DRAFT INTERNATIONAL STANDARD

IEC/DIS 61400-4

ISO/TC **60**

Secretariat: **ANSI**

Voting begins on:
2023-09-22

Voting terminates on:
2023-12-15

Wind energy generation systems —

Part 4:
Design requirements for wind turbine gearboxes

ICS: 27.180; 21.200

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Reference number
IEC/DIS 61400-4:2023(E)

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Published in Switzerland

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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WIND ENERGY GENERATION SYSTEMS –

Part 4: Design requirements for wind turbine gearboxes

FOREWORD

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International Standard IEC 61400-4 has been prepared by IEC technical committee 88: Wind energy generation systems, in co-operation with ISO technical committee 60: Gears.

It is published as a double logo standard.

This second edition cancels and replaces IEC 61400-4 ed.1 published in 2012. It constitutes a technical revision of IEC 61400-4 ed.1 with extended content and changes in all pertinent sections.

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

a) extension of the scope to wind turbines above 2 MW reference power;
b) considerations for converging differing approaches to reliability in gear, bearing and wind turbine standards;
c) a new clause on wind turbine loads specific to drivetrains;
d) revised clause on verification and validation;

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e) new clause on design requirements for plain bearings

f) expanded design considerations on the use of bearings based on avoiding standard failures;

g) a revised clause on considerations and requirements in the design and analysis of gearbox structural elements;

h) updated considerations and requirements on lubricants and lubrication systems;

i) removal of requirements for documenting the compliance of a design with the requirements of the standard in favour of reference to IECRE OD-501-2

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

FDIS	Report on voting
88/XXXX/FDIS	88/XXXX/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table. In ISO, the standard has been approved by 11 P-members out of 12 having cast a vote.

In addition, IEC TS 61400-4-1 has been issued in parallel with this edition of the standard, This Technical Specification describes requirements and recommendations for a unified and standardized method for reliability assessment of drivetrain components in wind turbines. The subject of reliability assessment is still under development and could therefore not achieve consensus for approval of an International Standard.

Parts of IEC 61400-4 ed.1 have been transferred into Technical Reports, with updates and amendments of the content:

- IEC TR 61400-4-2 provides additional information on lubrication of drivetrain components in wind turbines.
- IEC TR 61400-4-3 contains explanatory notes on the content of this standard, as well as supportive information for wind turbine gearbox design.

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 energy generation systems*, 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 web site 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.

A bilingual edition of this document may be issued at a later date.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

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INTRODUCTION

IEC 61400-4 outlines minimum requirements for specification, design, and verification of gearboxes in wind turbines. It does not serve as a complete design specification or instruction manual. It is intended for use by experienced designers of wind turbine drivetrains, gearboxes, and gears or bearings who are capable of selecting reasonable values for the design factors, based on knowledge of similar designs and the effects of such items as lubrication, deflection, manufacturing tolerances, metallurgy, residual stress, and system dynamics.

Any of the requirements of this standard may be altered:

- if more accurate data are available from full scale load tests, precise measurements, comprehensive mathematical analysis, or any combination of these;
- or on the basis of proven operating experience;
- or the evidence is accessible for independent assessment (e.g. by an accredited renewable energy certification body);

and the accuracy and reliability of the alternative method is demonstrated with respect to the safety and reliability of the complete wind turbine drive system.

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WIND ENERGY GENERATION SYSTEMS –

Part 4: Design requirements for wind turbine gearboxes

1 Scope

This part of the IEC 61400 series is applicable to enclosed speed increasing gearboxes for horizontal axis wind turbine drivetrains with a power rating in excess of 500 kW. This standard applies to newly designed gearboxes for wind turbines installed onshore or offshore. The technical requirements given in this standard are not intended for repaired or refurbished gearboxes, or for the extension of the service life beyond the design life.

This International Standard provides requirements and guidance on the analysis of the wind turbine loads in relation to the design of the gear and gearbox elements. The gearing elements covered by this standard include such gears as spur, helical or double helical and their combinations in parallel and epicyclic arrangements in the main power path. This standard does not apply to power take off (PTO) gears.

This standard includes requirements, design recommendations, and rating of gearboxes with rolling bearings, plain bearings, or combinations of both bearing types.

Also included are requirements and guidance on the engineering of shafts, shaft hub interfaces, lubrication, wind turbine controller interface, and the gear case structure to accomplish a design that is capable to withstand the environment and operating conditions of a wind turbine. Requirements for dynamic analysis of the gearbox within the wind turbine system are specified for the purpose of identifying load levels exceeding the predictions of the global aeroelastic simulation. The analysis of noise transmission and emission (e.g. tonal emission at gear mesh frequencies) is not within the scope of this document.

Further, this International Standard provides requirements and guidance on gearbox design verification, prototype testing and production testing, as well as consideration of design for service and maintenance.

Requirements and guidance for a systematic assessment of the design reliability of a gearbox design under reference operating conditions are given in IEC/TS 61400-4-1.

This International Standard is supported by two Technical Reports: IEC/TR 61400-4-2 provides additional information on lubrication of wind turbine drivetrains and IEC/TR 61400-4-3 contains explanatory notes and supportive information to the requirements specified in this standard.

The standard is written with conformity assessment and certification of the wind turbine in accordance with IECRE OD-501 in mind. The specific requirements for documenting conformity of a gearbox design with the technical requirements of this International Standard are described in IECRE OD-501-2.

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.

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