TECHNICAL REPORT

ISO/TR 6336-30

Second edition

Calculation of load capacity of spur and helical gears —

Part 30: Calculation examples for the application of ISO 6336 parts 1,2,3,5

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

Partie 30: Exemples d'application de l'ISO 6336 parties 1, 2, 3, 5

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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 second edition cancels and replaces the first edition (ISO 6336-30:2017), which has been technically revised according to ISO 6336-1:2019, ISO 6336-2:2019, ISO 6336-3:2019.

The main changes are as follows:

— introduction of tooth flank correction factor (auxiliary factor, see ISO 6336-2:2019) f_{ZCa};

— introduction of load distribution influence factor f_{ε};

— modification of the helix angle factor Y_{β};

— calculation of tooth form factor Y_F and stress correction factor Y_S generated with a shaper cutter;

— update to the qualifying comments in 4.2;

— update to the input variables (additional values, modified values).

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.

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Introduction

The ISO 6336 series 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.

— TS contain calculation methods that are still subject to further development.

— TR contain data that is informative, such as example calculations.

The procedures specified in ISO 6336-1 to ISO 6336-19 cover fatigue analyses for gear rating. The procedures described in ISO 6336-20 to ISO 6336-29 are predominantly related to the tribological behaviour of the lubricated flank surface contact. ISO 6336-30 to ISO 6336-39 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 ISO 6336 without referring to specific parts requires the use of only those parts that are designated as International Standards (see Table 1 for listing). When requesting further calculations, the relevant part or parts of ISO 6336 need to be specified. Use of a Technical Specification as acceptance criteria for a specific design needs to be agreed in advance between manufacturer and purchaser.

Table 1 — Overview of ISO 6336

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 — Flash temperature method		X	
Part 21: Calculation of scuffing load capacity — Integral temperature method		X	
Part 22: Calculation of micropitting load capacity (replaces: ISO/TR 15144-1)		X	
Part 30: Calculation examples for the application of ISO 6336-1, ISO 6336-2, ISO 6336-3 and, ISO 6336-5			X
Part 31: Calculation examples of micropitting load capacity (replaces: ISO/TR 15144-2)			X
NOTE At the time of publication of this document, some of the parts listed here were under development. Consult the ISO website.			

This document provides worked examples for the application of the calculation procedures defined in ISO 6336-1, ISO 6336-2, ISO 6336-3 and ISO 6336-5. The example calculations cover the application to spur, helical and double helical, external and internal cylindrical involute gears for both high speed and low speed operating conditions, determining the ISO safety factors against tooth flank pitting and tooth root bending strength for each gear set. The calculation procedures used are consistent with those presented in ISO 6336-1, ISO 6336-2, ISO 6336-3 and ISO 6336-5, unless qualifying comments are provided. Where qualifying comments have been included in this document, they reflect areas of the calculation procedures presented in the current standards where points of clarification are required or editorial errors have been identified. The changes defined within the qualifying comments will be implemented in future revisions of ISO 6336-1, ISO 6336-2, ISO 6336-3 and ISO 6336-5. No additional calculations are presented here that are outside of the referenced documents.

Eight worked examples are presented with the necessary input data for each gear set provided at the beginning of the calculation. Calculation details are presented in full for one worked example, with all following examples having summarized results data presented in tabular format.

For all calculations in this document, the flank tolerance classes according to ISO 1328-1 are applied.

Calculation of load capacity of spur and helical gears —

Part 30:
Calculation examples for the application of ISO 6336 parts 1,2,3,5

1 Scope

This document presents worked examples that apply exclusively the approximation methods for the determination of specific influential factors, such as the dynamic factor, K_v, and the load distributions factors $K_{H\alpha}$, $K_{H\beta}$, etc., where full analytical calculation procedures are provided within the referenced parts of ISO 6336.

Worked examples covering the more advanced analysis techniques and methods are not applicable to this document.

