# SLOVENSKI STANDARD
# SIST ENV 61400-1:1999

**01-april-1999**

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**Sistemi generatorjev vetrne turbine – 1. del: Varnostne zahteve (IEC 61400-1:1994)**

Wind turbine generator systems -- Part 1: Safety requirements

Windenergieanlagen -- Teil 1: Sicherheitsanforderungen

Aérogénérateurs -- Partie 1: Spécifications de sécurité



**Ta slovenski standard je istoveten z:** **ENV 61400-1:1995**

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**ICS:**

| | | |
|---|---|---|
| 27.180 | Sistemi turbin na veter in drugi alternativni viri energije | Wind turbine systems and other alternative sources of energy |

**SIST ENV 61400-1:1999** **en**

EUROPEAN PRESTANDARD
PRÉNORME EUROPÉENNE
EUROPÄISCHE VORNORM

# ENV 61400-1

February 1995

ICS 27.180

Descriptors: Wind turbine generator systems, specifications, safety, design, quality assurance, environments, installation, assembling, maintenance

English version

# Wind turbine generator systems
# Part 1: Safety requirements
# (IEC 1400-1:1994)

Aérogénérateurs
Partie 1: Spécifications de sécurité
(CEI 1400-1:1994)

Windturbogeneratorsysteme
Teil 1: Sicherheitsanforderungen
(IEC 1400-1:1994)



This European Prestandard (ENV) was approved by CENELEC on 1994-10-24 as a prospective standard for provisional application. The period of validity of this ENV is limited initially to three years. After two years the members of CENELEC will be requested to submit their comments, particularly on the question whether the ENV can be converted into a European Standard (EN).

CENELEC members are required to announce the existence of this ENV in the same way as for an EN and to make the ENV available promptly at national level in an appropriate form. It is permissible to keep conflicting national standards in force (in parallel to the ENV) until the final decision about the possible conversion of the ENV into an EN is reached.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC
European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung
**Central Secretariat: rue de Stassart 35, B - 1050 Brussels**

## Foreword

The text of document 88(CO)5, future edition 1 of IEC 1400-1, prepared by IEC TC 88, Wind turbine generator systems, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as ENV 61400-1 on 1994-12-06.

The following date was fixed:

- latest date by which the existence of the ENV has to be announced at national level (doa) 1995-02-15

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes A, B, C and ZA are normative and annex D is informative.
Annex ZA has been added by CENELEC.

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## Endorsement notice

The text of the International Standard IEC 1400-1:1994 was approved by CENELEC as a European Prestandard without any modification.

In the official version, for annex D "Bibliography", the following notes have to be added for the standards indicated:



IEC 34 NOTE: Harmonized as HD 53 / EN 60034 (modified).

IEC 173 NOTE: Harmonized as HD 27.S1:1974 (not modified).



IEC 269 NOTE: Part 1 harmonized as EN 60269-1 (not modified).

IEC 439 NOTE: Harmonized as EN 60439 (modified).

IEC 898 NOTE: Harmonized as EN 60898:1991 (modified).

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## ANNEX ZA (normative)

## OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE : When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

| IEC Publication | Date | Title | EN/HD | Date |
|---|---|---|---|---|
| 38 (mod) | 1983 | IEC Standard voltages* | HD 472 S1 | 1989 |
| 227 (mod) | series | Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V | HD 21 | series |
| 245 (mod) | series | Rubber insulated cables of rated voltages up to and including 450/750 V | HD 22 | series |
| 287 | 1982 | Calculation of the continuous current rating of cables (100 % load factor) | - | - |
| 364-5-54 (mod) | 1980 | Electrical installations of buildings Part 5: Selection and erection of electrical equipment Chapter 54: Earthing arrangements and protective conductors | HD 384.5.54 S1 | 1988 |
| 529 | 1989 | Degrees of protection provided by enclosures (IP Code) | EN 60529 | 1991 |
| 721-2-1 | 1982* | Classification of environmental conditions - Part 2: Environmental conditions appearing in nature Temperature and humidity | - | - |



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* The title of HD 472 S1 is: Nominal voltages for low voltage public electricity supply systems
IEC 721-2-1:1987 is harmonized as HD 478.2.1 S1:1989

| IEC Publication | Date | Title | EN/HD | Date |
|---|---|---|---|---|
| 1000 | series | Electromagnetic compatibility (EMC) | EN 61000 | series |
| 1024-1 (mod) | 1990 | Protection of structures against lightning - Part 1: General principles | ENV 61024-1 | 1995 |

