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Gear Manufacturers
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ANSI/AGMA ISO 23509-B17
(Identical to ISO 23509:2016)

American National Standard

Bevel and Hypoid Gear Geometry

ANSI/AGMA ISO 23509-B17

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Standard*****Bevel and Hypoid Gear Geometry***

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[Identical to ISO 23509:2016]

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Approved December 12, 2017

ABSTRACT

This standard specifies the geometry of bevel gears. The term bevel gears is used to mean straight, spiral, zerol bevel and hypoid gear designs. If the text pertains to one or more, but not all, of these, the specific forms are identified. This standard is intended for use by an experienced gear designer capable of selecting reasonable values for the factors based on his/her knowledge and background. It is not intended for use by the engineering public at large.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of ANSI/AGMA ISO 23509-B17, *Bevel and Hypoid Gear Geometry*.]

For many decades, information on bevel, and especially hypoid, gear geometry has been developed and published by the gear machine manufacturers. It is clear that the specific formulae for their respective geometries were developed for the mechanical generation methods of their particular machines and tools. In many cases, these formulae could not be used in general for all bevel gear types. This situation changed with the introduction of universal, multi-axis, CNC-machines, which in principle are able to produce nearly all types of gearing. The manufacturers were, therefore, asked to provide CNC programs for the geometries of different bevel gear generation methods on their machines.

This document integrates straight bevel gears and the three major design generation methods for spiral bevel gears into one complete set of formulae. In only a few places do specific formulae for each method have to be applied. The structure of the formulae is such that they can be programmed directly, allowing the user to compare the different designs.

The formulae of the three methods are developed for the general case of hypoid gears and to calculate the specific case of spiral bevel gears by entering zero for the hypoid offset. Additionally, the geometries correspond such that each gear set consists of a generated or non-generated wheel without offset and a pinion which is generated and provided with the total hypoid offset.

An additional objective of this document is that, on the basis of the combined bevel gear geometries, an ISO hypoid gear rating system can be established in the future.

ISO 23509:2016 was developed by Technical Committee ISO TC 60, *Gears*. The changes in the new document include:

- minor corrections of several formulae;
- the figures have been reworked;
- explanations have been added in 4.4;
- the structure of Formula (129) has been changed to cover the case $\zeta_m = 0^\circ$;
- a formula for the calculation of c_{be2} has been added as Formula (F.160);
- the values for α_{nC} and α_{nC} in Formulae (F.318) and (F.319) have been extended to three decimal digits to prevent rounding errors.

The AGMA Bevel Gearing Committee approved the adoption of ISO 23509:2016 in June 2017. It was approved as an American National Standard, ANSI/AGMA ISO 23509-B17, on December 12, 2017.

ANSI/AGMA ISO 23509-B17 replaces ANSI/AGMA ISO 23509-A08. The new document represents an identical adoption of ISO 23509:2016, which replaced ISO 23509:2006.

Suggestions for improvement of this standard will be welcome. They may be submitted to tech@agma.org.

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American National Standard –

Bevel and Hypoid Gear Geometry

1 Scope

This document specifies the geometry of bevel gears.

The term bevel gears is used to mean straight, spiral, zerol bevel and hypoid gear designs. If the text pertains to one or more, but not all, of these, the specific forms are identified.

The manufacturing process of forming the desired tooth form is not intended to imply any specific process, but rather to be general in nature and applicable to all methods of manufacture.

The geometry for the calculation of factors used in bevel gear rating, such as ISO 10300 (all parts), is also included.

This document is intended for use by an experienced gear designer capable of selecting reasonable values for the factors based on his/her knowledge and background. It is not intended for use by the engineering public at large.

Annex A provides a structure for the calculation of the methods provided in this document.

2 Normative references

There are no normative references in this document.

3 Terms, definitions and symbols

For the purposes of this document, the terms and definitions given in ISO 1122-1 and the following apply.

