelle and spinner mounted instruments*
- c) IEC 61400-50-2, *Wind energy generation systems – Part 50-2: Wind measurement – Application of ground-mounted remote sensing technology*
- d) IEC 61400-50-3, *Wind energy generation systems – Part 50-3: Use of nacelle-mounted lidars for wind measurements*

Procedures for calibration, classification, mounting and derivation of the measurement uncertainty of cup anemometers and ultrasonic anemometers are given in IEC 61400-50-1. Procedures for calibration, classification and derivation of the measurement uncertainty of remote sensing devices are given in IEC 61400-50-2. Special care should be taken in the selection of the instruments and methods chosen to measure the wind because it can influence the result of the test.

WIND ENERGY GENERATION SYSTEMS –

Part 50: Wind measurements – Overview

1 Scope

The IEC 61400 series of standards addresses wind energy generation technical requirements up to the point of interconnection with the utility grid system. The IEC 61400-50 series of standards comprises a sub-set of standards which specify the requirements for equipment and methods to be used in the measurement of the wind.

Wind measurements are required as inputs to various tests and analyses specified in other use-case standards in the IEC 61400 series (e.g. power performance, resource assessment, noise measurement). Whereas those other standards define use-cases for wind measurements, the IEC 61400-50 series sets those wind measurement requirements which are independent of the use-case. Its purpose is to ensure that wind measurements and the evaluation of uncertainties in those measurements are carried out consistently across the wind industry and that wind measurements are carried out such that the uncertainties can be quantified and that those uncertainties are within an acceptable range.

This document provides a general introduction to the options that are available for wind measurement, which are further detailed in the other parts of the IEC 61400-50 series.

2 Normative references

There are no normative references in this document.

3 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

complex terrain

terrain surrounding the test site that features significant variations in topography and terrain obstacles that can cause flow distortion

3.2

cut-in wind speed

lowest wind speed at which a wind turbine will begin to produce power

3.3

cut-out wind speed

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

3.4

data set

collection of data sampled over a continuous period