INTERNATIONAL STANDARD

ISO 6336-1

Third edition
2019-11

Calculation of load capacity of spur and helical gears —

Part 1:
Basic principles, introduction and general influence factors

Calcul de la capacité de charge des engrenages cylindriques à dentures droite et hélicoïdale —

Partie 1: Principes de base, introduction et facteurs généraux d'influence

Reference number
ISO 6336-1:2019(E)

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 60, *Gears*, Subcommittee SC 2, *Gear capacity calculation*.

This third edition cancels and replaces the second edition (ISO 6336-1:2006), which has been technically revised. It also incorporates the Technical Corrigendum ISO 6336-1:2006/Cor.1:2008.

The main changes compared to the previous edition are as follows:

— incorporation of ISO/TS 6336-4, ISO/TS 6336-20, ISO/TS 6336-21 and ISO/TS 6336-22 into Clause 4 (failure mode);

— update of application factors in Clause 5;

— integration of Clause 10 "Parameters of Hertzian contact";

— integration of Clause 11 "Lubricant parameters at given temperature".

A list of all parts in the ISO 6336 series can be found on the ISO website.

Any feedback or questions on this document should be directed to the user’s national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

ISO 6336 (all parts) consists of International Standards, Technical Specifications (TS) and Technical Reports (TR) under the general title *Calculation of load capacity of spur and helical gears* (see Table 1).

— International Standards contain calculation methods that are based on widely accepted practices and have been validated.

— Technical Specifications (TS) contain calculation methods that are still subject to further development.

— Technical Reports (TR) contain data that is informative, such as example calculations.

The procedures specified in parts 1 to 19 of the ISO 6336 series cover fatigue analyses for gear rating. The procedures described in parts 20 to 29 of the ISO 6336 series are predominantly related to the tribological behavior of the lubricated flank surface contact. Parts 30 to 39 of the ISO 6336 series include example calculations. The ISO 6336 series allows the addition of new parts under appropriate numbers to reflect knowledge gained in the future.

Requesting standardized calculations according to the ISO 6336 series without referring to specific parts requires the use of only those parts that are currently designated as International Standards (see Table 1 for listing). When requesting further calculations, the relevant part or parts of the ISO 6336 series need to be specified. Use of a Technical Specification as acceptance criteria for a specific design need to be agreed in advance between the manufacturer and the purchaser.

Table 1 — Parts of the ISO 6336 series (status as of DATE OF PUBLICATION)

Calculation of load capacity of spur and helical gears	International Standard	Technical Specification	Technical Report
Part 1: Basic principles, introduction and general influence factors	X		
Part 2: Calculation of surface durability (pitting)	X		
Part 3: Calculation of tooth bending strength	X		
Part 4: Calculation of tooth flank fracture load capacity		X	
Part 5: Strength and quality of materials	X		
Part 6: Calculation of service life under variable load	X		
Part 20: Calculation of scuffing load capacity (also applicable to bevel and hypoid gears) — Flash temperature method *(replaces: ISO/TR 13989-1)*		X	
Part 21: Calculation of scuffing load capacity (also applicable to bevel and hypoid gears) — Integral temperature method *(replaces: ISO/TR 13989-2)*		X	
Part 22: Calculation of micropitting load capacity *(replaces: ISO/TR 15144-1)*		X	
Part 30: Calculation examples for the application of ISO 6336 parts 1,2,3,5			X
Part 31: Calculation examples of micropitting load capacity *(replaces: ISO/TR 15144-2)*			X

This document and the other parts of the ISO 6336 series provide a coherent system of procedures for the calculation of the load capacity of cylindrical involute gears with external or internal teeth. The ISO 6336 series is designed to facilitate the application of future knowledge and developments, also the exchange of information gained from experience.

Design considerations to prevent fractures emanating from stress raisers in the tooth flank, tip chipping and failures of the gear blank through the web or hub will need to be analysed by general machine design methods.

Several methods for the calculation of load capacity, as well as for the calculation of various factors, are permitted (see 4.1.16). The directions in ISO 6336 are thus complex, but also flexible.

Included in the formulae are the major factors which are presently known to affect gear tooth damages which are covered by the ISO 6336 series. The formulae are in a form that will permit the addition of new factors to reflect knowledge gained in the future.

Calculation of load capacity of spur and helical gears —

Part 1: Basic principles, introduction and general influence factors

1 Scope

This document presents the basic principles of, an introduction to, and the general influence factors for the calculation of the load capacity of spur and helical gears. Together with the other documents in the ISO 6336 series, it provides a method by which different gear designs can be compared. It is not intended to assure the performance of assembled drive gear systems. It is not intended for use by the general engineering public. Instead, it is intended for use by the experienced gear designer who is capable of selecting reasonable values for the factors in these formulae based on the knowledge of similar designs and the awareness of the effects of the items discussed.

The formulae in the ISO 6336 series are intended to establish a uniformly acceptable method for calculating the load capacity of cylindrical gears with straight or helical involute teeth.

The ISO 6336 series includes procedures based on testing and theoretical studies as referenced by each method. The methods are validated for:

— normal working pressure angle from 15° to 25°;

— reference helix angle up to 30°;

— transverse contact ratio from 1,0 to 2,5.

If this scope is exceeded, the calculated results will need to be confirmed by experience.

The formulae in the ISO 6336 series are not applicable when any of the following conditions exist:

— gears with transverse contact ratios less than 1,0;

— interference between tooth tips and root fillets;

— teeth are pointed;

— backlash is zero.

The rating formulae in the ISO 6336 series are not applicable to other types of gear tooth deterioration such as plastic deformation, case crushing and wear, and are not applicable under vibratory conditions where there can be an unpredictable profile breakdown. The ISO 6336 series does not apply to teeth finished by forging or sintering. It is not applicable to gears which have a poor contact pattern.

The influence factors presented in these methods form a method to predict the risk of damage that aligns with industry and experimental experience. It is possible that they are not entirely scientifically exact. Therefore, the calculation methods from one part of the ISO 6336 series is not applicable in another part of the ISO 6336 series unless specifically referenced.

The procedures in the ISO 6336 series provide rating formulae for the calculation of load capacity with regard to different failure modes such as pitting, tooth root breakage, tooth flank fracture, scuffing and micropitting. At pitch line velocities below 1 m/s the gear load capacity is often limited by abrasive wear (see other literature such as References [23] and [22] for further information on such calculation).