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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

Reference number
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Contents

Page

Foreword

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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When ISO 10300:2001 (all parts, withdrawn) became due for (its first) revision, the opportunity was taken to include hypoid gears, since previously the series only allowed for calculating the load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.

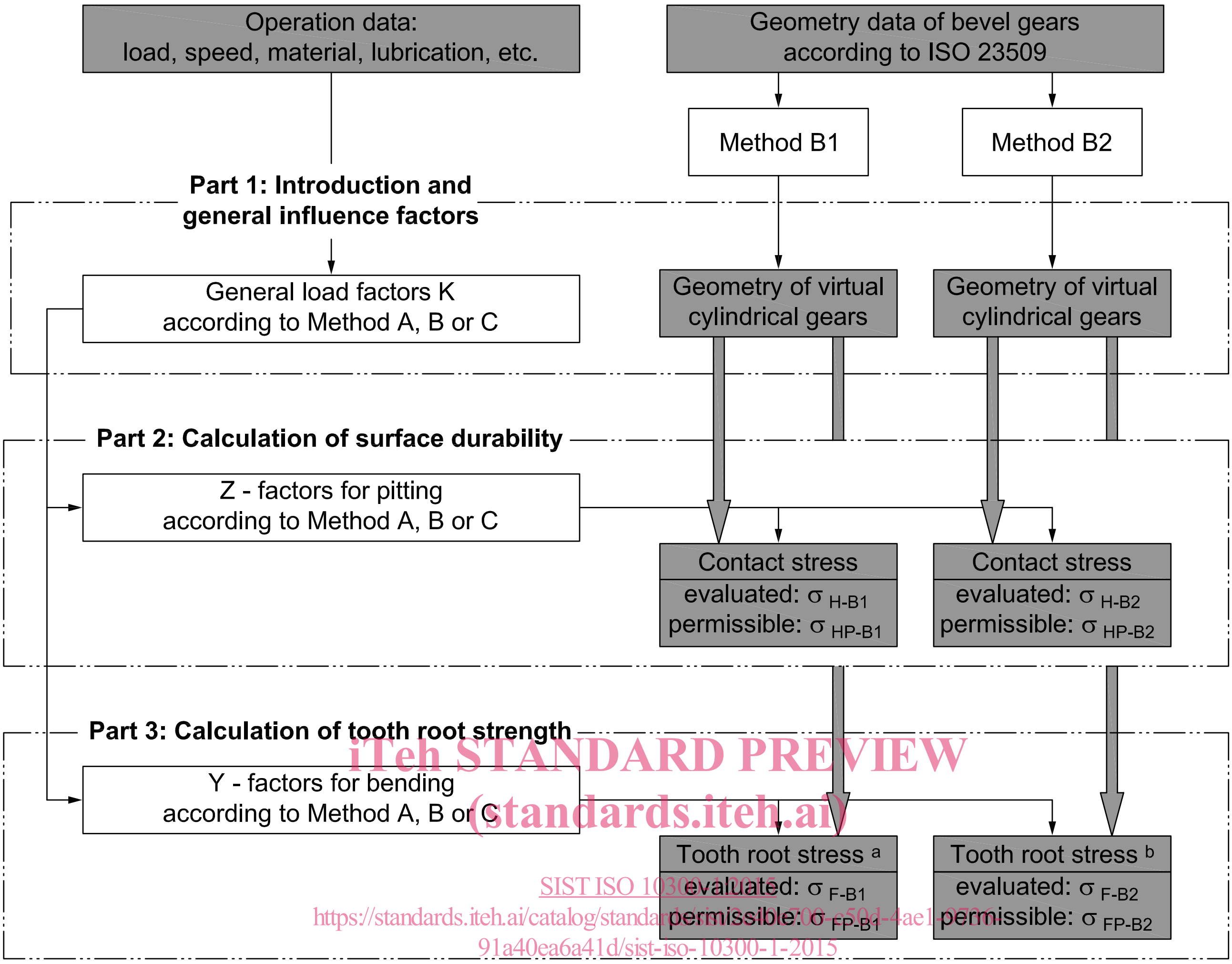
On the other hand, by means of such a computer program, a new calculation procedure for bevel and hypoid gears on the level of method B was developed and checked. It is part of the ISO 10300 series as submethod B1. Besides, if the hypoid offset, a, is zero, method B1 becomes identical to the set of proven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

3 Terms and definitions

For the purposes of this part of ISO 10300, terms and definitions given in ISO 1122-1 and ISO 23509 apply.