The example calculations presented in this document are provided for guidance on the application of ISO 6336-1:2019, ISO 6336-2:2019, ISO 6336-3:2019 and ISO 6336-5:2016. Any of the values, safety factors or the data presented do not represent recommended criteria for real gearing. Data presented within this document are for the purpose of aiding the application of the calculation procedures of ISO 6336-1, ISO 6336-2, ISO 6336-3 and ISO 6336-5.

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.

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

ISO 6336 (all parts), *Calculation of load capacity of spur and helical gears*

3 Terms, definitions, symbols and units

3.1 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 1122-1, ISO 6336 (all parts) and the following apply.

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

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.2 Symbols and units

The units of length metre, millimetre and micrometre are chosen in accordance with common practice. The conversions of the units are already included in the given formulae. All symbols used in this document are given in Table 2.

Table 2 — Symbols

Symbol	Description	Unit
A	Flank tolerance class	—
a	Centre distance	mm
B_f	Non-dimensional parameter	—
B_K	Non-dimensional parameter	—
B_P	Non-dimensional parameter	—
B_1	Constant	—
B_2	Constant	—
b	Facewidth (total facewidth if double helical)	mm
b_B	Facewidth per helical if double helical (b/2)	mm
b_{eff}	Contact facewidth	mm
b_s	Web thickness	mm
C_a	Tip relief	µm
C_B	Basic rack factor	—
C_f	Root relief	µm
C_M	Correction factor	—
C_R	Gear blank factor	—
C_{v1}	Constant	—
C_{v2}	Constant	—
C_{v3}	Constant	—
C_{v4}	Constant	—
C_{v5}	Constant	—
C_{v6}	Constant	—
C_{v7}	Constant	—
C_{ZL}	Lubrication film factor exponent	—
C_{ZR}	Roughness factor exponent	—
$c_{\gamma\alpha}$	Mean value of mesh stiffness per unit facewidth	N/(mm·µm)
$c_{\gamma\beta}$	Mean value of mesh stiffness per unit facewidth	N/(mm·µm)
c'	Maximum tooth stiffness per unit facewidth of gear pair	N/(mm·µm)
c'_{th}	Theoretical single stiffness	N/(mm·µm)
D_M	Ball diameter	mm
d	Reference diameter	mm
d_a	Tip diameter	mm
d_{an}	Virtual tip diameter	mm
d_b	Base circle diameter	mm
d_{bn}	Virtual base diameter	mm
d_{en}	Virtual outer single tooth contact diameter	mm
d_{Ff}	Root form diameter (based on x_E)	mm
d_f	Root diameter (based on x_E)	mm
d_m	Mean tooth diameter	mm
d_{Nf}	Start of active profile diameter	mm
d_n	Virtual reference diameter	mm
d_{sh}	External shaft diameter	mm
d_{shi}	Internal shaft diameter	mm
d_w	Working pitch diameter	mm

