INTERNATIONAL STANDARD

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Calculation of load capacity of bevel gears —

Part 1: Introduction and general influence factors

Calcul de la capacité de charge des engrenages coniques —
Partie 1: Introduction et facteurs généraux d'influence

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Foreword

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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. www.iso.org/directives

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 60, *Gears*, Subcommittee SC 2, *Gear capacity calculation*.

This second edition cancels and replaces the first edition (ISO 10300-1:2001), which has been technically revised.

ISO 10300 consists of the following parts, under the general title *Calculation of load capacity of bevel gears*:

— *Part 1: Introduction and general influence factors*

— *Part 2: Calculation of surface durability (pitting)*

— *Part 3: Calculation of tooth root strength*

Introduction

When ISO 10300:2001 (all parts, withdrawn) became due for (its first) revision, the opportunity was taken to include hypoid gears, since previously the series only allowed for calculating the load capacity of bevel gears without offset axes. The former structure is retained, i.e. three parts of the ISO 10300 series, together with ISO 6336-5, and it is intended to establish general principles and procedures for rating of bevel gears. Moreover, ISO 10300 (all parts) is designed to facilitate the application of future knowledge and developments, as well as the exchange of information gained from experience.

Several calculation methods, i.e. A, B and C, are specified, which stand for decreasing accuracy and reliability from A to C because of simplifications implemented in formulae and factors. The approximate methods in ISO 10300 (all parts) are used for preliminary estimates of gear capacity where the final details of the gear design are not yet known. More detailed methods are intended for the recalculation of the load capacity limits when all important gear data are given.

ISO 10300 (all parts) does not provide an upgraded calculation procedure as a method A, although it would be available, such as finite element or boundary element methods combined with sophisticated tooth contact analyses. The majority of Working Group 13 decided that neither is it sufficient for an International Standard to simply refer to such a complex computer program, nor does it make sense to explain it step by step in an International Standard.

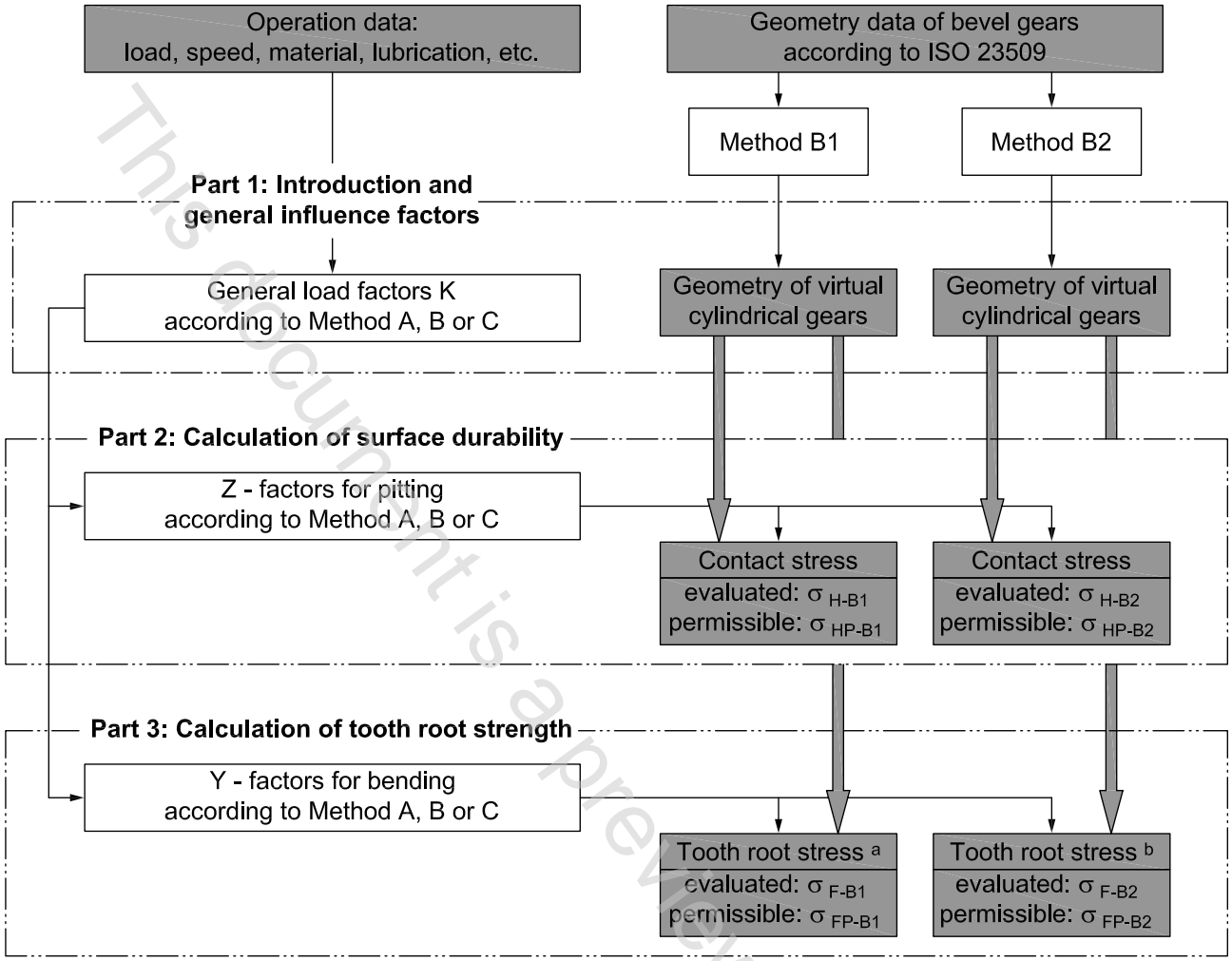
On the other hand, by means of such a computer program, a new calculation procedure for bevel and hypoid gears on the level of method B was developed and checked. It is part of the ISO 10300 series as submethod B1. Besides, if the hypoid offset, a, is zero, method B1 becomes identical to the set of proven formulae of the former version of ISO 10300 (all parts):2001.

