

Vetrne turbine – Zaščitni ukrepi – Zahteve za načrtovanje, delovanje in vzdrževanje

Wind turbines - Protective measures - Requirements for design, operation and maintenance

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EUROPEAN STANDARD

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**Wind turbines –
Protective measures –
Requirements for design, operation and maintenance**

Aérogénérateurs –
Mesures de protection –
Exigences pour la conception,
le fonctionnement et la maintenance

Windenergieanlagen –
Schutzmaßnahmen –
Anforderungen für Konstruktion,
Betrieb und Wartung

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Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 88, Wind turbine systems. This standard concerning protective measures stands in conjunction with the set of European standards for wind turbines (EN 61400 series).

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50308 on 2004-03-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2005-03-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2007-03-01

This European Standard was prepared under a mandate given to CENELEC by the European Commission and the European Free Trade Association and supports the essential requirements of Directive 98/37/EC

NOTE Revision of this standard will be undertaken as soon as possible.

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Introduction

This European Standard has been prepared as a harmonised standard to provide a means of conforming to the essential safety requirements of the Machinery Directive and associated EFTA regulations. For the determination of the hazards described in this standard EN 1050 should be applied.

The machinery concerned and the extent to which hazards, hazardous situations and events are covered is indicated in Clause 1 (Scope).

This standard is a product (family) standard (according to EN 292-1) giving common requirements for the wind turbines mentioned in Clause 1 (Scope).

The document contains a standard part and an informative annex.

Annex A consists of national normative documents and/or regulations that specify either the present safety requirements for personnel or give the national supplements to these minimum requirements at the time this standard was prepared (January 2000).

The format of the standard is based, where possible, on a practical approach for

- manufacturers and designers who have to meet the requirements,
- authorities who have to check the design,
- owners who have legal responsibilities.

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1 Scope

This European Standard specifies requirements for protective measures relating to the health and safety of personnel, relevant to commissioning, operation and maintenance of wind turbines.

It does not describe instructions and provisions for safe working during manufacture, transport, assembly and installation of the wind turbine.

Requirements are specified regarding

- hardware provisions being a part of the turbine such as platforms, ladders, lighting,
- manuals and warning signs to accommodate safe and quick operation, inspection and maintenance.

The requirements and/or measures specified account for the hazards

- of mechanical origin such as falling, slipping, locking in,
- of thermal origin (fire) such as burns by flames or explosions,
- of electricity such as contact with live parts,
- generated by noise such as stress and loss of hearing,
- generated by neglecting ergonomic principles in machine design such as unhealthy postures or human errors.

This standard is prepared for horizontal axis, grid connected wind turbines. For other concepts (e.g. vertical axis turbines) the principles are still valid, but the specific rules or requirements have to be adjusted to the actual concept.

Additional provisions and procedures are necessary for turbines installed in water or offshore. The present document only draws attention to these.

Provisions and procedures for lifts and Suspended Access Equipment (SAE) in the turbine tower are not included in this standard.

This standard is not applicable to wind turbines manufactured before the date of its publication by CENELEC.

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 292-1		Safety of machinery - Basic concepts, general principles for design Part 1: Basic terminology, methodology
EN 292-2	1991	Part 2: Technical principles and specifications
EN 418		Safety of machinery - Emergency stop equipment, functional aspects Principles for design
EN 457	1992	Safety of machinery - Auditory danger signals General requirements, design and testing (ISO 7731:1986, mod.)
EN 547-1		Safety of machinery - Human body dimensions Part 1: Principles for determining the dimensions required for openings for whole body access into machinery

