Corrections to the Standard ISO 6336 (Part 1)

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Abstract. The standard **ISO 6336 – Calculation of load capacity of spur and helical gears**, got out in 2006. There were some amendments later, but a lot of errors and typos still remain. These can cause some misunderstandings during applications of the standard, and they are irritating for users of this standard. This article is the last one of the articles which are concerned with this standard. This contribution deals with Part 1 of this standard and wants to show contained typos and errors. At the same time, however, it indicates their proper wording. For better reading of this article, you should have this standard (Part 1).

Keywords: ISO 6336 · Part 1 · Typos · Errors · Recommendations

1 Introduction

ISO 6336 is a key standard [1] for gearing checking and loading capacity assessment [2, 3]. It also addresses its service life [4]. In any task related to the design and optimization of the drive of mechanical systems, its application is absolutely necessary. Therefore, it is inadmissible to be misinterpreted or mistaken. And just for some mistakes and misinterpretations, this article points out. Due to the extent of this standard, articles concerned with the other parts were published recently; only Part 1 of this standard is dealt with in this article. The results of this work are applied to the author's software as well. Parts 2 of this standard was processed in [5], parts 3 and 6 were processed in [6]. The aim of the study was to help gear designer community to avoid errors in their projects.

2 Materials and Methods

"Basic principles, introduction and general influence factors" which is the first part of the standard ISO 6336 – Calculation of load capacity of spur and helical gears, got out in September 2006 (corrected version in April 2007) [1]. This part was amended with *Technical corrigendum 1*. This is a basic standard and instruction for the determination of very important factors (K_A, K_V, $K_{H\alpha}$, $K_{H\beta}$, $K_{F\alpha}$, $K_{F\beta}$). It calls user attention to contained typos and errors. At the same time, however, it indicates their proper wording. The edition of this part is bigger than the previous one (109 + 8 against 96 + 4 pgs.). It is interesting that the simplified calculation method C is still used for calculations of some factors in this part. Moreover, there is some new annex.

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3 Results and Discussion

This section contains notes on the content of the standard ISO 6336 (Part 1) [1].

Page 3, symbol …'ε' *relative eccentricity* … not found in the standard.
Page 3, symbol …'ζ' *roll angle* … but for *roll angle* is used symbol'ξ'(Part 2).
Page 4, symbol …'l' … missing description (*distance between feeler gauges*).
Page 4, symbol'n' *number of load cycles* … must have no unit (*[-]*).
Page 4, symbol …'τ' … *angular pitch* … instead *[mm]* should be *[rad].*
Page 8, symbols …'F_{ber}';'F_{bn}';'$F_{\beta 6}$' … not found in the standard.
Page 9, symbols …'f_{sh0}';'h_{min}';'l_a' … not found in the standard.
Page 10, symbols …'q_α';'T_n' … not found in the standard.
Page 11, symbols …'w_m';'w_t' … not found in the standard.
Page 24, there are different accuracy grades in the new standard ISO 1328-1 (2013), it will influence all which is concerned to this standard
Page 26, inaccurate lower line on the graph.
Page 27, line 5 top down – replace … 1,15 < $N \leq$ 1,5… With … 1,15 < N < 1,5…
Page 27, Eqs. (13), (14), (20) and (21) – there are unnecessary brackets.
Page 27, values – c_{v3}, c_{v4}, c_{v6} – do not exactly match graph for $\varepsilon_\gamma > 2$.
Page 29, line 5 top down – replace … *Table 3* … with … *Table 4* …
Page 29, Eq. (19) – replace … $f_{\alpha\ eff}$ … with … $f_{f\alpha\ eff}$ …
Page 29, footnote 4) – nonsensical clause number… 4.1.1.2
Page 30, line 6 bottom up – replace … *to Table 3* … with … *to Table 4* …
Page 30, line 4 bottom up – replace … *specified in* … with … *specified in 6.4.4* …
Page 31, Eq. (25) – replace … $m^*_{pla} = \frac{\pi}{8} \cdot \frac{d^4_{mpla}}{d^4_{bpla}}$ … with.
… $m^*_{pla} = \frac{\pi}{8} \cdot \frac{d^4_{mpla}}{d^2_{bpla}}$ …
Page 32, line 11 and 12 top down – instead … 1/2 … it would be better … 1,2 … (four times)
Page 32, point b) – replace subscript … *carr* … with … *ann* … (11 times).
Page 32, point b) – replace subscript … pla … with … *ann* …
Page 32, Eq. (26) – replace … $m^*_{carr} = \frac{\pi}{8} \cdot \frac{d^4_{mcarr}}{d^4_{bcarr}}$ … with.
… $m^*_{ann} = \frac{\pi}{8} \cdot \frac{d^4_{mann}}{d^2_{bann}}$ …
Page 32, Eq. (26) – it doesn't take into account the shape of the ring gear (diameters).
Page 33, line 5 top down – replace … moments of inertia … with … relative indivi-dual gear mass …
Page 33, Eq. (32) – replace … $q_2 = \frac{d_{i1}}{d_{m2}}$ … with … $q_2 = \frac{d_{i2}}{d_{m2}}$ …
Page 39, there are different accuracy grades in the new standard ISO 1328-1 (2013), it will influence all which is concerned to this standard
Page 41, line 14 bottom up – replace … *(see 7.6)* … with … *(see 7.5)* …
Page 41, line 14 bottom up – replace … *in 7.2.1* … with … *in 7.5.1* …
Page 43, in the schema replace … F_{by} … with … $F_{\beta y}$ …
Page 45, whole chapter 7.5 is slightly incomprehensible.
Page 47, Eq. (39) – replace … $2F_{\beta y}\ c_Y\ \beta$ … with … $2F_{\beta y}\ c_{\gamma\beta}$ …

