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Part 1: Design requirements

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Edition 4.0 2019-02

WIND ENERGY GENERATION SYSTEMS –

Part 1: Design requirements

INTERPRETATION SHEET 1

This interpretation sheet has been prepared by IEC technical committee 88: Wind energy generation systems.

The text of this interpretation sheet is based on the following documents:

DISH	Report on voting
88/1065/DISH	88/1078/RVDISH

Full information on the voting for the approval of this interpretation sheet can be found in the report on voting indicated in the above table.

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Question 1:

Subclause 6.4.2 mentions normal other environmental conditions that shall be taken into account and, specifically speaking, an ambient temperature range of –10 °C to +40 °C. Does this mean that the wind turbines shall be designed to operate at rated power up to 40 °C on the maximum limit, or does it mean that the wind turbine can be designed to operate at any maximum temperature limit below 40 °C, let's assume 35 °C or 32 °C, etc. ?

Answer 1:

The standard requires that turbines designed to one of the design classes stated in Table 1 in Subclause 6.2 be capable of operating and generating at temperatures up to +40 °C. There is no requirement that the turbine shall generate maximum rated power at +40 °C.

IEC 61400-1:2019-02/ISH1:2025-02(en-fr)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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Wind energy generation systems - Part 1: Design requirements

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 consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 61400-1 edition 4.1 contains the fourth edition (2019-02) [documents 88/696/FDIS and 88/701/RVD], its corrigendum 1 (2019-09) and its interpretation sheet 1 (2025-02), and its amendment 1 (2025-12) [documents 88/1109/FDIS and 88/1133/RVD].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

International Standard IEC 61400-1 has been prepared by IEC technical committee 88: Wind energy generation systems.

This fourth edition cancels and replaces the third edition published in 2005 and Amendment 1:2010. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) general update and clarification of references and requirements;
b) extension of wind turbine classes to allow for tropical cyclones and high turbulence;
c) Weibull distribution of turbulence standard deviation for normal turbulence model (NTM);
d) updated design load cases (DLCs), in particular DLC 2.1 and 2.2;
e) revision of partial safety factor specifications;
f) major revision of Clauses 8, 10 and 11;
g) introduction of cold climate requirements, Clause 14;
h) new Annex B on design load cases for site-specific or special class S wind turbine design or site suitability assessment;
i) new Annex J on prediction of the extreme wind speed of tropical cyclones by using Monte Carlo simulation method;
j) new Annex K on calibration of structural material safety factors and structural design assisted by testing;
k) new Annex L on assessment and effects of icing climate;
l) new Annex M on medium wind turbines.

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

FDIS	Report on voting
88/696/FDIS	88/701/RVD

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

The committee has decided that the contents of this document and its amendment 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, or
– revised.

INTRODUCTION

This part of IEC 61400 outlines minimum design requirements for wind turbines and is not intended for use as a complete design specification or instruction manual.

Any of the requirements of this document may be altered if it can be suitably demonstrated that the safety of the system is not compromised. This provision, however, does not apply to the classification and the associated definitions of external conditions in Clause 6. Compliance with this document does not relieve any person, organization, or corporation from the responsibility of observing other applicable regulations.

This document is not intended to give requirements for wind turbines installed offshore, in particular for the support structure. For offshore installations, reference is made to the IEC 61400-3 series.

1 Scope

This part of IEC 61400 specifies essential design requirements to ensure the structural integrity of wind turbines. Its purpose is to provide an appropriate level of protection against damage from all hazards during the planned lifetime.

This document is concerned with all subsystems of wind turbines such as control and protection functions, internal electrical systems, mechanical systems and support structures.

This document applies to wind turbines of all sizes. For small wind turbines, IEC 61400-2 can be applied. IEC 61400-3-1 provides additional requirements to offshore wind turbine installations.

This document is intended to be used together with the appropriate IEC and ISO standards mentioned in Clause 2.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60034 (all parts), *Rotating electrical machines*

IEC 60038, *IEC standard voltages*

IEC 60071-1, *Insulation co-ordination – Part 1: Definitions, principles and rules*

IEC 60071-2, *Insulation co-ordination – Part 2: Application guidelines*

IEC 60076 (all parts), *Power transformers*

IEC 60204-1, *Safety of machinery – Electrical equipment of machines – Part 1: General requirements*

IEC 60204-11:2000, *Safety of machinery – Electrical equipment of machines – Part 11: Requirements for HV equipment for voltages above 1 000 V AC or 1 500 V DC and not exceeding 36 kV*

IEC 60364 (all parts), *Low voltage electrical installations*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 60664-1, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

IEC 60664-3, *Insulation coordination for equipment within low-voltage systems – Part 3: Use of coating, potting or moulding for protection against pollution*