In view of the decision for ISO 10300 (all parts) to cover hypoid gears also, an annex, called: “Calculation of virtual cylindrical gears — Method B2”, is included in this part of ISO 10300. Additionally, ISO 10300-2 is supplemented by a separate clause: “Gear flank rating formulae — Method B2”; regarding ISO 10300-3, it was agreed that the former method B2, which uses the Lewis parabola to determine the critical section in the root and not the 30° tangent at the tooth fillet as method B1 does, now be extended by the AGMA methods for rating the strength of bevel gears and hypoid gears. It was necessary to present a new, clearer structure of the three parts, which is illustrated in Figure 1 (of this part of ISO 10300). Note, ISO 10300 (all parts) gives no preferences in terms of when to use method B1 and when method B2.

The procedures covered by ISO 10300 (all parts) are based on both testing and theoretical studies, but it is possible that the results obtained from its rating calculations might not be in good agreement with certain, previously accepted, gear calculation methods.

ISO 10300 (all parts) provides calculation procedures by which different gear designs can be compared. It is neither meant to ensure the performance of assembled gear drive systems nor intended for use by the average engineer. Rather, it is aimed at the experienced gear designer capable of selecting reasonable values for the factors in these formulae, based on knowledge of similar designs and on awareness of the effects of the items discussed.

NOTE Contrary to cylindrical gears, where the contact is usually linear, bevel gears are generally manufactured with profile and lengthwise crowning: i.e. the tooth flanks are curved on all sides and the contact develops an elliptical pressure surface. This is taken into consideration when determining the load factors by the fact that the rectangular zone of action (in the case of spur and helical gears) is replaced by an inscribed parallelogram for method B1 and an inscribed ellipse for method B2 (see Annex A for method B1 and Annex B for method B2). The conditions for bevel gears, different from cylindrical gears in their contact, are thus taken into consideration by the longitudinal and transverse load distribution factors.



Key

a One set of formulae for both, bevel and hypoid gears.

b Separate sets of formulae for bevel and for hypoid gears.

Figure 1 — Structure of calculation methods in ISO 10300 (all parts)

Calculation of load capacity of bevel gears —

Part 1:
Introduction and general influence factors

1 Scope

This part of ISO 10300 specifies the methods of calculation of the load capacity of bevel gears, the formulae and symbols used for calculation, and the general factors influencing load conditions.

The formulae in ISO 10300 (all parts) are intended to establish uniformly acceptable methods for calculating the pitting resistance and bending strength of straight, helical (skew), spiral bevel, Zerol and hypoid gears. They are applicable equally to tapered depth and uniform depth teeth. Hereinafter, the term "bevel gear" refers to all of these gear types; if not the case, the specific forms are identified.

The formulae take into account the known major factors influencing pitting on the tooth flank and fractures in the tooth root. The rating formulae are not applicable to other types of gear tooth deterioration such as plastic yielding, micropitting, case crushing, welding, and wear. The bending strength formulae are applicable to fractures at the tooth fillet, but not to those on the active flank surfaces, to failures of the gear rim or of the gear blank through the web and hub. Pitting resistance and bending strength rating systems for a particular type of bevel gears can be established by selecting proper values for the factors used in the general formulae. If necessary, the formulae allow for the inclusion of new factors at a later date. Note, ISO 10300 (all parts) is not applicable to bevel gears which have an inadequate contact pattern under load (see Annex D).

The rating system of ISO 10300 (all parts) is based on virtual cylindrical gears and restricted to bevel gears whose virtual cylindrical gears have transverse contact ratios of $\varepsilon_{v\alpha} < 2$. Additionally, the given relations are valid for bevel gears of which the sum of profile shift coefficients of pinion and wheel is zero (see ISO 23509).

WARNING — The user is cautioned that when the formulae are used for large average mean spiral angles $(\beta_{m1}+\beta_{m2})/2 > 45°$, for effective pressure angles $\alpha_e > 30°$ and/or for large face widths $b > 13\ m_{mn}$, the calculated results of ISO 10300 (all parts) should be confirmed by experience.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable to its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 1122-1, *Vocabulary of gear terms — Part 1: Definitions related to geometry*

ISO 6336-5, *Calculation of load capacity of spur and helical gears — Part 5: Strength and quality of materials*

ISO 10300-2:2014, *Calculation of load capacity of bevel gears — Part 2: Calculation of surface durability (pitting)*

ISO 10300-3:2014, *Calculation of load capacity of bevel gears — Part 3: Calculation of tooth root strength*

ISO 17485, *Bevel gears — ISO system of accuracy*

ISO 23509:2006, *Bevel and hypoid gear geometry*