BS EN IEC 61400-15-1:2025

BSI Standards Publication

Wind energy generation systems

Part 15-1: Site suitability input conditions for wind power plants

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National foreword

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The UK participation in its preparation was entrusted to Technical Committee PEL/88, Wind turbines.

A list of organizations represented on this committee can be obtained on request to its committee manager.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN IEC 61400-15-1

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English Version

Wind energy generation systems - Part 15-1: Site suitability input conditions for wind power plants (IEC 61400-15-1:2025)

Systèmes de génération d'énergie éolienne - Partie 15-1: Conditions à remplir pour l'acceptabilité d'un site pour les centrales éoliennes (IEC 61400-15-1:2025)

Windenergieanlagen - Teil 15-1: Eingangsbedingungen für die Standorteignung von Windkraftwerken (IEC 61400-15-1:2025)

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European foreword

The text of document 88/1041/FDIS, future edition 1 of IEC 61400-15-1, prepared by TC 88 "Wind energy generation systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61400-15-1:2025.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2026-05-31
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2028-05-31

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Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: www.cencenelec.eu.

Publication	Year	Title	EN/HD	Year
IEC 61400-1	2019	Wind energy generation systems - Part 1: Design requirements	EN IEC 61400-1	2019
IEC 61400-3-1	2019	Wind energy generation systems - Part 3-1: Design requirements for fixed offshore wind turbines	EN IEC 61400-3-1	2019
IEC 61400-12-1	2022	Wind energy generation systems - Part 12-1: Power performance measurement of electricity producing wind turbines	EN IEC 61400-12-1	2022
ISO 2533	1975	Standard Atmosphere	-	-
ISO/IEC 21778	2017	Information technology - The JSON data interchange syntax	-	-
ISO/IEC 10646	2020	Information technology - Universal coded character set (UCS)	-	-
ISO 3166	-	Country codes	-	-

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND ENERGY GENERATION SYSTEMS –

Part 15-1: Site suitability input conditions for wind power plants

FOREWORD

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IEC 61400-15-1 has been prepared by IEC technical committee 88: Wind energy generation systems. It is an International Standard.

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

Draft	Report on voting
88/1041/FDIS	88/1064/RVD

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.

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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/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,
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- revised.

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INTRODUCTION

This part of IEC 61400 defines a framework for assessment and reporting of the site suitability/turbine suitability input conditions for both onshore and offshore (fixed and floating) power plants.

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WIND ENERGY GENERATION SYSTEMS –

Part 15-1: Site suitability input conditions for wind power plants

1 Scope

The scope of this part of IEC 61400 is to define a framework for assessment and reporting of the site suitability/wind turbine suitability conditions for both onshore and offshore (fixed and floating) wind power plants. This includes:

a) definition, measurement, and prediction of the long-term meteorological and wind flow characteristics at the site;

b) integration of the long-term meteorological and wind flow characteristics with wind turbine and balance-of-plant characteristics;

c) characterizing environmental extremes and other relevant plant design drivers;

d) addressing documentation and reporting requirements to help ensure the traceability of the assessment processes.

The framework is defined such that applicable national norms are considered and industry best practices are utilized. This framework defines the minimum set of parameters. Additional parameters may be used if needed.

The meteorological and wind flow characteristics addressed in this document relate to wind conditions, where parameters such as wind speed, wind direction, turbulence intensity, wind shear, inflow angle, air density or air temperature are included to the extent that they affect the structural integrity of a wind turbine.

According to IEC 61400-1, IEC 61400-3-1 and IEC TS 61400-3-2, site specific conditions are wind conditions, marine conditions, other environmental conditions, soil conditions and electrical conditions. All of these site-specific conditions other than site specific wind conditions and related atmospheric variables addressed herein are out of scope for this document.

This document is framed to complement and support the scope of related IEC 61400 series by defining environmental input conditions. It is not intended to supersede the design and suitability requirements presented in those documents. Specific analytical and modelling procedures as described in IEC 61400-1, IEC 61400-2, IEC 61400-3-1 and IEC TS 61400-3-2 are excluded from the scope of this document.