4 Symbols and units

For the purposes of this document, the symbols given in ISO 701, ISO 17485 and ISO 23509 apply.

Table 1 contains symbols and their units which are used at more than one places of ISO 10300 (all parts). Other symbols, especially those of auxiliary variables, which are used in equations following closely after their definitions, are not listed in Table 1. Table 2 contains general subscripts used in ISO 10300 (all parts).

Table 1 — Symbols and units used in ISO 10300 (all parts)

Symbol	Description or term	Unit
a	hypoid offset	mm
a_{rel}	relative hypoid offset	—
a_v	centre distance of virtual cylindrical gear pair	mm
a_{vn}	centre distance of virtual cylindrical gear pair in normal section	mm
b	face width	mm
b_b	relative base face width	—
b_{ce}	calculated effective face width	mm
b_{eff}	effective face width (e.g. measured length of contact pattern)	mm
b_v	face width of virtual cylindrical gears	mm
$b_{v,eff}$	effective face width of virtual cylindrical gears	mm
c_v	empirical parameter to determine the dynamic factor	—
c_γ	mean value of mesh stiffness per unit face width	N/(mm · µm)
$c_{\gamma 0}$	mesh stiffness for average conditions	N/(mm · µm)
c'	single stiffness	N/(mm · µm)
c_0'	single stiffness for average conditions	N/(mm · µm)
d_e	outer pitch diameter	mm
d_m	mean pitch diameter	mm
d_T	tolerance diameter according to ISO 17485	mm
d_v	reference diameter of virtual cylindrical gear	mm
d_{va}	tip diameter of virtual cylindrical gear	mm
d_{van}	tip diameter of virtual cylindrical gear in normal section	mm
d_{vb}	base diameter of virtual cylindrical gear	mm
d_{vbn}	base diameter of virtual cylindrical gear in normal section	mm
d_{vf}	root diameter of virtual cylindrical gear	mm
d_{vn}	reference diameter of virtual cylindrical gear in normal section	mm
e	exponent for the distribution of the load peaks along the lines of contact	—
f	distance from the centre of the zone of action to a contact line	mm
f_{max}	maximum distance to middle contact line	mm
f_{maxB}	maximum distance to middle contact line at right side of contact pattern	mm
f_{max0}	maximum distance to middle contact line at left side of contact pattern	mm

Table 1 *(continued)*

Symbol	Description or term	Unit
f_{pt}	single pitch deviation	µm
$f_{p,eff}$	effective pitch deviation	µm
g_c	length of contact line (method B2)	mm
$g_{v\alpha}$	length of path of contact of virtual cylindrical gear in transverse section	mm
$g_{v\alpha n}$	relative length of action in normal section	—
g_J	relative length of action to point of load application (method B2)	—
g_η	relative length of action within the contact ellipse	—
h_{am}	mean addendum	mm
h_{a0}	tool addendum	mm
h_{fm}	mean dedendum	mm
h_{fP}	dedendum of the basic rack profile	mm
h_m	mean whole depth used for bevel spiral angle factor	mm
h_{vfm}	relative mean virtual dedendum	—
h_{Fa}	bending moment arm for tooth root stress (load application at tooth tip)	mm
h_N	load height from critical section (method B2)	mm
k'	contact shift factor	—
l_b	length of contact line (method B1)	mm
l_{b0}	theoretical length of contact line	mm
l_{bm}	theoretical length of middle contact line	mm
m_{et}	outer transverse module	mm
m_{mn}	mean normal module	mm
m_{mt}	mean transverse module	mm
m_{red}	mass per unit face width reduced to the line of action of dynamically equivalent cylindrical gears	kg/mm
m^*	relative individual gear mass per unit face width referred to line of action	kg/mm
n	rotational speed	min^{-1}
n_{E1}	resonance speed of pinion	min^{-1}
p	peak load	N/mm
p_{et}	transverse base pitch (method B2)	mm
p_{max}	maximum peak load	N/mm
p^*	relative peak load for calculating the load sharing factor (method B1)	—
p_{mn}	relative mean normal pitch	—
p_{nb}	relative mean normal base pitch	—
p_{vet}	transverse base pitch of virtual cylindrical gear (method B1)	mm
q	exponent in the formula for lengthwise curvature factor	—
q_s	notch parameter	—
r_{c0}	cutter radius	mm
r_{mf}	tooth fillet radius at the root in mean section	mm
r_{mpt}	mean pitch radius	mm
$r_{my\,0}$	mean transverse radius to point of load application (method B2)	mm
r_{va}	relative mean virtual tip radius	—