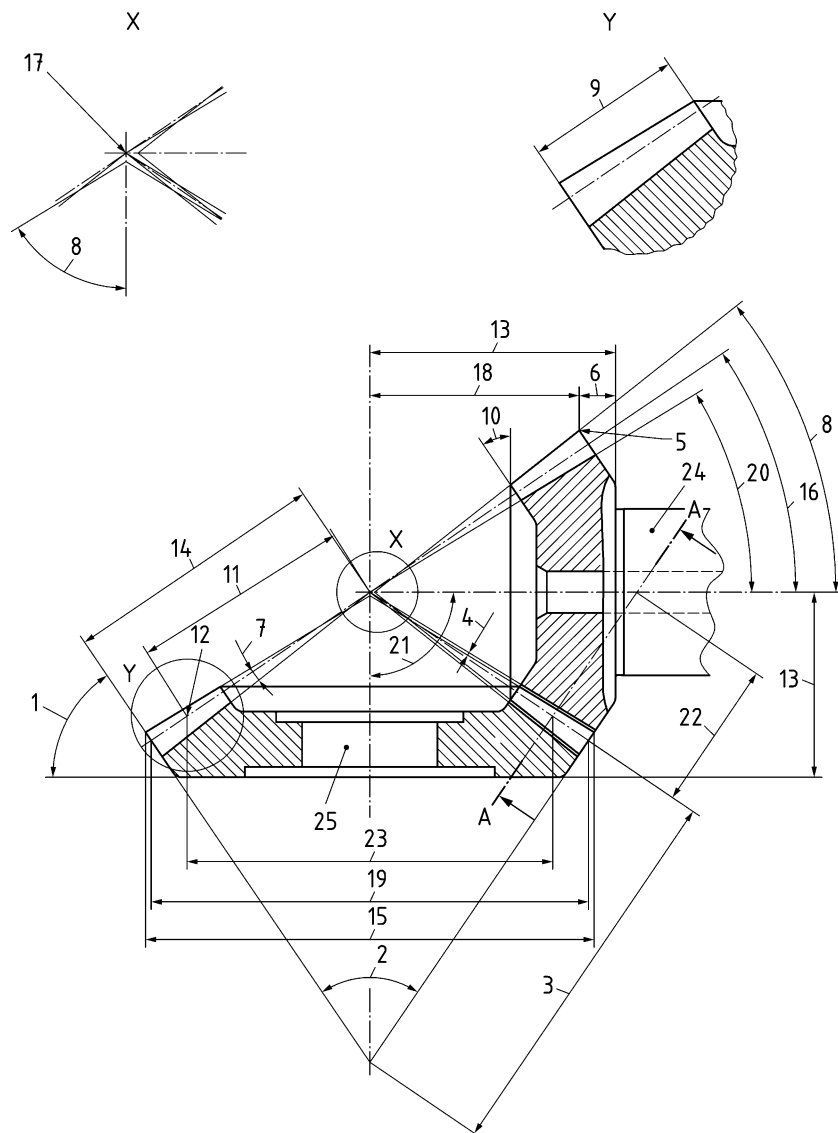
ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

NOTE 1 The symbols, terms and definitions used in this document are, wherever possible, consistent with other International Standards. It is known, because of certain limitations, that some symbols, their terms and definitions, as used in this document, are different from those used in similar literature pertaining to spur and helical gearing.

NOTE 2 Bevel gear nomenclature used throughout this document is illustrated in Figure 1, the axial section of a bevel gear, and in Figure 2, the mean transverse section. Hypoid nomenclature is illustrated in Figure 3.

Subscript 1 refers to the pinion and subscript 2 to the wheel.

