SLOVENSKI STANDARD

SIST ISO 23509:2008

01-julij-2008

Geometrija stoǵļ astih in hipoidnih zobnikov

Bevel and hypoid gear geometry

Géométrie des engrenages coniques et hypoïdes

Ta slovenski standard je istoveten z: ISO 23509:2006

ICS:

21.200 Gonila Gears

SIST ISO 23509:2008 en,fr

INTERNATIONAL STANDARD

ISO 23509

First edition
2006-09-01

Bevel and hypoid gear geometry

Géométrie des engrenages coniques et hypoïdes

Reference number
ISO 23509:2006(E)

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 23509 was prepared by Technical Committee ISO/TC 60, *Gears*, Subcommittee SC 2, *Gear capacity calculation*.

Introduction

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 formulas for their respective geometries were developed for the mechanical generation methods of their particular machines and tools. In many cases, these formulas 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 International Standard integrates straight bevel gears and the three major design generation methods for spiral bevel gears into one complete set of formulas. In only a few places do specific formulas for each method have to be applied. The structure of the formulas is such that they can be programmed directly, allowing the user to compare the different designs.

The formulas of the three methods are developed for the general case of hypoid gears and 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 International Standard is that on the basis of the combined bevel gear geometries an ISO hypoid gear rating system can be established in the future.

Bevel and hypoid gear geometry

1 Scope

This International 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.

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, is also included.

This International Standard is intended for use by an experienced gear designer capable of selecting reasonable values for the factors based on his 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 International Standard.

2 Normative references

The following referenced documents are indispensable for the application 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 1122-1:1998, *Vocabulary of gear terms — Part 1: Definitions related to geometry*

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

ISO 10300-2:2001, *Calculation of load capacity of bevel gears — Part 2: Calculation of surface durability (pitting)*

ISO 10300-3:2001, *Calculation of load capacity of bevel gears — Part 3: Calculation of tooth root strength*

3 Terms, definitions and symbols

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

NOTE 1 The symbols, terms and definitions used in this International Standard 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 International Standard 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.