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 61400-1:2019, *Wind energy generation systems – Part 1: Design requirements*

IEC 61400-3-1:2019, *Wind energy generation systems – Part 3-1: Design requirements for fixed offshore wind turbines*

IEC 61400-12-1:2022, *Wind energy generation systems – Part 12-1: Power performance measurements of electricity producing wind turbines*

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ISO 2533:1975, *Standard Atmosphere*

ISO/IEC 21778:2017, *Information technology – The JSON data interchange syntax*

ISO/IEC 10646:2020, *Information technology – Universal Coded Character Set (UCS)*

ISO 3166, *Country codes*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

NOTE All the below parameters are expected to represent the climate conditions over the design lifetime of the wind turbine and apply at hub height.

3.1
inflow angle
angle between a horizontal plane and the wind velocity vector at hub height

Note 1 to entry: The inflow angle is positive if the wind velocity vector is pointing upwards.

Note 2 to entry: Referred to as flow inclination angle in IEC 61400-1:2019.

3.2
turbulence intensity
TI
ratio of the wind speed standard deviation to the mean wind speed determined from the same set of measured wind speed data and taken over a period of 10 min and based on at least 1 Hz sampling frequency

3.3
mean ambient turbulence intensity
average of a subset of the turbulence intensities

Note 1 to entry: The subset typically represents a bin within a wind speed and wind direction matrix.

3.4
standard deviation of turbulence intensity
standard deviation of a subset of the turbulence intensities

Note 1 to entry: The subset typically represents a bin within a wind speed- and wind direction matrix.

3.5
associated data source
primary data source used to derive wind conditions for a given turbine location

Note 1 to entry: This can include, but is not limited to, meteorological towers, remote sensing devices, production data or model data.

3.6
number of samples
number of data points which form the basis of the associated parameter value

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3.7
mean wind shear exponent
wind shear (or power law) exponent as defined in IEC 61400-1:2019 and estimated across the rotor swept area

3.8
average turbulence intensity at 15 m/s
mean ambient turbulence intensity over all wind directions in the 15 m/s wind speed bin

Note 1 to entry: Bin width is defined as 14,5 to 15,5 m/s.

3.9
annual mean ambient temperature
annual mean ambient temperature at the site

3.10
annual wind frequency distribution
annual distribution of occurrences as a function of wind direction and/or wind speeds

3.11
Weibull distribution
probability distribution function

3.12
coefficient of variation
standard deviation divided by the mean value

3.13
extreme ambient turbulence intensity
extreme ten minute value of the ambient turbulence intensity with a return period of 50 years as a function of wind speed

3.14
omni-directional
one value describing all direction sectors

3.15
surface roughness
texture of the surface topography that is irregular (not smooth) due to the soil surface and/or the presence of vegetation and obstacles such as built-up areas

3.16
site suitability/turbine suitability
given combination of site conditions and turbine properties impacting structural integrity

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4 Symbols, units and abbreviated terms

4.1 Symbols and units

φ	annual mean inflow angle	[deg]
TI	mean ambient turbulence intensity as defined in 3.8	[-]
σ_σ	standard deviation of estimated wind speed standard deviation	[m/s]
α	mean wind shear (or power law) exponent	[-]
α_{eff}	effective wind shear exponent	[-]
d	displacement height	[m]
D	rotor diameter	[m]
z_{hub}	hub height	[m]
V_{50}	extreme wind speed (averaged over 10 min) with a recurrence interval of 50 years	[m/s]
V_{e50}	expected extreme wind speed (averaged over 3 s), with a recurrence time interval of 50 years	[m/s]
ρ	air density	[kg/m^3]
V_{ave}	annual mean wind speed at hub height	[m/s]
C	scale parameter of the Weibull distribution function	[m/s]
k	shape parameter of the Weibull distribution function	[-]
C_{CT}	turbulence structure correction parameter	[-]
P	air pressure	[hPa]
T	air temperature	[°C]
V_{xy}	horizontal component of wind speed	[m/s]
V_{z}	vertical component of wind speed	[m/s]
RH	relative humidity	[%]

4.2 Abbreviated terms

BOM Byte Order Mark
CFD Computational Fluid Dynamics
COV Coefficient of Variation
GEV Generalized Extreme Value Distribution
GPD Generalized Pareto Distribution
MCP Measure Correlate Predict
MIS Method of Independent Storms
NWP Normal Wind Profile Model
POT Peak-Over-Threshold
TI Turbulence Intensity
WS Wind Speed

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