FINAL DRAFT
Technical Report

IEC/DTR 61400-4-3

Wind energy generation systems —

Part 4-3: Explanatory notes on IEC 61400-4 - Supportive information for wind turbine gearbox design

Systèmes de génération d'énergie éolienne —

Partie 4-3: Notes explicatives sur l'IEC 61400-4 — Informations complémentaires pour la conception des multiplicateurs d'éoliennes

ISO/TC **60**

Secretariat: **ANSI**

Voting begins on:
2026-03-06

Voting terminates on:
2026-05-01

This draft is submitted to a parallel vote in ISO and in IEC.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

Reference number
IEC/DTR 61400-4-3:2026(en)

© IEC 2026

© IEC 2026 – All rights reserved

CONTENTS

FOREWORD 3
INTRODUCTION 5
1 Scope 6
2 Normative references 6
3 Terms, definitions, abbreviated terms, units and conventions 6
3.1 Terms and definitions 6
3.2 Abbreviated terms and units 6
4 Gears 10
4.1 Design considerations 10
4.1.1 Aspect ratio 10
4.1.2 Profile shift 10
4.1.3 Pinion mounting 10
4.2 Minimum safety factors, S_F and S_H 10
4.2.1 Gear fatigue life rating in previous editions 10
4.2.2 Transition to ISO 6336:2019 11
4.3 Background for micropitting analysis 14
4.4 Background for the tooth flank fracture analysis 15
5 Rolling bearings 15
5.1 Preliminary bearing selection 15
5.2 Background for rating life and contact stress limits 16
5.2.1 Combined modified reference rating life, $L_{n\mathrm{mr}}$ 16
5.2.2 Contact stress values 17
5.3 Method for load bin reduction 18
5.3.1 Purpose 18
5.3.2 Combining adjacent load bins 18
5.3.3 Weighted load averaging 19
5.4 Simplified bearing contact stress calculation 20
5.4.1 Purpose 20
5.4.2 Influence factors 20
5.4.3 Procedure 20
5.5 Calculation of lubricant film thickness 27
5.6 Bearing arrangement selection 29
5.6.1 General 29
5.6.2 Planet carrier 30
5.6.3 Planet bearings 30
5.6.4 Parallel shafts 30
6 Structural elements 30
7 Robustness testing 31
7.1 Background 31
7.2 Test specification 32
7.2.1 Objectives 32
7.2.2 Test conditions 32
7.2.3 Limitations 32
7.3 Accelerated life testing 33
Bibliography 34

Figure 1 – Variation of load distribution influence factor with contact ratio according to ISO 6336-3:2019 12
Figure 2 – Variation of helix angle factor with helix angle according to ISO 6336-3:2006 and ISO 6336-3:2019 12
Figure 3 – Comparison of tooth root stresses between ISO 6336-3:2006 Method B, ISO 6336-3:2019 Method B, and an ISO 6336 Method A finite element calculation 13
Figure 4 – Gradual increase of $S_{F\ min}$ according to IEC 61400-4:2023 and ISO 6336-3:2019 Method B 14
Figure 5 – Comparison of contact stress values from equivalent load to reference load 18
Figure 6 – Load bin reduction by lumping neighbouring load bins 19
Figure 7 – Effects of clearance and preload on pressure distribution in radial roller bearings 22
Figure 8 – Nomenclature for bearing curvature 23
Figure 9 – Stress distribution over the elliptical contact area 25

Table 1 – Guide values for basic rating life L_{h10} for preliminary bearing selection (as previously recommended in IEC 61400-4:2012) 16
Table 2 – Static load factors for radial bearings 21
Table 3 – Reference standards for structural components 31
Table 4 – Overall safety level of structural components 31

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

Wind energy generation systems - Part 4-3: Explanatory notes on IEC 61400-4 series - Supportive information for wind turbine gearbox design

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC TR 61400-4-3 has been prepared by IEC technical committee 88: Wind energy generation systems. It is a Technical Report.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
88/XX/DTR	88/XX/RVDTR

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 Technical Report is English.

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 of 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,

– withdrawn, or

– revised.

INTRODUCTION

The purpose of this document is to provide explanations and supportive information to IEC 61400-4. The contents are non-normative but cover important aspects of gearbox design and verification.

This document also provides a review of the history, background, and previous requirements, and how some of the requirements in IEC 61400-4 have developed over time.

1 Scope

This document, which is a Technical Report, provides non-binding information regarding wind turbine gearbox design and verification.

The explanatory notes in this document are provided to give context, history, and supportive information to selected design requirements in IEC 61400-4. This is provided for gear design considerations in Clause 4 and rolling bearings in Clause 5. History and rationale for design verification by robustness testing is included in Clause 6.

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

IEC 61400-4, *Wind energy generation systems - Part 4: Design requirements for wind turbine gearboxes*

3 Terms, definitions, abbreviated terms, units and conventions

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 61400-1 and IEC 61400-4 apply.

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

– IEC Electropedia: available at http://www.electropedia.org/

– ISO Online browsing platform: available at http://www.iso.org/obp

3.2 Abbreviated terms and units

This technical report uses equations and relationships from several engineering specialties. As a result there are, in some cases, conflicting definitions for the same symbol. All the symbols used in the document are nevertheless listed, but, if there is ambiguity, the specific definition is presented in the clause where they are used in equations, graphs, or text.

$A_{FF,max}$	maximum material exposure	–
a	contact ellipse dimension perpendicular to the direction of motion	mm
a_{ISO}	life modification factor, based on a systems approach of life calculation	–
b	contact ellipse dimension parallel to the direction of motion	mm
C_r	basic dynamic radial load rating	N
C_T	contact truncation factor	–
$C_{\delta L}$	elastic constant	–
D_w	ball or roller diameter	mm
D_{pw}	working pitch diameter	mm