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Bevel gear

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Gear Manufacturing Association (JGMA)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS B 1704**: 1978 has been replaced with this Standard.

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Bevel gear

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **ISO 17485** published in 2006 with some modifications of the technical contents to make the contents comprehensive.

The portions given sidelines or dotted underlines are the matters in which the contents of the original International Standard have been modified. A list of modifications with the explanations is given in Annex JA.

1 Scope

This Standard specifies the classification system for the geometrical accuracy of bevel gears and hypoid gears. Also, this Standard defines the terms related to the gear accuracy and specifies the structure and tolerances of the gear accuracy grade. This Standard is applicable to a single gear and a pair of gears, and not applicable to the gear unit assembly.

The single pitch deviation tolerance and the total cumulative pitch deviation tolerance shall be described in Annex A, the single-flank composite deviation measuring method shall be described in Annex B, and the accuracy of small module bevel gears shall be described in Annex C.

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

ISO 17485:2006 *Bevel gears—ISO system of accuracy* (MOD)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) listed below shall be applied.

JIS B 0102:1999 *Vocabulary of gear terms—Definitions related to geometry*

NOTE : Corresponding International Standard: ISO/DIS 1122-1:1994 *Vocabulary of gear terms—Part 1: Definitions related to geometry* (IDT)

ISO 10300-1:2001 *Calculation of load capacity of bevel gears—Part 1: Introduction and general influence factors*

ISO 23509:2006 *Bevel and hypoid gear geometry*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS B 0102:1999** and **ISO 23509:2006**, and the following apply.

3.1 index deviation F_x

displacement of any tooth flank from its theoretical position, relative to a datum tooth flank

3.2 mean normal module m_{mn}

normal module at the mean cone distance calculated according to equation (1)

$$m_{mn} = \frac{d_m}{z} \cos \beta_m = \frac{R_m}{R_c} m_{et} \cos \beta_m \dots\dots\dots (1)$$

Symbols used in equation (1) shall be in accordance with table 1.

3.3 reference gear

gear of known accuracy that is designed specifically to mesh with the gear to be inspected for composite deviation and contact marking tests

3.4 total run-out F_r

difference between the maximum and minimum distance perpendicular to the pitch cone, of a probe (ball or cone) placed successively in each tooth space, with the probe contacting both the right and the left flanks at the tolerance circle approximately mid tooth-depth

The tolerance thereof shall be in accordance with 6.3.4.

3.5 tooth mesh component single-flank composite deviation f_{is}

value of the greatest single-flank composite deviation over any one pitch ($360^\circ/z$) after removal of the long-term component (sinusoidal effect of eccentricity), during a single-flank composite test, when the wheel is moved through one revolution

This Standard specifies the tolerance direction for tooth mesh component single-flank composite deviation to be along the arc of the tolerance diameter circle in a transverse section. Tolerances are provided in 6.3.5.

3.6 total single-flank composite deviation F_{is}

total deviation, measured from minimum to maximum, during a single-flank composite test, when the wheel is moved through one revolution

This Standard specifies the tolerance direction for total single-flank composite deviation to be along the arc of the tolerance diameter circle in a transverse section. Tolerances are provided in 6.3.6.

See Annex B for the single-flank composite deviation measuring method.

3.7 single pitch deviation f_{pt}

displacement of any tooth flank from its theoretical position relative to the corresponding flank of an adjacent tooth

As shown in figure 1, a point on a tooth to a point on the adjacent tooth shall be measured on the tolerance diameter circle. The condition wherein the actual tooth flank position is nearer to the adjacent flank than the theoretical position shall be considered a minus (–) deviation, and the condition wherein the actual tooth flank position is farther from the adjacent tooth flank than the theoretical position shall be considered a plus (+) deviation.

This Standard specifies the tolerance direction of measurement for single pitch deviation to be along the arc of the tolerance diameter circle in the transverse section. Tolerances are provided in **6.3.2**.

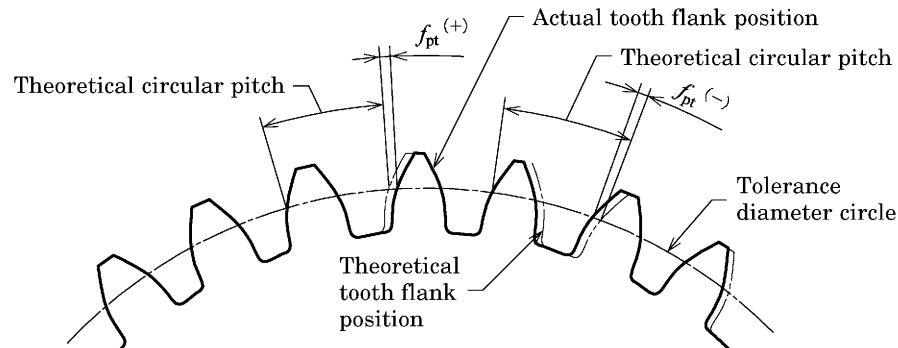


Figure 1 Pitch deviation

3.8 tolerance diameter d_T

diameter where the mean cone distance R_m and the midpoint of the working tooth depth intersect (see figure 2)

The tolerance diameter of pinion d_{T1} and the tolerance diameter of wheel d_{T2} shall be calculated according to equation (2) and equation (3).

$$d_{T1} = d_{m1} + 2 (0.5h_{mw} - h_{am2}) \cos \delta_1 = d_{m1} + (h_{am1} - h_{am2}) \cos \delta_1 \dots\dots (2)$$

$$d_{T2} = d_{m2} - 2 (0.5h_{mw} - h_{am2}) \cos \delta_2 = d_{m2} + (h_{am2} - h_{am1}) \cos \delta_2 \dots\dots (3)$$

Values of d_m , h_{mw} and δ shall be obtained from the summary sheets on manufacturing or according to the equation specified in **ISO 10300-1:2001** or **ISO 23509:2006**. Symbols shall be in accordance with table 1.