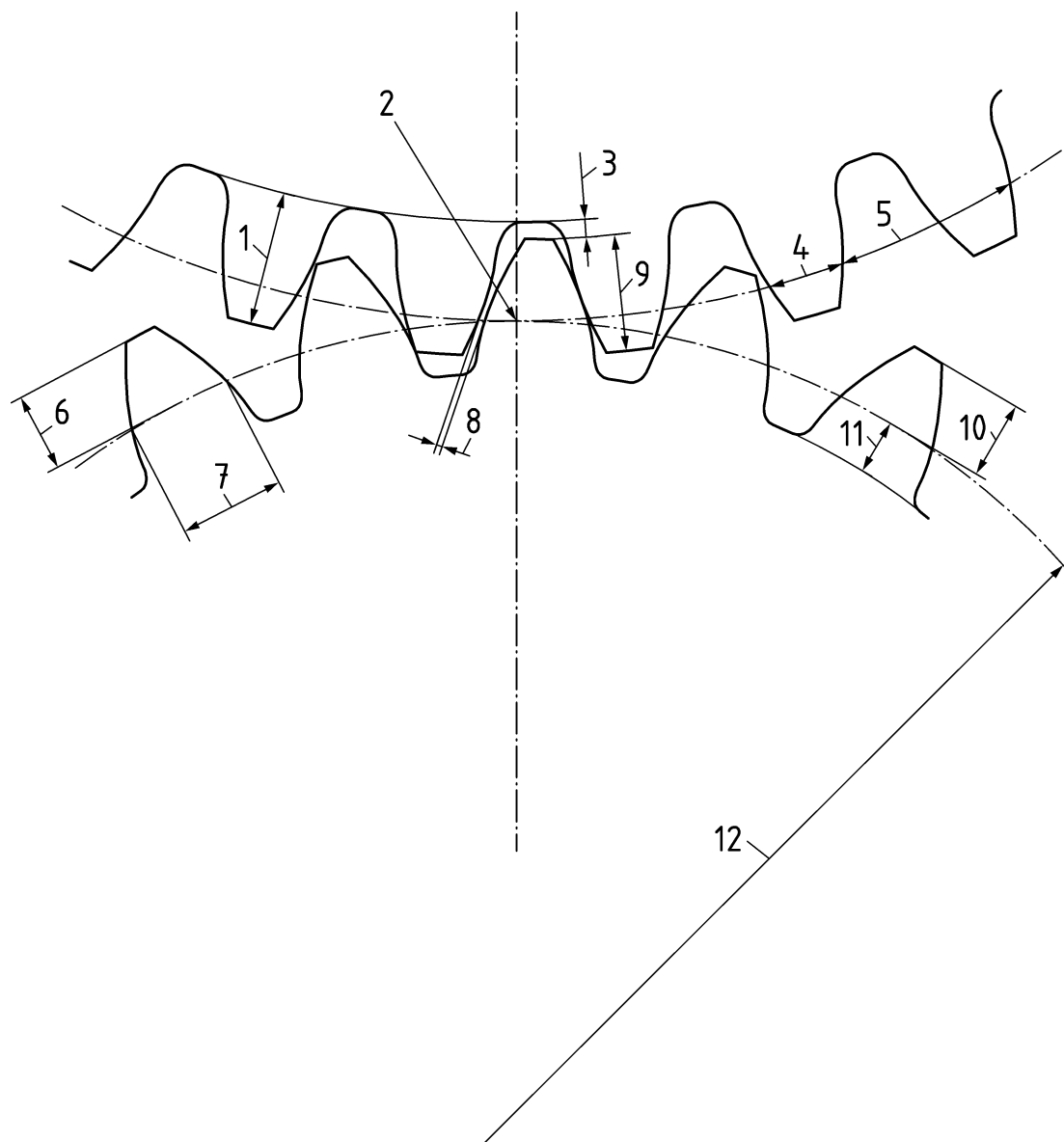


Key

1 back angle	10 front angle	19 outer pitch diameter, d_{e1} , d_{e2}
2 back cone angle	11 mean cone distance, R_m	20 root angle, δ_{f1} , δ_{f2}
3 back cone distance	12 mean point	21 shaft angle, Σ
4 clearance, c	13 mounting distance	22 equivalent pitch radius
5 crown point	14 outer cone distance, R_e	23 mean pitch diameter, d_{m1} , d_{m2}
6 crown to back	15 outside diameter, d_{ae1} , d_{ae2}	24 pinion
7 dedendum angle, θ_{f1} , θ_{f2}	16 pitch angle, δ_1 , δ_2	25 wheel
8 face angle δ_{a1} , δ_{a2}	17 pitch cone apex	
9 face width, b	18 crown to crossing point, t_{x01} , t_{x02}	

NOTE See Figure 2 for mean transverse section, A-A.