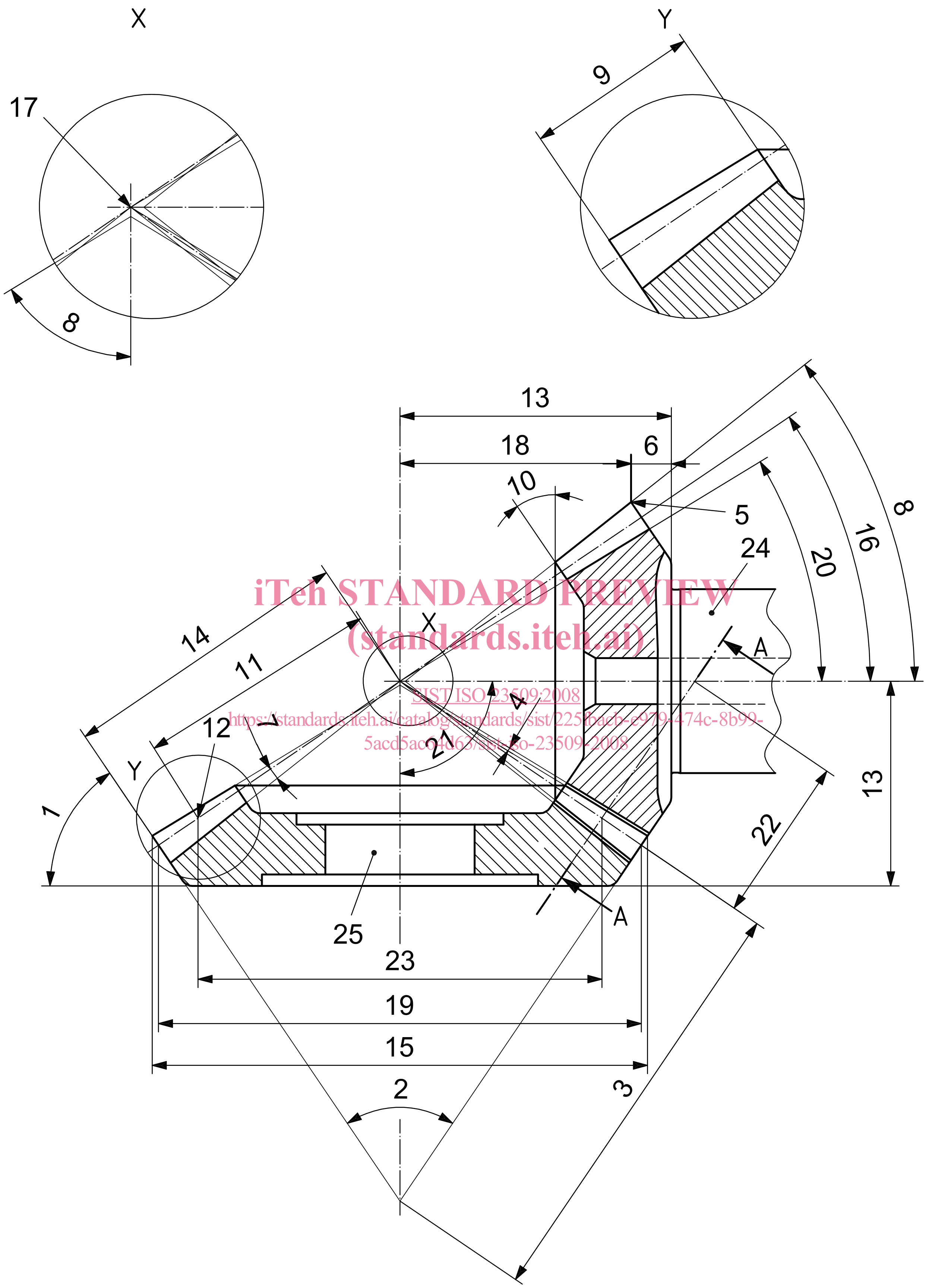


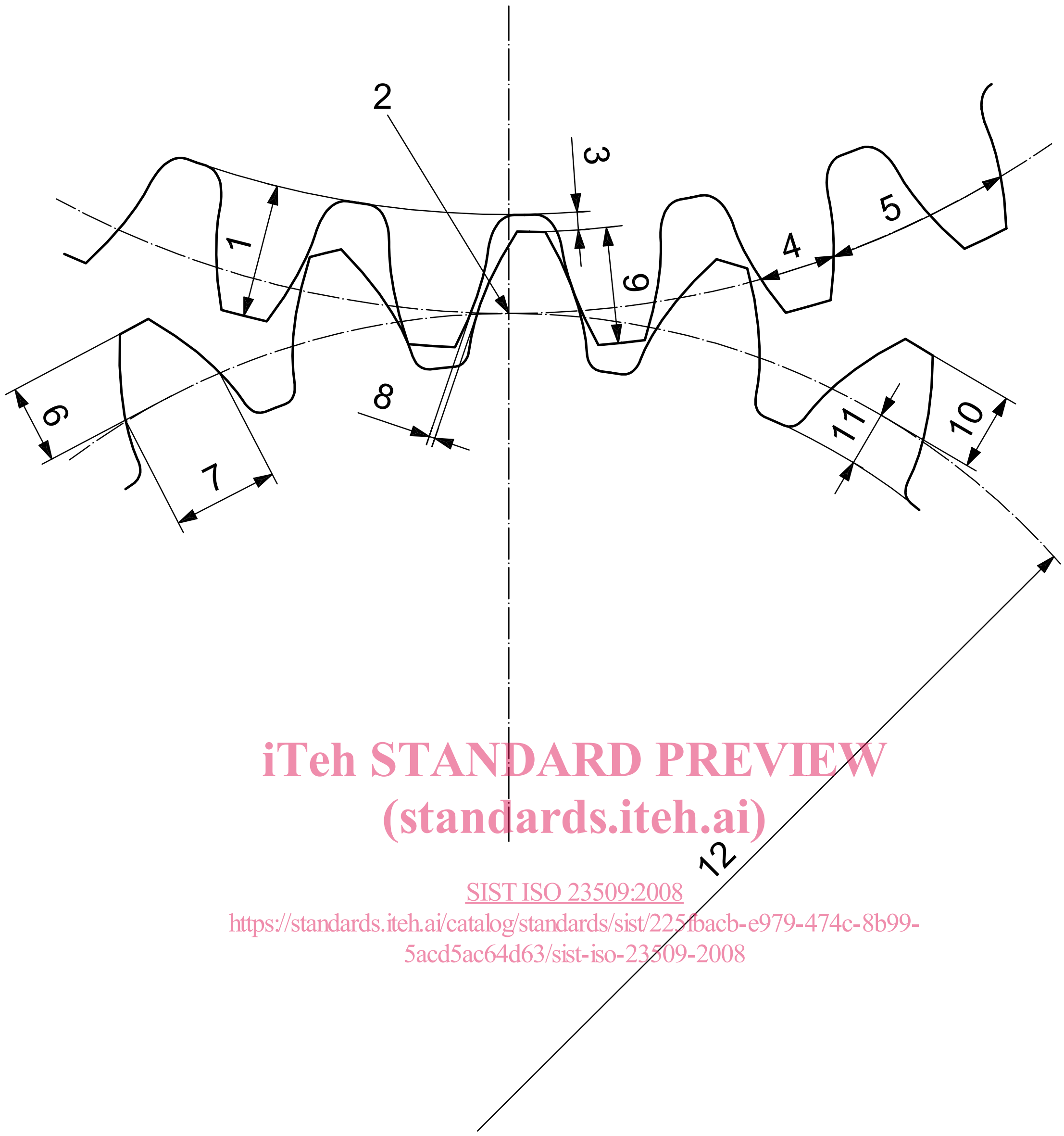
Figure 1 — Bevel gear nomenclature — Axial plane