Page 47, Eq. (39 ÷ 42) – replace … $c_{Y\beta}$ … with … $c_{\gamma\beta}$ …
Page 47, line 7 top down – replace … of effective misalignment to … with … of effective equivalent misalignment to …
Page 48, line 9 top down – replace … *with Method B* … with … *with Method C* …
Page 48, line 2 bottom up – replace … *for* E_n*, IF* … with … *c) For* E_n*, IF* …
Page 50, in the key replace … *St, St (cast), V,* … with … *St, St (cast),V, V (cast),*
Page 50, in the key replace …rotational velocity… with …circumferential speed
Page 51, in the key replace … *St,St (cast), V,* … with … *St, St (cast), V, V (cast),*
Page 51, in the key replace … *rotational speed* … with … *circumferential speed.*
Page 52, replace … *see Annex D* … with … *see Annex B* …
Page 52, replace … *see Annex E* … with … *see Annex B* …
Page 53, line 11 top down – replace … *deformations* f_{shi} … with … *deformations* f_{sh}..
Page 53, Eq. (54) – replace … $f_m \geq f_{H\beta 5}$ … with … $f_{ma} \geq f_{H\beta 5}$ …
Page 53, line 9 bottom up – replace … $K_{H\beta}$*, or* … with … f_{ma}*, or* …
Page 54, line 13 top down – replace …*Fig. 13a) to e)* … with … *Fig. 12a) to f)*..
Page 54, line 21 top down – … *by point b* … what is”point b” ?
Page 55, line 16 top down – replace … *Annex D* … with … *Annex B* …
Page 56 ÷ 59, the vertical symmetry axes and the horizontal axes of the teeth are to be dashed
Page 59, line 5 top down – … *dashed line* … there is no such line in the Fig. 13. Page 59, line 3 bottom up – replace … *to 7.5.3.6* … with … *to 7.5.3.4* …
Page 60, line 8 bottom up – replace …*in gear load*… with …*in preliminary gear load.*
Page 60, line 3 bottom up – unknown symbol $f_{\sigma \beta}$.
Page 60, line Eq. (62) – unknown symbol $f_{\Sigma \beta}$.
Page 62, line 10 top down – replace … $f_{be\text{-}1}$ … with … f_{be1} …
Page 62, line 10 top down – replace … $f_{be\text{-}2}$ … with … f_{be2} …
Page 62, root circles are to be a thin solid line.
Page 63, line 6 bottom up – replace … *in 6.4.1* … with … *in 6.3.1* …
Page 64, line 11 top down – replace … *footnotes 10 and 11* … with … *footnotes 11 and 12* …
Page 68, in the key replace … *St,St (cast), V,* … with … *St, St (cast), V, V (cast),*
Page 68, in the key replace … *tangential velocity* … with … *circumferential speed* …
Page 69, in the key replace … *St,St (cast), V,* … with … *St, St (cast), V, V (cast),*
Page 69, in the key replace … *tangential velocity* … with … *circumferential speed* …
Page 71, point c) – this is inconsistent with the equation (91), (validity for $\beta \leq 45°$ or $\beta \leq 30°$)
Page 76, equation (A.3) – replace … f_{shT} … with … f_{sh} …
Page 77, equation (A.5) is the same as equation (A.8).
Page 78, equation (A.11) – replace … $f_{ma} = f_{\beta xT}$ -|(… with … $f_{ma} = f_{\beta xT} +$ |(…
Page 78, equation (A.12) – replace … $f_{ma} = f_{\beta xT} +$ |(… with … $f_{ma} = f_{\beta xT}$ -|(…
Page 79, line 8 top down – replace … *helix modification* … with … helix angle modification …
Page 79, line 13 top down – replace … *“see Fig. 8)”.* … with … *“see Figure B.1.”*
Page 79, equation (B.1) – replace … $f_{mac} =$ … with … $f_{ma} =$ …
Page 80, line 9 top down – replace … *in B.1* … with … – *in B.2* …
Page 80, equation (B.4) – replace … $C_{I(II)} = f_{sh} + 1{,}5 f_{H\beta}$ … with