IEC 60721 (all parts), *Classification of environmental conditions*

IEC 61000-6-2, *Electromagnetic compatibility (EMC) – Part 6-2: Generic standards – Immunity standard for industrial environments*

~~IEC 61400-3, *Wind turbines – Part 3: Design requirements for offshore wind turbines*~~

IEC 61400-3-1, *Wind energy generation systems - Part 3-1: Design requirements for offshore wind turbines*

IEC 61400-4, *Wind Turbines – Part 4: Design requirements for wind turbine gearboxes*

IEC 61400-6, *Wind energy generation systems - Part 6: Tower and foundation design requirements*

IEC 61400-24, *Wind turbines – Part 24: Lightning protection*

IEC 61439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 61800-4, *Adjustable speed electrical power drive systems – Part 4: General requirements – Rating specifications for AC power drive systems above 1 000 V AC and not exceeding 35 kV*

IEC 61800-5-1, *Adjustable speed electrical power drive systems – Part 5-1: Safety requirements – Electrical, thermal and energy*

IEC 62271 (all parts), *High-voltage switchgear and controlgear*

IEC 62305-3, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

IEC 62305-4, *Protection against lightning – Part 4: Electrical and electronic systems within structures*

IEC 62477-1:2012, *Safety requirements for power electronic converter systems and equipment – Part 1: General*

ISO 76, *Rolling bearings – Static load ratings*

ISO 281, *Rolling bearings – Dynamic load ratings and rating life*

ISO 2394, *General principles on reliability for structures*

ISO 2533, *Standard Atmosphere*

ISO 4354, *Wind actions on structures*

ISO 6336-2, *Calculation of load capacity of spur and helical gears – Part 2: Calculation of surface durability (pitting)*

ISO 6336-3:2006, *Calculation of load capacity of spur and helical gears – Part 3: Calculation of tooth bending strength*

ISO 12494:2001, *Atmospheric icing on structures*

ISO 13850, *Safety of machinery – Emergency stop function – Principles for design*

ISO/TS 16281, *Rolling bearings – Methods for calculating the modified reference rating life for universally loaded bearings*

Bibliography

IEC 60146 (all parts), *Semiconductor converters*

IEC 60173:1964, *Colours of the cores of flexible cables and cords*

IEC 60227 (all parts), *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 60245 (all parts), *Rubber insulated cables – Rated voltages up to and including 450/750 V*

IEC 60269 (all parts), *Low-voltage fuses*

IEC 60287 (all parts), *Electric cables – Calculation of the current rating*

IEC 60439 (all parts), *Low-voltage switchgear and controlgear assemblies*

IEC 60446:2007, *Basic and safety principles for man-machine interface, marking and identification – Identification of conductors by colours or alphanumerics*

IEC 60617, *Graphical symbols for diagrams* (available at http://std.iec.ch/iec60617)

IEC 60755, *General requirements for residual current-operated protective devices*

IEC 60898 (all parts), *Electrical accessories – Circuit-breakers for overcurrent protection for household and similar installations*

IEC 61000-6-1, *Electromagnetic compatibility (EMC) – Part 6-1: Generic standards – Immunity standard for residential, commercial and light-industrial environments*

IEC 61000-6-4, *Electromagnetic compatibility (EMC) – Part 6-4: Generic standards – Emission standard for industrial environments*

IEC 61310-1:2007, *Safety of machinery – Indication, marking and actuation – Part 1: Requirements for visual, acoustic and tactile signals*

IEC 61310-2:2007, *Safety of machinery – Indication, marking and actuation – Part 2: Requirements for marking*

IEC 61400-2, *Wind turbines – Part 2: Small wind turbines*

~~IEC 61400-3-1, *Wind turbines – Part 3-1: Design requirements for fixed offshore wind turbines*[61]~~

IEC TS 61400-3-2, *Wind energy generation systems - Part 3-2: Design requirements for floating offshore wind turbines*

~~IEC 61400-6, *Wind turbines – Part 6: Tower and foundation design requirements*[62]~~

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

~~[61] Under preparation. Stage at the time of publication: IEC CDV 61400-3-1:2017.~~

~~[62] Under preparation. Stage at the time of publication: IEC CDV 61400-6:2017.~~

IEC 61400-13, *Wind turbines – Part 13: Measurement of mechanical loads*

IEC 61400-21, *Wind turbines – Part 21: Measurement and assessment of power quality characteristics of grid connected wind turbines*

IEC 61508 (all parts), *Functional safety of electrical/electronic/programmable electronic safety-related systems*

IEC 61508-1:2010, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 1: General requirements*

IEC 61508-6, *Functional safety of electrical/electronic/programmable electronic safety-related systems – Part 6: Guidelines on the application of IEC 61508-2 and IEC 61508-3*

IEC 62061:2005, *Safety of machinery – Functional safety of safety-related electrical, electronic and programmable electronic control systems*
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