Table 1 *(continued)*

Symbol	Description or term	Unit
r_{vn}	relative mean virtual pitch radius	—
s_{mn}	mean normal circular thickness	mm
s_{pr}	amount of protuberance at the tool	mm
s_{Fn}	tooth root chord in calculation section	mm
s_N	one-half tooth thickness at critical section (method B2)	mm
u	gear ratio of bevel gear	—
u_v	gear ratio of virtual cylindrical gear	—
v_{et}	tangential speed at outer end (heel) of the reference cone	m/s
$v_{et,max}$	maximum pitch line velocity at operating pitch diameter	m/s
v_g	sliding velocity in the mean point P	m/s
$v_{g,par}$	sliding velocity parallel to the contact line	m/s
$v_{g,vert}$	sliding velocity vertical to the contact line	m/s
v_{mt}	tangential speed at mid-face width of the reference cone	m/s
v_Σ	sum of velocities in the mean point P	m/s
$v_{\Sigma h}$	sum of velocities in profile direction	m/s
$v_{\Sigma l}$	sum of velocities in lengthwise direction	m/s
$v_{\Sigma,vert}$	sum of velocities vertical to the contact line	m/s
w	angle of contact line relative to the root cone	°
x_{hm}	profile shift coefficient	—
x_{sm}	thickness modification coefficient	—
x_N	tooth strength factor (method B2)	mm
x_{oo}	distance from mean section to point of load application	mm
y_p	running-in allowance for pitch deviation related to the polished test piece	µm
y_J	location of point of load application for maximum bending stress on path of action (method B2)	mm
y_3	location of point of load application on path of action for maximum root stress	mm
y_α	running-in allowance for pitch error	µm
z	number of teeth	—
z_v	number of teeth of virtual cylindrical gear	—
z_{vn}	number of teeth of virtual cylindrical gear in normal section	—
z_0	number of blade groups of the cutter	—
A	auxiliary factor for calculating the dynamic factor $K_{v\text{-}C}$	—
A^*	related area for calculating the load sharing factor Z_{LS}	mm
A_{sne}	outer tooth thickness allowance	mm
B	accuracy grade according to ISO 17485	—
C_F	correction factor of tooth stiffness for non average conditions	—
C_{lb}	correction factor for the length of contact lines	—
C_{ZL}, C_{ZR}, C_{ZV}	constants for determining lubricant film factors	—
E	modulus of elasticity, Young's modulus	N/mm²
E, G, H	auxiliary variables for tooth form factor (method B1)	—