… $C_{I(II)} = f_{sh} + 1{,}5\ f_{H\beta} + (5 \div 10)$ …
Page 80, line 11 bottom up – replace … *in A.1* … with … *in B.2* …
Page 80, equation (B.5) – replace … $C_{I(II)} = 0{,}5\ (f_{sh} + 1{,}5 f_{H\beta})$ … with
… $C_{I(II)} = 0{,}5\ (f_{sh} + 1{,}5\ f_{H\beta}) + (5 \div 10)$ …
Page 68, Fig. 1 replace with Fig. 2.

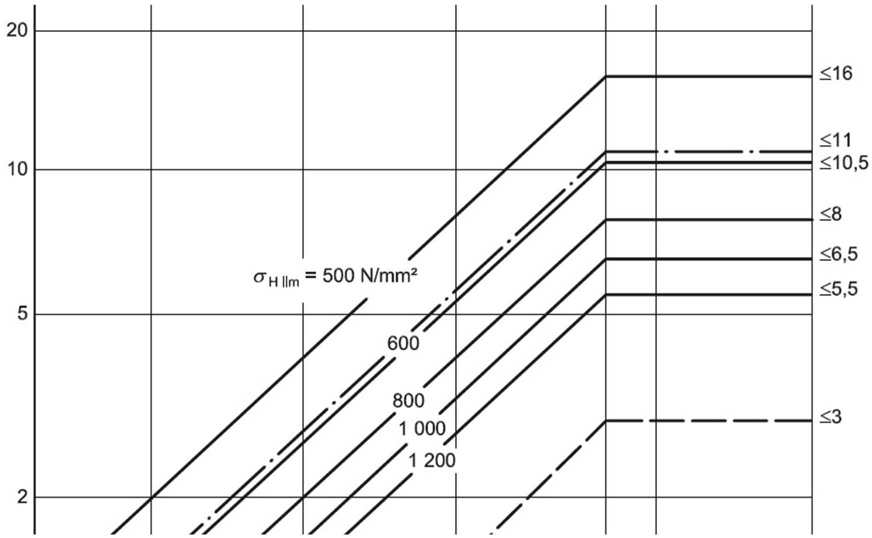

Fig. 1. Determination of running-in allowance of gear pair.