Other publications:

ISO 2394:1986 - General principles on reliability for structures

ISO 9001:1987 - Quality systems - Model for quality assurance in design/ development, production, installation and servicing

ISO 9002:1987 - Quality systems - Model for quality assurance in production and installation

ISO 9003:1987 - Quality systems - Model for quality assurance in final inspection and test

# NORME INTERNATIONALE
# INTERNATIONAL STANDARD

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**IEC**
**1400-1**

Première édition
First edition
1994-12

## Aérogénérateurs –

## Partie 1:
Spécifications de sécurité



## Wind turbine generator systems –

## Part 1:
Safety requirements





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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# WIND TURBINE GENERATOR SYSTEMS –

# Part 1: Safety requirements

## FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. 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. The 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 the IEC on technical matters, prepared by technical committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.



3) They have the form of recommendations for international use published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.



5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.

International Standard IEC 1400-1 has been prepared by IEC technical committee 88: Wind turbine generator systems.

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

| DIS | Report on voting |
|---|---|
| 88(CO)5 | 88(CO)7 |

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

Annexes A, B and C form an integral part of this standard.

Annex D is for information only.

# INTRODUCTION

This part of IEC 1400 outlines minimum safety requirements for wind turbine generator systems and is not intended for use as a complete design specification or instruction manual.

Any of the requirements of this standard may be waived if it can be suitably demonstrated that the safety of the system is not compromised. Nevertheless, this waiver does not apply to clause 3.

Compliance with this standard does not relieve any person, organization, or corporation of the responsibility of observing other applicable regulations.

# WIND TURBINE GENERATOR SYSTEMS –

# Part 1: Safety requirements

## 1 General

### 1.1 Scope and object

This part of IEC 1400 deals with safety philosophy, quality assurance and engineering integrity, and specifies requirements for the safety of wind turbine generator systems (WTGS), including design, installation, maintenance, and operation under specified environmental conditions. Its purpose is to provide the appropriate level of protection against damage from all hazards from these systems during their planned lifetime.

This standard applies to WTGS with swept area equal to or larger than 40 m². This standard is also concerned with all sub-systems of WTGS such as control and protection mechanisms, internal electrical systems, mechanical systems, support structures, foundations and the electrical interconnection equipment.

This standard should be used together with the appropriate IEC/ISO standards.



### 1.2 Normative references



The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 1400. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1400 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 38: 1983, *IEC standard voltages*

IEC 227: *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V*

IEC 245: *Rubber insulated cables of rated voltages up to and including 450/750 V*

IEC 287: 1982, *Calculation of the continuous current rating of cables (100 % load factor)*

IEC 364: *Electrical installations of buildings*

IEC 364-5-54: 1980, *Electrical installations of buildings – Part 5: Selection and erection of electrical equipment – Chapter 54: Earthing arrangements and protective conductors*

IEC 529: 1989, *Degrees of protection provided by enclosures (IP Code)*

IEC 721-2-1 1982, *Classification of environmental conditions – Part 2: Environmental conditions appearing in nature – Temperature and humidity*

IEC 1000: *Electromagnetic compatibility (EMC)*

IEC 1024-1: 1990, *Protection of structures against lightning – Part 1: General principles*

ISO 2394: 1986, *General principles on reliability for structures*

ISO 9001: 1987, *Quality systems – Model for quality assurance in design/development, production, installation and servicing*

ISO 9002: 1987, *Quality systems – Model for quality assurance in production and installation*

ISO 9003: 1987, *Quality systems – Model for quality assurance in final inspection and test*

## 1.3 Definitions

For the purpose of this part of IEC 1400, the following definitions apply.



1.3.1 **annual average**: Mean value of a set of measured data of sufficient size and duration to serve as an estimate of the expected value of the quantity.

NOTE – The time period should be a whole number of years to average out non-stationary effects such as seasonality.



1.3.2 **annual average wind speed**: Wind speed averaged according to the definition of annual average.

1.3.3 **blocking** (wind turbines): Use of a mechanical pin or other device to prevent movement, for instance, of the rotor shaft or yaw mechanism.

1.3.4 **brake** (wind turbines): Device capable of reducing the rotor speed or stopping rotation.

1.3.5 **catastrophic failure** (wind turbines): Disintegration or collapse of a component or structure that results in loss of vital function which impairs safety.

1.3.6 **control system** (wind turbines): Sub-system that receives information about the condition of the wind turbine and/or its environment and adjusts the turbine in order to maintain it within its operating limits.