Table 2 *(continued)*

Symbol	Description	Unit
E	Young's modulus	N/mm^2
$E_{1,2}$	Auxiliary value (for form factor for pinion or wheel)	—
F_{m}	Mean transverse tangential load	N
F_{t}	Nominal tangential load at the reference cylinder	N
F_{tH}	Determinant tangential load	N
$F_{\beta\mathrm{x}}$	Initial equivalent misalignment	µm
$F_{\beta\mathrm{y}}$	Effective equivalent misalignment (after running-in)	µm
$f_{\mathrm{f}\alpha\mathrm{eff}}$	Effective profile deviation after running-in	µm
$f_{\mathrm{f}\alpha}$	Profile form deviation (see ISO 1328-1)	µm
$f_{\mathrm{H}\beta}$	Helix slope deviation (see ISO 1328-1)	µm
f_{ma}	Mesh misalignment	µm
f_{pb}	Transverse base pitch deviation (the values of f_{pT} can be used for calculations in accordance with the ISO 6336 series, using tolerances according to ISO 1328-1)	µm
f_{pbeff}	Effective transverse base pitch deviation after running-in	µm
f_{pT}	Single pitch tolerance (see ISO 1328-1, ISO 6336 refers to f_{pT} as f_{pt})	µm
f_{sh}	Equivalent misalignment	µm
f_{sh0}	Shaft deformation under specific load	µm
f_{ZCa}	Tooth flank correction factor (auxiliary factor, see ISO 6336-2:2019)	—
f_{ε}	Load distribution influence factor	—
G	Auxiliary value (for form factor)	—
H	Auxiliary value (for form factor)	—
h	Tooth depth	mm
h_{Fe}	Bending moment arm	mm
h_{fP}	Basic rack dedendum	mm
h_{K}	Tip chamfer	mm
K	Constant	—
K_{A}	Application factor	—
$K_{\mathrm{F}\alpha}$	Transverse load factor	—
$K_{\mathrm{F}\beta}$	Face load factor	—
$K_{\mathrm{H}\alpha}$	Transverse load factor	—
$K_{\mathrm{H}\beta}$	Face load factor	—
K_{v}	Dynamic factor	—
K_{γ}	Mesh load factor	—
k	Number of teeth spanned	—
L	Auxiliary notch parameter	—
l	Bearing span	mm
M_{dK}	Dimension between balls	mm
m_{n}	Normal module	mm
m_{red}	Reduced gear pair mass per unit facewidth	kg/mm
N	Resonance ratio	—
N_{F}	Exponent	—
N_{L}	Number of load cycles	—
N_{M}	Number of meshes	—
$n_{1,2}$	Rotation speed of pinion (or wheel)	min^{-1}

Table 2 *(continued)*

Symbol	Description	Unit
n_{E1}	Resonance speed	min^{-1}
p_{bn}	Virtual base pitch	mm
pr	As cut basic rack undercut	mm
q	Material allowance for finishing	mm
q_s	Notch parameter	—
q_{sT}	Notch parameter of standard reference test piece	—
q'	Flexibility of pair of meshing teeth	(mm·µm)/N
Ra	Arithmetic mean roughness value, Ra = 1/6 Rz	µm
Rz	Mean peak-to-valley roughness (ISO 4287:1997[a] including ISO 4287:1997/Cor 1:1998, ISO 4287:1997/Cor 2:2005, ISO 4287:1997/Amd 1:2009 and ISO 4288:1996[b])	µm
Rz_{10}	Mean relative peak-to-valley roughness for gear pair	µm
S_F	Safety factor for bending	—
S_{Fn}	Tooth root normal chord	mm
S_H	Safety factor for surface durability	—
s	Bearing span offset	mm
s_{pr}	Residual fillet undercut, $s_{pr} = pr - q$	mm
$T_{1,2}$	Nominal torque at pinion/wheel	Nm
v	Circumferential velocity at the reference cylinder	m/s
v_w	Pitch line velocity	m/s
W_k	Span measurement	mm
x	Nominal profile shift coefficient	—
x_E	Generating profile shift coefficient	—
$x_{E,V}$	Generating profile shift coefficient (pre-finishing)	—
x_0	Pinion cutter profile shift coefficient	—
Y_B	Rim thickness factor	—
Y_{DT}	Deep tooth factor	—
Y_F	Tooth form factor	—
Y_N	Life factor (tooth root stress)	—
Y_{NT}	Life factor for reference test conditions (tooth root stress)	—
Y_{RrelT}	Relative surface factor	—
Y_S	Stress correction factor	—
Y_{ST}	Stress correction factor, relevant to the dimensions of the reference test gears	—
Y_X	Size factor	—
Y_β	Helix angle factor	—
$Y_{\delta relT}$	Relative notch sensitivity factor for reference stress	—
y_f	Running-in allowance	µm
y_α	Running-in allowance	µm
y_β	Running-in allowance	µm
Z_B	Single pair tooth contact factor	—
Z_D	Single pair tooth contact factor	—
Z_E	Elasticity factor	$\sqrt{N / mm^2}$
Z_H	Zone factor	—
Z_L	Lubricant factor	—