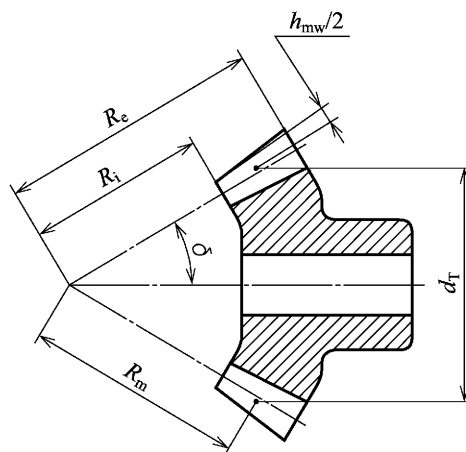
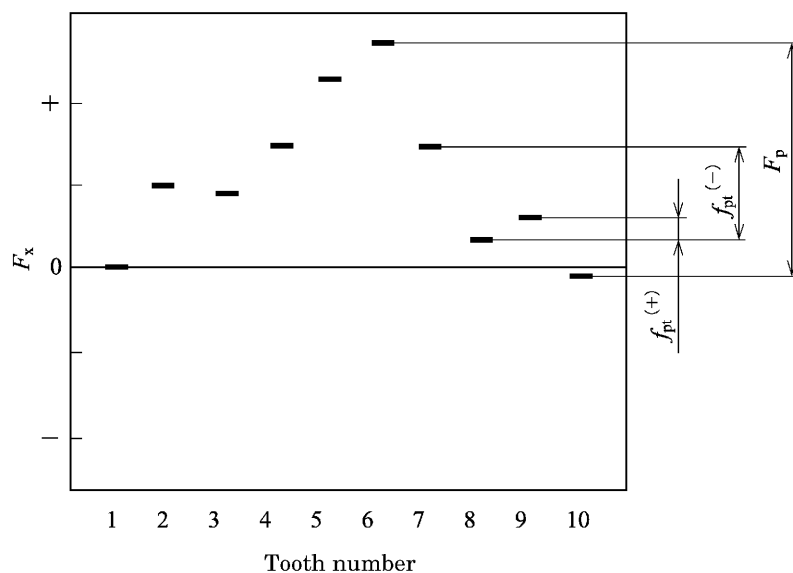


Figure 2 Tolerance diameter

3.9 total cumulative pitch deviation F_p

largest algebraic difference between any two index deviation values for a specified flank (left or right)

As shown in figure 3, the distinction for rotation direction or the plus and minus signs are not designated. This Standard specifies the tolerance direction of measurement for total cumulative pitch deviation to be along the arc of the tolerance diameter circle in the transverse section. Tolerances are provided in 6.3.3.



F_s : index deviation
 f_{pt} : single pitch deviation
 F_p : total cumulative pitch deviation

Figure 3 Relation between measured value and respective deviations

3.10 transmission error θ_e

angular deviation of the driven gear position corresponding to the given angular position of the driving gear from the theoretical value in the single-flank composite test

The unit shall be “ μrad ”. See Annex B for the measuring method of the transmission error.

4 Symbols and units

For the purposes of this Standard, the symbols and units shall be in accordance with table 1.

Table 1 Symbols

Symbol	Term	Unit	Where first used in this Standard
B	Accuracy grade		6.3.1
d_m	Mean pitch diameter	mm	3.8
d_T	Tolerance diameter	mm	3.8
F_{is}	Total single-flank composite deviation	μm	3.6
F_{isT}	Total single-flank composite deviation tolerance	μm	6.3.6
F_p	Total cumulative pitch deviation	μm	3.9
F_{pT}	Total cumulative pitch deviation tolerance	μm	6.3.3
F_r	Total run-out deviation	μm	3.4
F_{rT}	Total run-out deviation tolerance	μm	6.3.4
F_x	Index deviation	μm	3.1
f_{is}	Tooth mesh component single-flank composite deviation	μm	3.5
$f_{is(\text{design})}$	Design tooth mesh component single-flank composite deviation	μm	6.3.5
f_{isT}	Tooth mesh component single-flank composite deviation tolerance	μm	6.3.5
f_{pt}	Single pitch deviation	μm	3.7
f_{ptT}	Single pitch deviation tolerance	μm	6.3.2
h_{am}	Mean addendum depth	mm	3.8
h_{mw}	Mean working tooth depth	mm	3.8
m_{et}	Outer normal module	mm	3.2
m_{mn}	Mean normal module	mm	3.2
R_e	Outer cone distance	mm	3.2
R_i	Inner cone distance	mm	Figure 2
R_m	Mean cone distance	mm	3.2
z	Number of teeth		3.2
β_m	Mean spiral angle	°	3.2
δ	Pitch cone angle	°	3.8
θ_c	Transmission error	μrad	3.10
Subscript			
Symbol	Term		
m	Mean		
T	Tolerance		
1	Pinion		
2	Wheel		

5 Accuracy grade and evaluation for gear accuracy

5.1 Accuracy grade

The accuracy grade shall be divided in ten grades of Grade 2 to Grade 11.

Grade 2 has the smallest tolerance and Grade 11 has the largest.