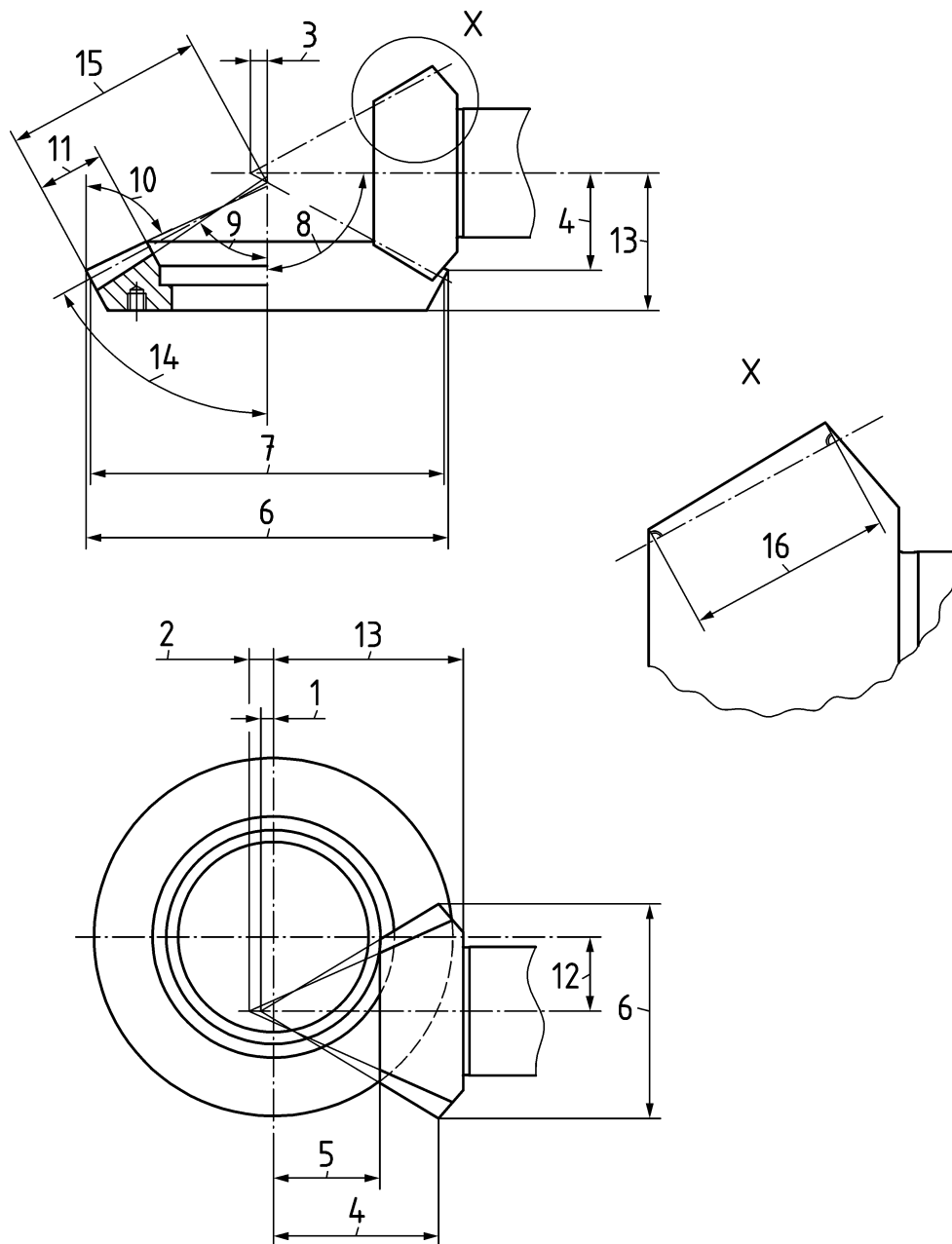
Figure 1 — Bevel gear nomenclature — Axial plane

**Key**

1	whole depth, h_m	5	circular pitch	9	working depth, h_{mw}
2	pitch point	6	chordal addendum	10	addendum, h_{am}
3	clearance, c	7	chordal thickness	11	dedendum, h_{fm}
4	circular thickness	8	backlash	12	equivalent pitch radius

NOTE See A-A in Figure 1.

Figure 2 — Bevel gear nomenclature — Mean transverse section

**Key**

1	face apex beyond crossing point, t_{zF1}	7	outer pitch diameter, d_{e1}, d_{e2}	13	mounting distance
2	root apex beyond crossing point, t_{zR1}	8	shaft angle, Σ	14	pitch angle, δ_2
3	pitch apex beyond crossing point, t_{z1}	9	root angle, δ_{f1}, δ_{f2}	15	outer cone distance, R_e
4	crown to crossing point, t_{xo1}, t_{xo2}	10	face angle of blank, δ_{a1}, δ_{a2}	16	pinion face width, b_1
5	front crown to crossing point, t_{xi1}	11	wheel face width, b_2		
6	outside diameter, d_{ae1}, d_{ae2}	12	hypoid offset, a		

NOTE Apex beyond crossing point values are positive when crossing point lies inside the respective cone.

Figure 3 — Hypoid nomenclature

3.1 Terms and definitions

3.1.1

mean chordal addendum

$$h_{amc1}, h_{amc2}$$

height from the top of the gear tooth to the chord subtending the circular thickness arc at the mean cone distance in a plane normal to the tooth face

3.1.2

mean addendum

$$h_{am1}, h_{am2}$$

height by which the gear tooth projects above the pitch cone at the mean cone distance

3.1.3

outer normal backlash allowance

$$j_{en}$$

amount by which the tooth thicknesses are reduced to provide the necessary backlash in assembly

Note 1 to entry: It is specified at the outer cone distance.

3.1.4

coast side

<by normal convention> convex pinion flank in mesh with the concave wheel flank

3.1.5

cutter radius

$$r_{c0}$$

nominal radius of the face type cutter or cup-shaped grinding wheel that is used to cut or grind the spiral bevel teeth

3.1.6

sum of dedendum angles

$$\Sigma\theta_f$$

sum of the pinion and wheel dedendum angles

3.1.7

sum of constant slot width dedendum angles

$$\Sigma\theta_{fc}$$

sum of dedendum angles for constant slot width

3.1.8

sum of modified slot width dedendum angles

$$\Sigma\theta_{fm}$$

sum of dedendum angles for modified slot width taper

3.1.9

sum of standard depth dedendum angles

$$\Sigma\theta_{fs}$$

sum of dedendum angles for standard depth taper