Table 2 *(continued)*

Symbol	Description	Unit
Z_N	Life factor (contact stress)	—
Z_{NT}	Life factor for reference test conditions (contact stress)	—
Z_R	Roughness factor	—
Z_W	Work hardening factor	—
Z_X	Size factor	—
Z_v	Velocity factor	—
Z_β	Helix angle factor	—
Z_ε	Contact ratio factor	—
z	Number of teeth	—
z_n	Virtual number of teeth	—
z_0	Pinion cutter number of teeth	—
α_n	Normal pressure angle	°
α_{en}	Virtual form factor pressure angle	°
α_{Fen}	Virtual load direction angle	°
α_t	Transverse pressure angle	°
α_{wt}	Transverse working pressure angle	°
β	Helix angle (without subscript, at reference cylinder)	°
γ	Auxiliary angle	°
ε_α	Transverse contact ratio	—
$\varepsilon_{\alpha n}$	Virtual contact ratio	—
ε_β	Overlap ratio	—
ε_γ	Total contact ratio	—
θ	Auxiliary value (for form factor)	rad
ν	Poisson's ratio	—
ν_{40}	Lubrication viscosity	mm^2/s
ρ	Material density	kg/m^3
ρ	Radius of curvature	mm
ρ_{aP0}	Pinion cutter tip radius coefficient	—
ρ_F	Radius of root fillet	mm
ρ_{fP}	Root fillet radius of the basic rack for cylindrical gears	mm
ρ_{red}	Relative radius of curvature	mm
ρ'	Slip layer thickness	mm
σ_{F0}	Nominal tooth root stress	N/mm^2
σ_F	Tooth root stress	N/mm^2
σ_{Flim}	Allowable stress number (bending)	N/mm^2
σ_{FP}	Permissible bending stress	N/mm^2
$\sigma_{FPlonglife}$	Permissible bending stress (long life)	N/mm^2
σ_{FPref}	Permissible bending stress (reference condition)	N/mm^2
σ_H	Contact stress	N/mm^2
$\sigma_{H\,lim}$	Allowable stress number (surface)	N/mm^2
σ_{H0}	Nominal contact stress at pitch point	N/mm^2
σ_{HP}	Permissible contact stress	N/mm^2
$\sigma_{HPlonglife}$	Permissible contact stress (long life)	N/mm^2
σ_{HPref}	Permissible contact stress (reference)	N/mm^2

Table 2 *(continued)*

Symbol	Description	Unit
σ_s	Yield stress	N/mm^2
$\sigma_{0,2}$	Proof stress	N/mm^2
χ^*	Relative stress gradient in root of a notch	mm^{-1}
χ_P^*	Stress gradient – smooth, polished test piece	mm^{-1}
χ_T^*	*Stress gradient for reference test piece*	mm^{-1}

[a] Cancelled and replaced by ISO 21920-2:2021.

[b] Cancelled and replaced by ISO 21920-3:2021.

4 Worked examples

4.1 General

Clause 4 presents examples for the calculation of the safety factor for surface durability, S_H, and safety factor for tooth breakage, S_F. For all examples, where various calculation methods are presented for the determination of specific influencing factors, the approximate methods detailed in the ISO 6336 series are applied. Where a specific method is used to calculate an influence parameter, the method used is denoted as a subscript to that factor (as defined in ISO 6336-1).

The calculations results in specific aspects of the rating procedure to highlight the influence of specific gear pair geometry, quality or application.

For example 1 in 4.3, the full calculation procedure is presented including the formulae. For all subsequent calculations, only the tabulated input and results data are provided.

