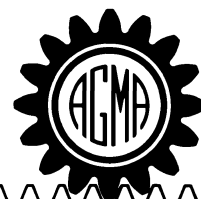


AMERICAN GEAR MANUFACTURERS ASSOCIATION

*Rating the Pitting Resistance and Bending
Strength of Hypoid Gears*



AGMA INFORMATION SHEET

(This Information Sheet is NOT an AGMA Standard)

American
Gear
Manufacturers
Association

Rating the Pitting Resistance and Bending Strength of Hypoid Gears
AGMA 932-A05

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Approved January 19, 2005

ABSTRACT

This information sheet provides a method by which different hypoid gear designs can be compared. The formulas are intended to establish a uniformly acceptable method for calculating the pitting resistance and bending strength capacity of both curved and skewed tooth hypoid gears. They apply equally to tapered depth and uniform depth teeth.

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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 AGMA Information Sheet 932-A05, *Rating the Pitting Resistance and Bending Strength of Hypoid Gears*.]

The material present in AGMA 932-A05 was originally included in an annex of the draft for ANSI/AGMA 2003-B97. The intent was to have a proposed rating method that would complement the hypoid geometry presented in ANSI/AGMA 2005-C95. It was removed from ANSI/AGMA 2003-B97 during the ballot process to allow for its timely publication. The committee felt this material should be expanded and presented in a separate information sheet prior to standardization.

The first draft of AGMA 932-A05 was made in June, 2003. It was approved by the AGMA Technical Division Executive Committee in January, 2005.

Suggestions for improvement of this information sheet will be welcome. They should be sent to the American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314.

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American Gear Manufacturers Association –

Rating the Pitting Resistance and Bending Strength of Hypoid Gears

1 Scope

This information sheet provides a method for calculating the pitting resistance and bending strength of hypoid gears using the procedures of ANSI/AGMA 2003-B97.

1.1 Rating formulas

The knowledge and judgment required to evaluate the various rating factors come from years of accumulated experience in designing, manufacturing and operating gear units. Empirical factors given in this document are general in nature. AGMA application standards may use other empirical factors that are more closely suited to the particular field of application. This document is intended for use by the experienced gear designer, capable of selecting reasonable values for the factors. It is not intended for use by the engineering public at large.

1.2 Exceptions

The exceptions in clause 1.2 of ANSI/AGMA 2003-B97 apply for hypoid gears. Lengthwise sliding in hypoids reduces their efficiency. Torque losses between driving pinion and gear range from 2 to 15 percent depending on the offset, spiral angles, velocity and lubrication. The equations neglect

efficiency. The user can adjust input or output to account for losses.

2 Normative references

The following documents contain provisions which, through reference in this text, constitute provisions of this information sheet. At the time of publication, the editions were valid. All publications are subject to revision, and the users of this document are encouraged to investigate the possibility of applying the most recent editions of the publications listed.

ANSI/AGMA 2003-B97, *Rating the Pitting Resistance and Bending Strength of Generated Straight Bevel, Zerol Bevel and Spiral Bevel Gear Teeth*

ANSI/AGMA 2005-D03, *Design Manual for Bevel Gears*

3 Nomenclature

The symbols used in this information sheet are shown in table 1.

NOTE: The symbols and terms contained in this document may vary from those used in other AGMA standards. Users of this information sheet should assure themselves that they are using these symbols and terms in the manner indicated herein.

System international (SI) units of measure are shown in parentheses in table 1 and in the text.

Equations are shown in two formats: the first is non-metric, the second is with SI units, constants and ISO symbols, designated by “M” in the equation number.

Example:

$$s_{wc} = \frac{s_{ac} C_L C_H}{S_H K_T C_R} \quad (2)$$

$$\sigma_{HP} = \frac{\sigma_H \lim Z_{NT} Z_W}{S_H K_\theta Z_Z} \quad (2M)$$

Table 1 - Symbols

AGMA symbol	ISO symbol	Terms	Units	Where first used
A_m	R_m	Mean cone distance	in (mm)	Eq 5
A_{mG}	R_{m2}	Gear mean cone distance	in (mm)	Eq 5
C_H	Z_W	Hardness ratio factor	--	Eq 8
C_i	Z_i	Inertia factor for gears with low contact ratio, pitting resistance	--	Eq 18
C_L	Z_{NT}	Stress cycle factor for pitting resistance	--	Eq 8
C_p	Z_E	Elastic coefficient	$[lb/in^2]^{0.5}$ $([N/mm^2]^{0.5})$	Eq 7
C_R	Z_Z	Reliability factor for pitting resistance	--	Eq 8
C_s	Z_x	Size factor for pitting resistance	--	Eq 7
C_{xc}	Z_{xc}	Crowning factor	--	Eq 7
D	d_{e2}	Gear outer pitch diameter	in (mm)	Eq 1
d	d_{e1}	Pinion outer pitch diameter	in (mm)	Eq 1
E	a	Hypoid offset	in (mm)	Annex A
F	b	Net face width	in (mm)	Eq 2
F_{eP}	b'_1	Effective face width of pinion	in (mm)	Eq 19
F_{eG}	b'_2	Effective face width of gear	in (mm)	Eq 20
F_G	b_2	Gear face width	in (mm)	Eq 2
F_P	b_1	Pinion face width	in (mm)	Eq 11
I	Z_I	Geometry factor for pitting resistance	--	Eq 7
J'_P	Y'_{J1}	Modified pinion bending strength geometry factor	--	Eq 13
J_G	Y_{J2}	Geometry factor for gear bending strength	--	Eq 12
J_P	Y_{J1}	Geometry factor for pinion bending strength	--	Eq 11
K_i	Y_i	Inertia factor for gears with low contact ratio, bending strength	--	Eq 19
K_L	Y_{NT}	Stress cycle factor for bending strength	--	Eq 14
K_m	$K_{H\beta}$	Load distribution factor	--	Eq 7
K_o	K_A	Overload factor	--	Eq 7
K_R	Y_Z	Reliability factor for bending strength	--	Eq 14
K_s	Y_X	Size factor for bending strength	--	Eq 11
K_T	K_θ	Temperature factor	--	Eq 8
K_v	K_v	Dynamic factor	--	Eq 7
K_x	Y_β	Tooth lengthwise curvature factor	--	Eq 11
m_{NI}	ϵ_{NI}	Load sharing ratio for pitting resistance	--	Eq 18
m_{NJ}	ϵ_{NJ}	Load sharing ratio for bending strength	--	Eq 19
N	z_2	Number of teeth on gear	--	Eq 1
n	z_1	Number of teeth on pinion	--	Eq 1
n_G	n_2	Gear speed	rpm	Eq 10
P_{ac}	P_{az}	Allowable transmitted power for pitting resistance	hp (kw)	Eq 10
$P_{at P, G}$	$P_{ay 1, 2}$	Allowable transmitted power, pinion or gear, for bending strength	hp (kw)	Eq 16
P_d	--	Outer transverse diametral pitch	in^{-1}	Eq 6
P_{dG}	--	Outer transverse diametral pitch of gear	in^{-1}	Eq 6

(continued)