Key

1 back angle
2 back cone angle
3 back cone distance
4 clearance, c
5 crown point
6 crown to back
7 dedendum angle, θ_{f1}, θ_{f2}
8 face angle δ_{a1}, δ_{a2}
9 face width, b
10 front angle
11 mean cone distance, R_m
12 mean point
13 mounting distance
14 outer cone distance, R_e
15 outside diameter, d_{ae1}, d_{ae2}
16 pitch angle, δ_1, δ_2
17 pitch cone apex
18 crown to crossing point, t_{xo1}, t_{xo2}
19 outer pitch diameter, d_{e1}, d_{e2}
20 root angle, δ_{f1}, δ_{f2}
21 shaft angle, Σ
22 equivalent pitch radius
23 mean pitch diameter, d_{m1}, d_{m2}
24 pinion
25 wheel

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

Figure 1 — Bevel gear nomenclature — Axial plane (*continued*)



Key

1 whole depth, h_m

2 pitch point

3 clearance, c

4 circular thickness

5 circular pitch

6 chordal addendum

7 chordal thickness

8 backlash

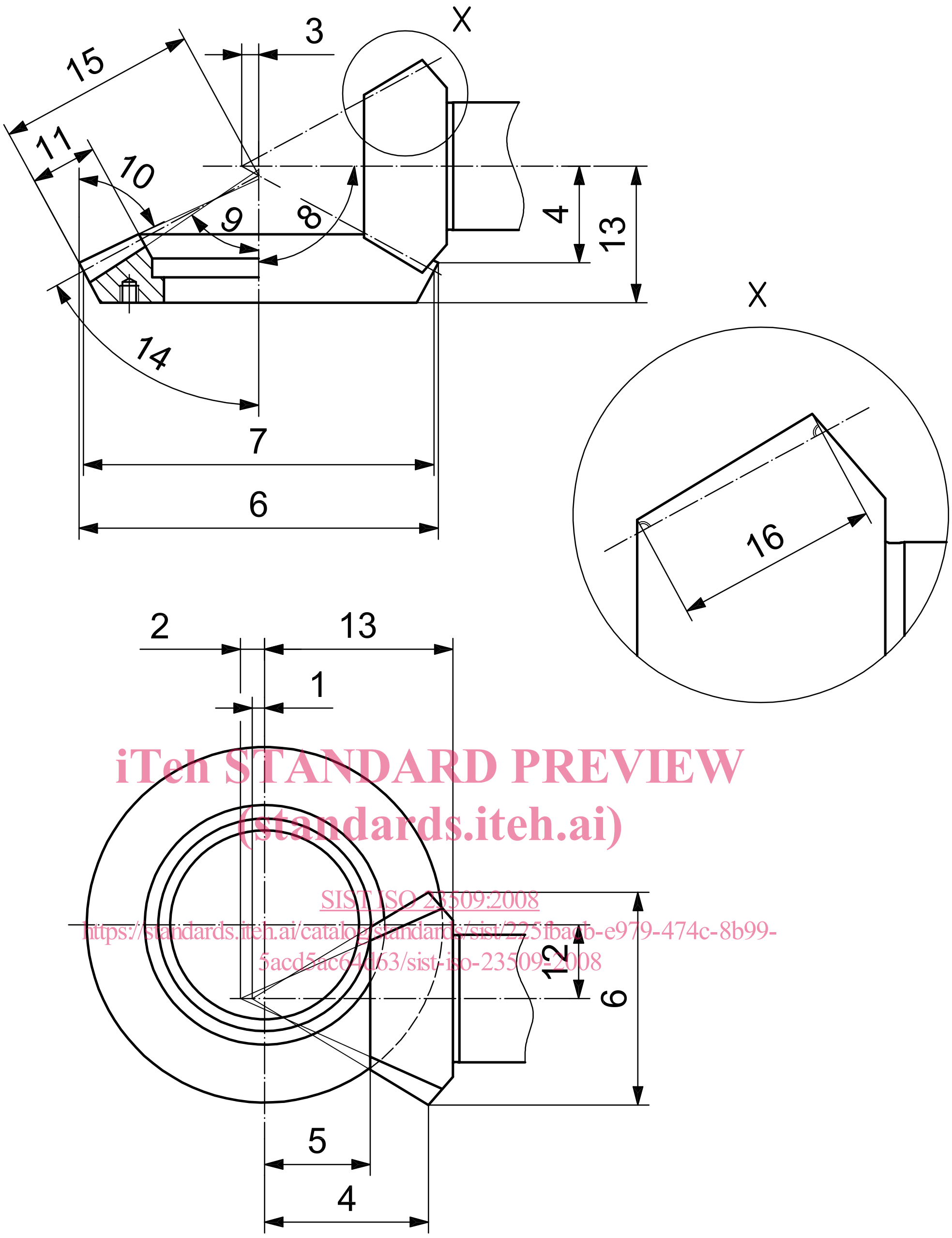
9 working depth, h_{mw}

10 addendum, h_{am}

11 dedendum, h_{fm}

12 equivalent pitch radius

Figure 2 — Bevel gear nomenclature — Mean transverse section (A-A in Figure 1)



Key

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

NOTE 1 Apex beyond centreline of mate (positive values).

NOTE 2 Apex before centreline of mate (negative values).

Figure 3 — Hypoid nomenclature

3.1 Terms and definitions

3.1.1
pinion [wheel] mean normal 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
pinion [wheel] 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 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

3.1.10
sum of uniform depth dedendum angles
$\Sigma\theta_{fU}$
sum of dedendum angles for uniform depth

3.1.11
pinion [wheel] mean dedendum
h_{fm1}, h_{fm2}
depth of the tooth space below the pitch cone at the mean cone distance

3.1.12
mean whole depth
h_m
tooth depth at mean cone distance

3.1.13
mean working depth
h_{mw}
depth of engagement of two gears at mean cone distance

3.1.14
direction of rotation
direction determined by an observer viewing the gear from the back looking toward the pitch apex

3.1.15
drive side
by normal convention, concave pinion flank in mesh with the convex wheel flank

3.1.16
face width
b
length of the teeth measured along a pitch cone element

3.1.17
mean addendum factor
c_{ham}
apportions the mean working depth between wheel and pinion mean addendums

NOTE The gear mean addendum is equal to c_{ham} times the mean working depth.

3.1.18
mean radius of curvature
$\rho_{m\beta}$
radius of curvature of the tooth surface in the lengthwise direction at the mean cone distance

3.1.19
number of blade groups
z_0
number of blade groups contained in the circumference of the cutting tool

3.1.20
number of teeth in pinion [wheel]
z_1, z_2
number of teeth contained in the whole circumference of the pitch cone

3.1.21
number of crown gear teeth
z_p
number of teeth in the whole circumference of the crown gear

NOTE The number may not be an integer.

3.1.22
mean normal chordal pinion [wheel] tooth thickness
s_{mnc1}, s_{mnc2}
chordal thickness of the gear tooth at the mean cone distance in a plane normal to the tooth trace