In a number of areas, points of clarification of the procedure or specific criteria that differ slightly from the definitions provided in ISO 6336-1, ISO 6336-2 and ISO 6336-3 are incorporated within the example calculations. The points reflect the true intention of the procedures of ISO 6336-1, ISO 6336-2 and ISO 6336-3 and are defined in 4.2.

NOTE 1 The calculations and results presented were performed using computer-based procedures. If the calculations are performed manually, it is possible that small differences between the results appear.

NOTE 2 In the presented results, all values for K factors are presented with rounding to two decimal places (X,XX); however, for the actual calculations, the results for each factor have been used with unrounded values.

4.2 Qualifying comments

4.2.1 Calculation of base pitch deviation, f_{pb}

The value calculated for f_{pb} is by means of Formula (1), and is applied without rounding:

$$f_{pb} = f_{pT} \cdot \cos(\alpha_t) \tag{1}$$

where f_{pT} is provided by ISO 1328-1.

4.2.2 Calculation of running-in allowance, y_α, for the transverse load factors $K_{H\alpha}$ and $K_{F\alpha}$

The following criteria defined in ISO 6336-1:2019, 8.3.1, are applied only for the calculation of $K_{H\alpha}$ and $K_{F\alpha}$:

— The base pitch deviation, f_{pb}, accounts for the total effect of all gear tooth deviations which affect the transverse load factor. If, nevertheless, the profile form deviation, $f_{f\alpha}$, is greater than the base pitch deviation, the profile form deviation $f_{f\alpha}$ is used instead of the base pitch deviation f_{pb}.

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— If profile modifications compensate for the deflections of the teeth at the actual load level, 50 % of the base pitch deviation f_{pb} and its corresponding running-in value $y_{\alpha}(f_{pb})$ respectively the profile form deviation $f_{f\alpha}$ and its corresponding running-in value $y_{\alpha}(f_{f\alpha})$ is used for the calculation of $K_{H\alpha}$. This reduction applies for examples 1 and 4 of this document.

The criteria listed above do not apply for determining f_{pb} and $f_{f\alpha}$ for the calculation of K_v according to ISO 6336-1:2019, 6.5.4.

4.2.3 Calculation of mesh stiffness, c_{γ}

The calculation of mesh stiffness, c_{γ}, in accordance with method B of ISO 6336-1:2019, 9.3.3, is applied for all example calculations. For all c_{γ} calculations, the use of the nominal profile shift coefficient, x, and nominal basic rack dedendum, h_{fP}, is applied. The generating profile shift coefficient, x_E, is not used, even where x_E is used for other strength calculations associated with the tooth root. Virtual number of teeth of helical gears were calculated with Formula (16) of ISO 6336-3:2019 rather than approximate formula given in Formula (81) of ISO 6336-1:2019.

4.2.4 Application of lubricant film Z_L, Z_v and Z_R, hardness Z_W and size Z_X influence factors

According to the ISO 6336 series, the permissible contact stress numbers for static and reference condition, including all relevant influence factors as defined, will be calculated. For limited life, linear interpolation on a log–log scale, following the procedure of Z_{NT}, between these two values is applied. The linear interpolation on a log-log-scale for limited life leads to a value Z_N, which can be different to the value Z_{NT}.

The displayed values of Z_L, Z_v, Z_R, Z_W and Z_X in the output tables of this document show the interpolated values of each Z-factor.

4.2.5 Calculation of the permissible contact stress in the limited life range (Z_N and Z_{NT})

For the calculation of the permissible contact stress in the limited life range, the following procedure is considered according to ISO 6336-2:2019:

— Calculation of the permissible contact stress for static stress $\sigma_{HP,stat}$ and for reference stress $\sigma_{HP,stat}$ according to ISO 6336-2:2019, 5.4.3 with the use of Z_{NT}.