1.3.7 **cut-in wind speed** ($V_{in}$): Lowest wind speed at hub height at which the wind turbine starts to produce useable power (see hub height).

1.3.8 **cut-out wind speed** ($V_{out}$): Maximum wind speed at hub height at which the wind turbine is designed to produce useable power (see hub height).

1.3.9 **design limits**: Maximum or minimum values used in a design.

1.3.10 **dormant failure**: Failure of a component or system which remains undetected during normal operation.

1.3.11 **downwind**: In the main wind direction.

1.3.12 **electrical power network**: Particular installations, substations, lines or cables for the transmission and distribution of electricity.

NOTE – The boundaries of the different parts of this network are defined by appropriate criteria, such as geographical situation, ownership, voltage, etc.

1.3.13 **emergency shutdown** (wind turbines): Rapid shutdown of the wind turbine triggered by a protection system or by manual intervention.

1.3.14 **environmental conditions**: Those characteristics of the environment (altitude, temperature, humidity, etc.) which may affect performance.

1.3.15 **external conditions** (wind turbines): Factors affecting the operation of wind turbine including the wind regime and other climatic factors, i.e. snow, ice etc.

1.3.16 **extreme wind speed**: Highest average wind speed, averaged over $t$ s, that is likely to be experienced within a specified time period of $T$ years (recurrence period: $T$ years).



NOTE – In this standard recurrence periods of $T$ = 50 years and $T$ = 1 year and averaging times of $t$ = 3 s and $t$ = 10 min are used. In popular language the less precise term "survival wind speed" is often used. In this standard, however, the turbine is designed using the extreme wind speed for design load cases.



1.3.17 **fail-safe**: Design property of an item which prevents its failures from resulting in critical faults.

1.3.18 **gust**: Temporary change in the wind speed which may be characterized by its rise-time, its amplitude and its duration.

1.3.19 **horizontal axis wind turbine**: Wind turbine whose rotor axis is substantially parallel to the wind flow.

1.3.20 **hub** (wind turbine): Fixture for attaching the blades or blade assembly to the rotor shaft.

1.3.21 **hub height**: Height of the centre of the wind turbine rotor above the terrain surface. For a vertical axis wind turbine, the hub height is the height of the equator plane.

1.3.22 **idling** (wind turbines): Condition of a wind turbine generator that is rotating slowly and not producing power.

1.3.23 **inertial sub-range**: Frequency interval of the wind turbulence spectrum, where eddies, after attaining isotropy, undergo successive break-up with negligible energy dissipation.

NOTE – At a typical 10 m/s wind speed, the inertial sub-range is roughly from 0,02 Hz to 2 kHz.

1.3.24 **interconnection**: Single or multiple transmission link between transmission systems enabling electricity to be exchanged between these systems by means of circuits and/or transformers.

NOTE – (wind turbines) Electrical connection between a wind turbine generator system and a network in which energy can be transferred from the wind turbine to the network and vice versa.

1.3.25 **isolated operation**: Stable and temporary operation of a discrete part of a power system after network splitting.

1.3.26 **limit state**: State of a structure and the loads acting upon it beyond which the structure no longer satisfies the design requirement (see ISO 2394).

NOTE – The purpose of design calculations (i.e. the design requirement for the limit state) is to keep the probability of a limit state being reached below a certain value prescribed for the type of structure in question (see ISO 2394).

1.3.27 **logarithmic wind shear law**: See wind profile.

1.3.28 **maximum power** (wind turbines): Highest level of net electrical power delivered by a wind turbine in normal operation.

1.3.29 **mean wind speed**: Statistical mean of the instantaneous value of the wind speed averaged over a given time period which can vary from a few seconds to many years.



1.3.30 **nacelle**: Housing which contains the drive-train and other elements on top of a horizontal axis wind turbine tower.



1.3.31 **network connection point** (wind turbines): Low-voltage tap on the transformer of the wind turbine or the connection point to the electrical bus of the site facilities.

1.3.32 **parking brake** (wind turbines): Brake capable of preventing rotor movement.

1.3.33 **power collection system** (wind turbines): Electrical system that collects the power from a wind turbine, and feeds it into a network step-up transformer or into electrical loads.

1.3.34 **power law for wind shear**: See wind profile.

1.3.35 **power output**: Power delivered by a device in a specific form and for a specific purpose.

NOTE – (wind turbines) The electric power delivered by a WTGS.

1.3.36 **protection system** (wind turbines): System which ensures that a WTGS remains within the design limits.