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Edition 1.0 2015-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Wind turbines –
Part 13: Measurement of mechanical loads

Éoliennes –
Partie 13: Mesurage des charges mécaniques

IEC 61400-13:2015-12(en-fr)

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WIND TURBINES –

Part 13: Measurement of mechanical loads

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.

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This International Standard IEC 61400-13 has been prepared by IEC technical committee 88: Wind turbines.

This standard replaces IEC TS 61400-13 published in 2001. This first edition constitutes a technical revision and transition from technical specification to International Standard.

This first edition includes the following changes with respect to the technical specification:

a) scope of the document focused to load measurements for the purpose of model validation;
b) number of measurement load cases to match the new scope reduced;
c) capture matrix requirements to match the new scope reduced;
d) requirements to address the state of the art technology updated.

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

CDV	Report on voting
88/511/CDV	88/554/RVC

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.

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

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.

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INTRODUCTION

In the process of structural design of a wind turbine, thorough understanding about, and accurate quantification of, the loading is of utmost importance.

In the design stage, loads can be predicted with aeroelastic models and codes. However, such models have their shortcomings and uncertainties, and they always need to be validated by measurement.

Mechanical load measurements can be used both as the basis for design and as the basis for certification. Design aspects for wind turbines are covered by IEC 61400-1 whilst certification procedures are described in IEC 61400-22. This standard is aimed at the test institute, the turbine manufacturer and the certifying body and clearly defines the minimum requirements for a mechanical loads test resulting in consistent, high quality reproducible test results.

WIND TURBINES –

Part 13: Measurement of mechanical loads

1 Scope

This part of the IEC 61400 describes the measurement of fundamental structural loads on wind turbines for the purpose of the load simulation model validation. The standard prescribes the requirements and recommendations for site selection, signal selection, data acquisition, calibration, data verification, measurement load cases, capture matrix, post-processing, uncertainty determination and reporting. Informative annexes are also provided to improve understanding of testing methods.

The methods described in this document can also be used for mechanical loads measurements for other purposes such as obtaining a measured statistical representation of loads, direct measurements of the design loads, safety and function testing, or measurement of component loads. If these methods are used for an alternative objective or used for an unconventional wind turbine design, the required signals, measurement load cases, capture matrix, and post processing methods should be evaluated and if needed adjusted to fit the objective.

These methods are intended for onshore electricity-generating, horizontal-axis wind turbines (HAWTs) with rotor swept areas of larger than 200 m^2. However, the methods described may be applicable to other wind turbines (for example, small wind turbines, ducted wind turbines, vertical axis wind turbines).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at <http://www.electropedia.org/>)

IEC 61400-1:2005, *Wind turbines – Part 1: Design requirements*

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

ISO/IEC Guide 98-3, *Uncertainty of measurement – Part 3: Guide to the expression of uncertainty in measurement*

3 Terms and definitions

For the purposes of this document, the terms and definitions related to wind turbine systems or wind energy in general of IEC 60050-415 as well as the following apply.

3.1
blade
rotating aerodynamically active part of the rotor

3.2
blade root
that part of the blade that is connected to the hub of the rotor

3.3
brake status
status indicating if the brake is applied or not

3.4
calibration
determination of the transfer function and its coefficients from sensor output to the physical value

3.5
capture matrix
organization of the measured time series according to their mean wind speeds and turbulence intensities

3.6
chord line
imaginary straight line that joins the leading and trailing edges of a blade airfoil cross-section

3.7
cut-in wind speed
lowest wind speed at hub height at which the wind turbine starts to produce power in the case of steady wind without turbulence

3.8
cut-out wind speed
highest wind speed at hub height at which the wind turbine is designed to produce power in the case of steady wind without turbulence

3.9
design loads
loads that the turbine is designed to withstand

Note 1 to entry: They are obtained by applying the appropriate partial load factors to the characteristic values.

3.10
edgewise
direction that is parallel to the local chord

Note 1 to entry: In contrast, lead lag is the direction that is parallel to the plane of the swept surface and perpendicular to the longitudinal axis of the undeformed rotor blade.

3.11
flatwise
direction that is perpendicular to the local chord, and spanwise blade axis

Note 1 to entry: In contrast, flapwise is the direction that is perpendicular to the surface swept by the undeformed rotor blade axis.

3.12
hub
fixture for attaching the blades or blade assembly to the main shaft

3.13
nacelle
housing which contains the drive train and other equipment on the top of a HAWT tower

3.14
natural frequency
eigenfrequency
frequency at which a structure will choose to vibrate when perturbed and allowed to vibrate freely

3.15
outboard
towards the blade tip

3.16
parked wind turbine
depending on the design of the wind turbine, parked refers to the turbine being either in a standstill or an idling condition

3.17
rated power
quantity of power assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment

Note 1 to entry: Maximum continuous electrical power output which a wind turbine is designed to achieve under normal operating and external conditions.

3.18
rated wind speed
minimum wind speed at hub height at which a wind turbine's rated power is achieved in the case of steady wind without turbulence

3.19
reference wind speed
basic parameter for wind speed used for defining wind turbine classes

Note 1 to entry: Other design related climatic parameters are derived from the reference wind speed and other basic wind turbine class parameters.

Note 2 to entry: A turbine designed for a wind turbine class with a reference wind speed v_{ref}, is designed to withstand climates for which the extreme 10 min average wind speed with a recurrence period of 50 years at turbine hub height is lower than or equal to v_{ref}.

3.20
rotor centre
point on the main shaft in the plane perpendicular to the main shaft that contains the blade co-ordinate origin of the reference blade

3.21
rotor plane
plane perpendicular to the main shaft and which includes the rotor centre

3.22
steady-state operation
state of operation of the turbine during which it remains in a steady state such as during power production, power production + fault condition and when parked and for which the external conditions remain essentially steady

3.23
transient event
event during which the state of operation of the wind turbine changes, such as during shutdown