Table 1 *(continued)*

Symbol	Description or term	Unit
F	auxiliary variable for mid-zone factor	—
F_{mt}	nominal tangential force at mid-face width of the reference cone	N
F_{mtH}	determinant tangential force at mid-face width of the reference cone	N
F_{n}	nominal normal force	N
F_{vmt}	nominal tangential force of virtual cylindrical gears	N
HB	Brinell hardness	—
K	constant; factor for calculating the dynamic factor K_{v-B}	—
K_{v}	dynamic factor	—
K_{v}*	preliminary dynamic factor for non-hypoid gears	—
K_{A}	application factor	—
K_{F0}	lengthwise curvature factor for bending stress	—
$K_{F\alpha}$	transverse load factor for bending stress	—
$K_{F\beta}$	face load factor for bending stress	—
$K_{H\alpha}$	transverse load factor for contact stress	—
$K_{H\alpha}$*	preliminary transverse load factor for contact stress for non-hypoid gears	—
$K_{H\beta}$	face load factor for contact stress	—
$K_{H\beta\text{-be}}$	mounting factor	—
N	reference speed related to resonance speed n_{E1}	—
N_{L}	number of load cycles	—
P	nominal power	kW
Ra	= CLA = AA arithmetic average roughness	µm
R_{e}	outer cone distance	mm
R_{m}	mean cone distance	mm
R_{mpt}	relative mean back cone distance	—
Rz	mean roughness	µm
Rz_{10}	mean roughness for gear pairs with relative curvature radius ρ_{rel} = 10 mm	µm
S_{F}	safety factor for bending stress (against breakage)	—
$S_{F,min}$	minimum safety factor for bending stress	—
S_{H}	safety factor for contact stress (against pitting)	—
$S_{H,min}$	minimum safety factor for contact stress	—
$T_{1,2}$	nominal torque of pinion and wheel	Nm
W_{m2}	wheel mean slot width	mm
$Y_{1,2}$	tooth form factor of pinion and wheel (method B2)	—
Y_{f}	stress concentration and stress correction factor (method B2)	—
Y_{i}	inertia factor (bending)	—
Y_{A}	root stress adjustment factor (method B2)	—
Y_{BS}	bevel spiral angle factor	—
Y_{Fa}	tooth form factor for load application at the tooth tip (method B1)	—
Y_{FS}	combined tooth form factor for generated gears	—
Y_{J}	bending strength geometry factor (method B2)	—
Y_{LS}	load sharing factor (bending)	—

Table 1 *(continued)*

Symbol	Description or term	Unit
Y_{NT}	life factor (bending)	—
$Y_{R,Rel\,T}$	relative surface condition factor	—
Y_{Sa}	stress correction factor for load application at the tooth tip	—
Y_{ST}	stress correction factor for dimensions of the standard test gear	—
Y_X	size factor for tooth root stress	—
$Y_{\delta,rel\,T}$	relative notch sensitivity factor	—
Y_ε	contact ratio factor for bending (method B1)	—
Z_i	inertia factor (pitting)	—
Z_v	speed factor	—
Z_A	contact stress adjustment factor (method B2)	—
Z_E	elasticity factor	$(N/mm^2)^{1/2}$
Z_{FW}	face width factor	—
Z_{Hyp}	hypoid factor	—
Z_I	pitting resistance geometry factor (method B2)	—
Z_K	bevel gear factor (method B1)	—
Z_L	lubricant factor	—
Z_{LS}	load sharing factor (method B1)	—
$Z_{M\text{-}B}$	mid-zone factor	—
Z_{NT}	life factor (pitting)	—
Z_R	roughness factor for contact stress	—
Z_S	bevel slip factor	—
Z_W	work hardening factor	—
Z_X	size factor	—
α_a	adjusted pressure angle (method B2)	°
α_{an}	normal pressure angle at tooth tip	°
α_{et}	effective pressure angle in transverse section	°
$\alpha_{eD,C}$	effective pressure angle for drive side/coast side	°
α_f	limit pressure angle in wheel root coordinates (method B2)	°
α_{lim}	limit pressure angle	°
$\alpha_{nD,C}$	generated pressure angle for drive side/coast side	°
α_{vet}	transverse pressure angle of virtual cylindrical gears	°
α_{Fan}	load application angle at tooth tip of virtual cylindrical gear (method B1)	°
α_L	normal pressure angle at point of load application (method B2)	°
β_{bm}	mean base spiral angle	°
β_m	mean spiral angle	°
β_v	helix angle of virtual gear (method B1), virtual spiral angle (method B2)	°
β_{vb}	helix angle at base circle of virtual cylindrical gear	°
β_B	inclination angle of contact line	°
γ	auxiliary angle for length of contact line calculation (method B1)	°
γ'	projected auxiliary angle for length of contact line	°
γ_a	auxiliary angle for tooth form and tooth correction factor	°