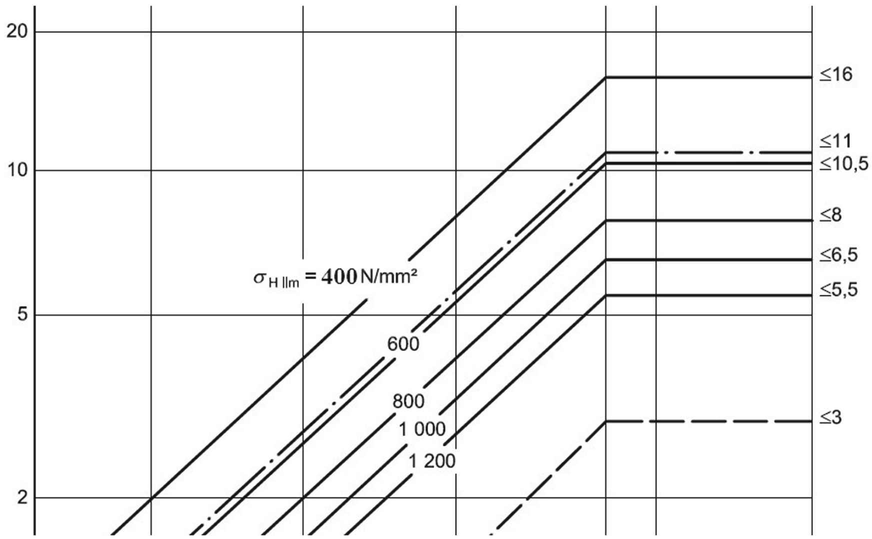

Fig. 2. Determination of running-in allowance of gear pair - corrected.

Page 80, line 8 bottom up – replace … *Equation (B.2)* … with … *Equation (B.3)* …
Page 81, equation (B.9) – replace … b_{red} =(0,8 à 0,9) … with … b_{red} =(0,8 to 0,9) …
Page 82, equation (C.1) – replace … $C_\beta^* = \frac{c_\beta \cdot c_{\gamma\beta}}{F_m/b}$ … with … $C_\beta^* = \frac{C_\beta \cdot c_{\gamma\beta}}{F_m/b}$ …
Page 69, Fig. 3 replace with Fig. 4.
Page 80, Fig. 5 – left replace with corrected version Fig. 5 – right.
Page 82, title of the Clause C.2.2 – replace … *mesh misalignment* … with … *initial equivalent misalignment* …
Page 83, graph is incomplete (planned article in the near future).
Page 84, equation (C.5) – replace … $+\frac{(F_{\beta x})^2}{16 \cdot C_\beta^*}$ … with … $+\frac{\left(F_{\beta x}^*\right)^2}{16 \cdot C_\beta^*}$
Page 85, equation (D.1), (D.2) – replace … E … with … G …
Page 85, equation (D.2) – replace … $f_{tmax}(\xi) =$ … with … $f_{tmax} =$ …
Page 85, equation (D.3) – replace … $f_m =$ … with … $f_{tm} =$ …
Page 85, equation (D.4) – replace … $f_b =$ … with … $f_b(\xi) =$ …

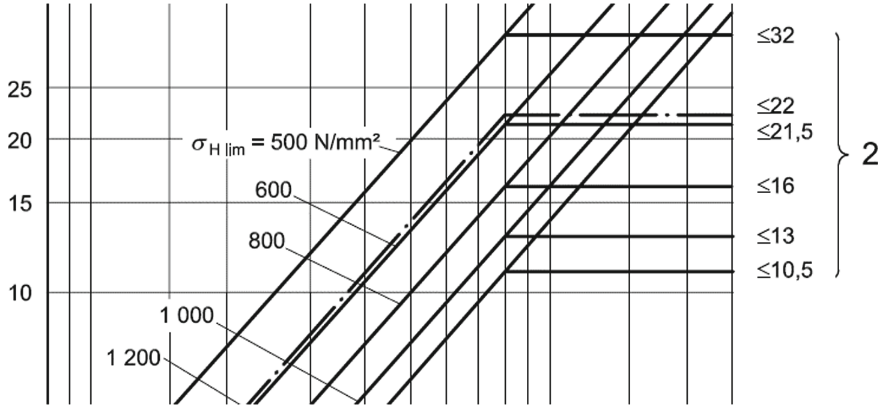

Fig. 3. Determination of running-in allowance of gear pair part 2.