EN 547-3		Safety of machinery - Human body dimensions Part 3: Anthropometric data for whole body access into machinery and access openings
EN 563		Safety of machinery – Temperatures of touchable surfaces Ergonomics data to establish temperature limit values for hot surfaces
EN 795		Personal protective equipment against falls from a height Anchorage devices - Requirements and testing
EN 953		Safety of machinery – Guards – General requirements for the design and construction of fixed and movable guards
EN 981		Safety of machinery – System of auditory and visual danger information signals
EN 982		Safety of machinery - Safety requirements for hydraulic and pneumatic systems and parts - Hydraulics
EN 983		Safety of machinery - Safety requirements for hydraulic and pneumatic systems and parts - Pneumatics
EN 1037		Safety of machinery – Prevention of unexpected start up
EN 1050		Safety of machinery – Principles for risk assessment
ISO 4871	1996	Acoustics – Determination of sound power levels of noise sources using sound pressure – Engineering method in an essentially free field over a reflecting plane
EN ISO 11202	1995	Acoustics – Noise emitted by machinery and equipment – Measurement of emission sound pressure levels at a work station and at other specified positions – Survey method in situ
EN ISO 11688-1	1998	Acoustics – Recommended practice for the design of low-noise machinery and equipment - Part 1: Planning
EN ISO 14122-1	¹⁾	Safety of machinery Part 1: Permanent means of access to machines and industrial plants - Choice of a fixed means of access between two levels
EN ISO 14122-2	¹⁾	Part 2: Working platforms and gangways
EN ISO 14122-3	¹⁾	Part 3: Stairways, stepladders and guard-rails
EN ISO 14122-4	¹⁾	Part 4: Fixed ladders
EN 50160		Voltage characteristics of electricity supplied by public distribution systems
EN 50172		Emergency escape lighting systems
EN 50199		Electromagnetic compatibility (EMC) - Product standard for arc welding equipment
ENV 1070		Safety of machinery – Terminology
ENV 61400-1		Wind turbine generating systems - Part 1: Safety requirements
EN 61400-11	1998	Wind turbine generator systems – Part 11: Acoustic noise measurement techniques (IEC 61400-11:1998)
HD 472		Nominal voltages for low-voltage public electricity supply systems (IEC 60038, mod.)

3 Definitions – Terminology

For the purpose of this standard the definitions given in EN 292, ENV 61400-1 and EN ISO 4871 apply.

¹⁾ At draft stage.

4 Safety requirements and protective measures

4.1 General requirements

Wind turbines shall be designed according the principles of EN 292. The general principles to avoid risks to health and safety are laid down in Clause 5 of EN 292-1 (Strategy for selecting safety measures).

The initial design of wind turbines must take account of how risks to the health and safety of persons are to be minimised. Structural provisions include e.g. door-openings, access-openings, floors, platforms and railings, ladders with fall protection equipment, passages and working spaces, anchorage points and hand grips, lighting, guarding of moving parts, protection against electrical hazards, sound barriers, noise isolation or thermal isolation. Some of these provisions have an effect on the structural integrity of the turbine e.g. door openings, doorstep height, access openings.

The design shall include provisions for permanent safe access (ladders, platforms, anchorage points, lighting, etc.) to reach the locations for inspection and maintenance activities and to perform these activities safely. All items shall be safe during the turbine lifetime (providing that they are maintained according to the operator's instruction manual and maintenance manual for the turbine).

Accessible parts of the machinery shall have no sharp edges, no sharp angles and no rough surfaces likely to cause injury.

Normal control of the wind turbine shall be possible without ascending to the turbine nacelle.

Control panels shall be placed so that unintentional or erroneous operation is prevented. If a wind turbine has more than one control panel/unit, it shall only be possible to operate it from one panel/unit at a time. Where remote operation of a wind turbine is possible (e.g. via a modem link) a local control switch shall be available to cut off the remote mode and all other control systems in the turbine with the exception of any emergency stop.

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It shall be possible to block, vent, release or isolate/disconnect any stored or trapped energy that can cause risk during maintenance where parts of the turbine are powered by an energy source other than wind, such as

- electrical energy inside a capacitor bank or battery,
- mechanical energy inside a spring loaded system or brake system,
- hydraulic energy inside pressurised accumulators,
- gravity.

EN 982 shall be followed to release stored energy.

EN 1037 shall be followed to prevent unexpected start-up.

4.2 Passages

Doors, hatches, access and escape passages shall be in accordance with 6.0 of EN 292-2.

Dimensions are based on EN 547-1 and EN 547-3.

4.2.1 Access

All normal access points to wind turbines shall be equipped by the manufacturer with means to make the turbines inaccessible, so as to prevent unauthorised persons from gaining access. In particular, access to the control panel, the machinery and electrical parts of the wind turbine by unauthorised persons shall be prevented.

Access ways, passages, doors and climbing provisions shall be designed with personnel safety in mind. They shall not be obstructed by fixed auxiliary appliances, piping, wiring or by stored items.

Doors being the entrance to the turbine and/or to rooms with electrical switch gear (having an escape function) shall have

- provision of unobstructed passage at least 0,6 m wide, which may have rounded off corners,
- no sharp edges likely to cause injury,
- a (additionally installed) horizontal part to step on of at least 0,3 m wide,
- a platform or floor inside and outside with a difference of level of no more than 0,1 m,
- the capability of opening immediately, without the use of tools/keys,
- the capability to prevent persons from being locked inside,
- a door grip on both sides,
- the capability of being secured in the open position.