Table 1 *(continued)*

Symbol	Description or term	Unit
δ	pitch angle of bevel gear	°
δ_a	face angle	°
δ_f	root angle	°
$\varepsilon_{v\alpha}$	transverse contact ratio of virtual cylindrical gears	—
$\varepsilon_{v\alpha n}$	transverse contact ratio of virtual cylindrical gears in normal section	—
$\varepsilon_{v\beta}$	face contact ratio of virtual cylindrical gears	—
$\varepsilon_{v\gamma}$	virtual contact ratio (method B1), modified contact ratio (method B2)	—
ε_N	load sharing ratio for bending (method B2)	—
ε_{NI}	load sharing ratio for pitting (method B2)	—
ζ_m	pinion offset angle in axial plane	°
ζ_{mp}	pinion offset angle in pitch plane	°
ζ_R	pinion offset angle in root plane	°
ϑ	auxiliary quantity for tooth form and tooth correction factors	radiant
ϑ_{mp}	auxiliary angle for virtual face width (method B1)	°
θ_{v2}	angular pitch of virtual cylindrical wheel	radiant
ξ	assumed angle in locating weakest section	radiant
ξ_h	one half of angle subtended by normal circular tooth thickness at point of load application	radiant
ρ	density of gear material	kg/mm^3
ρ_{a0}	cutter edge radius	mm
ρ_F	fillet radius at point of contact of 30° tangent	mm
ρ_{Fn}	fillet radius at point of contact of 30° tangent in normal section	mm
ρ_{fP}	root fillet radius of basic rack for cylindrical gears	mm
ρ_{rel}	radius of relative curvature vertical to contact line at virtual cylindrical gears	mm
ρ_t	relative radius of profile curvature between pinion and wheel (method B2)	—
ρ_{va0}	relative edge radius of tool	—
ρ'	slip layer thickness	mm
σ_F	tooth root stress	N/mm^2
$\sigma_{F,lim}$	nominal stress number (bending)	N/mm^2
σ_{FE}	allowable stress number (bending)	N/mm^2
σ_{FP}	permissible tooth root stress	N/mm^2
σ_H	contact stress	N/mm^2
$\sigma_{H,lim}$	allowable stress number for contact stress	N/mm^2
σ_{HP}	permissible contact stress	N/mm^2
τ	angle between tangent of root fillet at weakest point and centreline of tooth	°
ν	Poisson's ratio	—
ν_0	lead angle of face hobbing cutter	°
ν_{40}, ν_{50}	nominal kinematic viscosity of the oil at 40 °C and 50 °C respectively	mm^2/s
φ	auxiliary angle to determine the position of the pitch point	°
ω	angular velocity	rad/s

Table 1 *(continued)*

Symbol	Description or term	Unit
ω_{Σ}	angle between the sum of velocities vector and the trace of pitch cone	°
χ^X	relative stress drop in notch root	mm⁻¹
$\chi_T{}^X$	relative stress drop in notch root of standardized test gear	mm⁻¹
Σ	shaft angle	°

Table 2 — General subscripts in ISO 10300 (all parts)

Subscripts	Description
0	tool
1	pinion
2	wheel
A, B, B1, B2, C	value according to method A, B, B1, B2 or C
D	Drive flank
C	Coast flank
T	relative to standardized test gear dimensions
(1), (2)	trials of interpolation

5 Application

5.1 Calculation methods

5.1.1 General

ISO 10300 (all parts) provides the procedures to predict load capacity of bevel gears. The most valid method is full-scale and full-load testing of a specific gear set design. However, at the design stage or in certain fields of application, some calculation methods are needed to predict load capacity. Therefore, methods A, B and C are used in this part of ISO 10300, while method A, if its accuracy and reliability are proven, is preferred over method B, which in turn is preferred over method C.