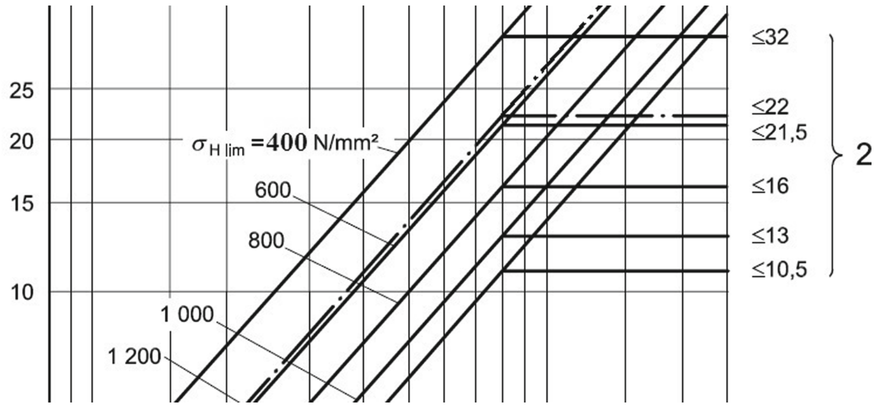

Fig. 4. Determination of running-in allowance of gear pair part 2 - corrected.

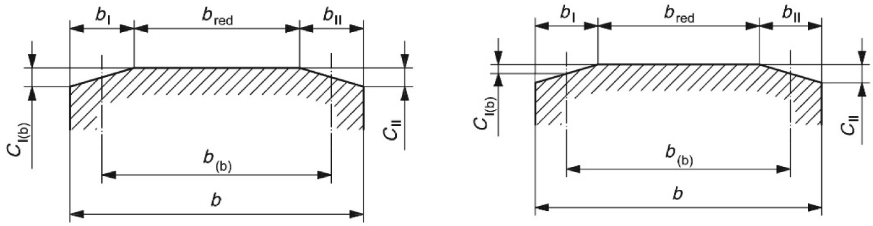

Fig. 5. Amount and width of end relief – left original, – right corrected

Page 86, on schem torque must enter from the left side of the shaft.
Page 86, in graph values for curves *b, c, e* are in *[mm]*, but value for the curve *d* is in *[μm]*
Page 87, equation (D.10) – the first line of the equation is meaningless.
Page 87, line 2 bottom up – replace … *component* f_{sb} … with … *component* f_{sh} …

4 Conclusions

This introductory part of ISO 6336 affects all of the following ones. Above all, there is an overview of the notations and symbols used. Furthermore, the series of factors defined and calculated in this section are subsequently used in Parts 2, 3 and 6. It would seem that typos and errors in this section are very much, but this is related to the difficulty and scope of this first part of ISO 6336. Finally, it should be noted that Annex E of this first part is not dealt with here.

References

1. ISO 6336 Part 1 :2006. *Calculation of load capacity of spur and helical gears – Basic principles, introduction and general influence factors.*
2. ISO 6336 Part 2 :2006. *Calculation of load capacity of spur and helical gears – Calculation of surface durability (pitting).*
3. ISO 6336 Part 3 :2006. *Calculation of load capacity of spur and helical gears – Calculation of tooth bending strength.*
4. ISO 6336 Part 6 :2006. *Calculation of load capacity of spur and helical gears – Calculation of service life under variable load.*
5. Medvecký, Š., at al. : Current Methods of Construction Design, pages 127–130. Comments on ISO 6336–2. Springer International Publishing, 2020. ISBN 978–3–030–33146–7.
6. Němček, M.: *Remarks and corrections to the standard ISO 6336.* Scientific Journal of Silesian University of Technology – series Transport. Volume 99, pages 115–124. Katowice 2018. ISSN 0209–3324. (parts 3 and 6 were processed)