The lowest part of the doorsteps shall have a maximum height of 0,3 m above standing level and give a free opening height of 1,8 m minimum.

Nacelle covers that can be opened, doors and hatches affected by wind or gravity shall be capable of being secured in the open as well in the closed position. They shall be designed to be held securely open in wind speeds up to the maximum wind speed allowable for maintenance of the turbine, including allowance for gusts.

Foot supports and hand grips shall be available alongside any passage through a wall if no platform is installed there.

Hatch openings in a wall for entry by a person shall have a minimum free opening of 0,4 m x 0,6 m. In a floor they shall have a minimum free opening of 0,6 m x 0,6 m. If structurally governed, reduction to a size of 0,4 m x 0,6 m is permitted. Alternatively a trapezoidal shape is permitted. The corners of these openings may be rounded off.

Openings through floors and platforms shall have a hinged cover, which shall have two stable positions: open and closed.

4.2.2 Escape

An alternative escape route from the nacelle shall be available if the normal access route can be blocked (e.g. by fire). This alternative escape route shall be indicated by signs and be described in the user (safety) manual. The escape route shall be designed free of any obstructions. The means of escape can be a ladder or a descent device. An appropriate descent device shall be chosen for specific turbine types and heights. A device shall be fire proof enough to allow escape from the nacelle to the ground in the event of fire. It shall be suitable for the number of persons to be evacuated. Descent devices can be either permanently located in the turbine or brought by personnel.

An anchorage point shall be available for every descent device (see 4.5).

The escape route from working areas in front of electrical switch gear shall offer unobstructed passage according to the requirements in EN 50199.

Provision shall be made to evacuate an injured person from any room or area, including the nacelle, occupied for work or inspections.

The nacelle shall have an extra hatch to the outside apart from the normal entrance. It shall be possible to open this hatch from both inside and outside.

Hatches for the emergency descent of personnel shall be located to ensure easy evacuation. They must be designed not to present any risk of persons accidentally falling from the nacelle. The minimum dimensions shall be 0,6 m x 0,6 m. The corners in the passage opening may be rounded off. An anchorage point shall be provided near the emergency hatch.

4.3 Rooms / working areas

Rooms or areas where work or inspections have to be done shall fulfil the requirements of EN 547-1 and EN 547-3.

Auxiliary electrical connection points for light and power shall normally be provided in rooms or areas where work or inspections have to be done. Auxiliary power shall normally be available when the turbine itself is electrically isolated.

An operating room, a low voltage and a medium voltage switch room inside a tower shall be protected with a ceiling/floor directly above (medium voltage is 1 kV to 35 kV, according to EN 50160 and HD 472). If an operating room or a medium voltage room is equipped with electrical switch gear the working-space in front of the electrical cabinets shall be at least 0,75 m wide and 2,0 m high.

Measures shall be taken to avoid the build up of hazardous toxic, flammable or explosive gases in any areas of the wind turbine. If a power transformer is installed these measures shall include sealing arrangements of the transformer room or the provision of adequate ventilation, also in the situation of a grid loss.

Provisions shall be made to store in a safe and secure way any specialist working equipment, safety equipment and/or manuals that have to be available in a turbine, including – where appropriate – by means of adequate ventilation, detection or protection.

4.4 Floors, platforms, standing-, working places

Platforms, working places and standing places shall be in accordance with EN ISO 14122-2, EN ISO 14122-3 and EN ISO 14122-4.

A floor shall

- cover the horizontal cross section of the turbine tower and have no free openings wider than 0,1 m x 0,1 m without a toe plate;
- be fixed and flat;
- have an anti slip surface;
- be calculated for at least
 - a concentrated load of 1,5 kN over 0,2 m x 0,2 m,
 - an evenly distributed load of 3 kN/m² with a possible maximum of 10 kN for a tower floor,
 - a deflection not exceeding 1/200 of the floor span;
- be installed directly above an operating room, a low voltage or a medium voltage room;
- be installed for the step-over to the nacelle no more than 3 m below the tower top.

A platform shall have a free standing area no less than 0,5 m x 0,5 m and shall be calculated for strength as a floor.

A standing place shall offer (if in use) the space to stand with both feet fully supported on an equal level.

A platform and a standing place shall

- offer a free space with a minimum of 2,1 m vertical headroom and 0,6 m wide above the standing area;
- be fixed and flat (partly removable or fold back permissible);