— Calculation of the permissible contact stress for the limited life range $\sigma_{HP,lim}$ by applying the formulae in ISO 6336-2:2019, 5.4.4.3. The application of the formulae results in the calculation and usage of Z_N (e. g. for case hardened or through hardened material) with no pitting permissible:

$$Z_N = \left(\frac{5 \cdot 10^7}{N_L}\right)^{0{,}3705 \cdot \log \frac{\sigma_{HP,stat}}{\sigma_{HP,ref}}}$$

— The obtained permissible contact stress for the limited life range $\sigma_{HP,lim}$ is equal to the permissible contact stress σ_{HP}, which is subsequently used to calculate the pitting stress limit σ_{HG} according to ISO 6336-2:2019, 5.4.3 and eventually the safety against pitting S_H according to ISO 6336-2:2019, 5.2.

4.2.6 Application of work hardening factor, Z_W

In example 5 in 4.7, a surface-hardened pinion is used with a through-hardened cast iron wheel. According to ISO 6336-2:2019, 13.3.2, the calculation method is only valid for through-hardened steel, not through-hardened cast iron. To be on the conservative side, the work hardening factor for the wheel is set to Z_{W2} = 1,0. For all other cases where both gears are either through-hardened or surface-hardened, $Z_{W1,2}$ = 1 for both pinion and wheel applies.

4.2.7 Determination of *Rz*

The determination of *Rz* from the specified *Ra* values is determined by the approximation suggested in ISO 6336-2:2019, 12.3.2.3.1, footnote 2, where $Rz = 6 \cdot Ra$.

4.2.8 Facewidth for calculations involving double helical gears

For calculations involving double helical gears (such as example 7), and for the application of ISO 6336-2:2019, Formula (40) b_B is used instead of b.

4.2.9 Calculation of ε_β for double helical gears

For the calculation of ε_β for double helical gears, the value applies for only one helix. For example, the value for facewidth, b, is replaced by b_B.

4.2.10 Calculation of $f_{H\beta5}$ and $f_{H\beta}$

The calculation of $f_{H\beta5}$ for use in the determination of the initial equivalent misalignment, $F_{\beta x}$, in ISO 6336-1:2019, 7.5.3.4 is performed in accordance with ISO 1328-1 for flank tolerance class 5 with the as required rounding applied.

4.2.11 Helix tolerance $f_{H\beta5}$ and $f_{H\beta}$ for double helical gears

When calculating the helix tolerance value $f_{H\beta5}$ and $f_{H\beta}$ for double helical gears, the facewidth of one helix is used, i.e. b_B.

4.2.12 Calculation of root diameter, d_f

For all calculations presented within this document, the calculation of the root diameter, d_f, is performed with the generating profile shift coefficient, x_E, and not the nominal profile shift coefficient, x (see also 4.2.16).

4.2.13 Calculations for internal gears

For all calculations involving internal gears (example 6), the input data uses negative values for diameters as defined in the ISO 6336 series.

4.2.14 Rounding of values

The calculations within this document have been conducted with unrounded values. The values documented in the table are rounded.

4.2.15 Deviations of values

Numeric calculations and different programming of calculation programs can lead to slight deviations of the values when recalculating. The calculated values documented in this document were achieved by different calculation programs. Deviations were accepted in a defined range, as the basic statement of the calculation remains. The range of acceptable deviations for the calculations in this document was defined as the following:

— Absolute deviation: 0,01.

— Relative deviation: 0,5 %.

Values for the calculations were within the absolute and relative deviation range.

4.2.16 Nominal and generated values

The values were calculated with nominal values if not otherwise stated in this document (e.g. in 4.2.12) or the corresponding standard (e.g. bending geometry according to ISO 6336-3:2019).

4.2.17 ISO 1328-1

ISO 1328-1 was used for the calculation of the allowable values of deviations.

4.2.18 Values for reference only

Values in the input table (e.g. nominal profile shift coefficient *x*) are put in parenthesis when they are calculated and for reference only.

4.3 Example 1: Single helical case carburized gear pair

For example 1, input values and output values are given in Tables 3 and 4, respectively.

A full calculation description is provided in Annex A.