ISO 10300 (all parts) allows the use of mixed factor rating methods within method B1 or method B2. For example: method B for dynamic factor $K_{v\text{-}B}$ can be used with method C face load factor $K_{H\beta\text{-}C}$.

5.1.2 Method A

Where sufficient experience from the operation of other, similar designs is available, satisfactory guidance can be obtained by the extrapolation of the associated test results or field data. The factors involved in this extrapolation may be evaluated by the precise measurement and comprehensive mathematical analysis of the transmission system under consideration, or from field experience. All gear and load data are required to be known for the use of this method, which shall be clearly described and presented with all mathematical and test premises, boundary conditions and any specific characteristics of the method that influence the result. The accuracy and the reliability of the method shall be demonstrated. Precision, for example, shall be demonstrated through comparison with other, acknowledged gear measurements. The method should be approved by both the customer and the supplier.

5.1.3 Method B

Method B provides the calculation formulae to predict load capacity of bevel gears for which the essential data are known. However, sufficient experience from the operation of other, similar designs is needed in the evaluation of certain factors even in this method. The validity of these evaluations for the given operating conditions shall be checked.

5.1.4 Method C

Where suitable test results or field experience from similar designs, are unavailable for use in the evaluation of certain factors, a further simplified calculation method, method C, should be used.

5.2 Safety factors

The allowable probability of failure shall be carefully weighed when choosing a safety factor, in balancing reliability against cost. If the performance of the gears can be accurately appraised by testing the unit itself under actual load conditions, lower safety factors may be permitted. The safety factors shall be determined by dividing the calculated permissible stress by the specific evaluated operating stress.

In addition to this general requirement, and the special requirements relating to surface durability (pitting) and tooth root strength (see ISO 10300-2 and ISO 10300-3, respectively), safety factors shall be determined only after careful consideration of the reliability of the material data and of the load values used for calculation. The allowable stress numbers used for calculation are valid for a given probability of failure, or damage (the material values in ISO 6336-5, for example, are valid for a 1 % probability of damage), the risk of damage being reduced as the safety factors are increased, and vice versa. If loads, or the response of the system to vibration, are estimated rather than measured, a larger factor of safety should be used.

The following variations shall also be taken into consideration in the determination of a safety factor:

— variations in gear geometry due to manufacturing tolerances;

— variations in alignment of gear members;

— variations in material due to process variations in chemistry, cleanliness and microstructure (material quality and heat treatment);

— variations in lubrication and its maintenance over the service life of the gears.

The appropriateness of the safety factors will thus depend on the reliability of the assumptions, such as those related to load, on which the calculations are based, as well as on the reliability required of the gears themselves, in respect of the possible consequences of any damage that might occur in the case of failure.

Supplied gears or assembled gear drives should have a minimum safety factor for contact stress $S_{H,min}$ of 1,0. The minimum bending stress value $S_{F,min}$ should be 1,3 for spiral bevel including hypoid gears, and 1,5 for straight bevel gears or those with $\beta_m \leq 5°$.

The minimum safety factors against pitting damage and tooth breakage should be agreed between the supplier and customer.

5.3 Rating factors

5.3.1 Testing

The most effective overall approach to gear system performance management is through the full-scale, full-load testing of a proposed new design. Alternatively, where sufficient experience of similar designs exists and results are available, a satisfactory solution can be obtained through extrapolation from such data. On the other hand, where suitable test results or field data are not available, rating factor values should be chosen conservatively.

5.3.2 Manufacturing tolerances

Rating factors should be evaluated based on the minimum acceptable quality limits of the expected variation of component parts in the manufacturing process. The accuracy grade, B, shall preferably be determined as specified in ISO 17485, e.g. single pitch deviation for calculating the dynamic factor $K_{v\text{-}B}$.

