INTERNATIONAL STANDARD

ISO 4468

Second edition
2009-06-01

Gear hobs — Accuracy requirements

Fraises-mères — Exigences d'exactitude

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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

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Foreword

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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 4468 was prepared by Technical Committee ISO/TC 60, *Gears*, Subcommittee SC 1, *Nomenclature and wormgearing*.

This second edition cancels and replaces the first edition (ISO 4468:1982), which has been technically revised.

Gear hobs — Accuracy requirements

1 Scope

This International Standard specifies requirements for the accuracy of general-purpose hobs of 0,5 module to 40 module.

These hobs are intended for producing gears which conform to ISO 53 and ISO 54.

This International Standard applies to hobs for spur and helical gears. It applies to solid (monobloc) and inserted blade hobs.

The elemental features of hobs are graded according to accuracy, as follows:

— Grade 4A;

— Grade 3A;

— Grade 2A:

— Grade A;

— Grade B;

— Grade C;

— Grade D.

Grade 4A is the highest order of precision.

In addition to the elemental tests for hobs, this International Standard gives permitted tolerances for composite tests that are taken along the cutting edges on the line of action. The two groups of tests are not equivalent and one shall choose between one or the other. If there was no previous agreement, the hob is regarded as belonging to the precision class specified if it satisfies one or the other of the two methods of inspection.

NOTE The tolerances in this International Standard were determined for gear hobs whose dimensions conform to ISO 2490, but with certain precautions they can be applied to hobs not specified 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 53, *Cylindrical gears for general and heavy engineering — Standard basic rack tooth profile*

ISO 54, *Cylindrical gears for general engineering and for heavy engineering — Modules*

ISO 286-2, *ISO system of limits and fits — Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts*

ISO 1122-1, *Vocabulary of gear terms — Part 1: Definitions related to geometry*

ISO 2490, *Solid (monobloc) gear hobs with tenon drive or axial keyway, 0,5 to 40 module — Nominal dimensions*

3 Terms and definitions

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

3.1
radial runout of hub diameter
total deviation in radial distance of the hub periphery from the axis

3.2
axial runout of hub face
total axial deviation of the hub face from a true plane of rotation

3.3
radial runout of tips of teeth
total deviation in the radial distance from the axis to the tips of the hob teeth

3.4
straightness and radial alignment over cutting depth
angular relationship between the tooth face and a radial line intersecting the tooth face at the hob outside diameter, measured in a plane perpendicular to the axis

3.5
adjacent spacing of cutting face of gashes
maximum deviation between any two consecutive cutting face measurements

3.6
total spacing of cutting face of gashes
maximum deviation between any two cutting face measurements

3.7
gash lead deviation per 100 mm
maximum deviation as the probe contacts the tooth faces within axial region of the gash

NOTE Allowable values for deviations are given per 100 mm of cutting face width.

3.8
tooth profile deviation
maximum deviation of that portion of the hob tooth that generates an unmodified involute profile

3.8.1
tooth profile deviation when line of action test is used
maximum deviation of that portion of the hob tooth that generates an unmodified involute profile when the line of action test is used

NOTE Test 8A is used for tooth profile deviation when the line of action test is used.

3.9
tooth thickness
normal tooth thickness difference of actual and reference datum at the reference cylinder

NOTE Negative only.

3.9.1
addendum
difference of addendum values related to designed normal tooth thickness observed during testing

NOTE Positive only. Test 9A is used for addendum.

3.9.2
tooth thickness difference along one gash
difference between maximum and minimum nominal tooth thickness along one gash at the reference cylinder

NOTE Test 9B is used for tooth thickness difference along one gash. This test is only valid for quality Grades 4A, 3A and 2A.

3.10
lead deviation on adjacent teeth
maximum lead deviation between any two consecutive teeth

3.11
lead deviation in one axial pitch
maximum deviation between any two teeth within any group of consecutive teeth contained in one axial pitch; the number of teeth in one axial pitch is the number of teeth encountered by the measurement probe as it moves parallel to the reference axis during lead testing for a distance of one axial pitch of the hob

NOTE The number of teeth is determined by the number of gashes, the number of threads and, in the case of helical gash hobs, the gash lead.

3.11.1
lead deviation in one axial pitch when line of action test is used
maximum deviation between any two teeth within any group of consecutive teeth contained in one axial pitch when the line of action test is used

NOTE Test 11A is used for lead deviation in one axial pitch when the line of action test is used.

3.12
lead deviation in three axial pitches
maximum lead deviation between any two teeth contained in three axial pitches; the number of teeth in three axial pitches is that number of teeth encountered by the measurement probe as it moves parallel to the reference axis during lead testing for a distance of three axial pitches of the hob

NOTE The number of teeth is determined by the number of gashes, the number of threads and, in the case of helical gash hobs, the gash lead.

3.12.1
lead deviation in three axial pitches when line of action test is used
maximum lead deviation between any two teeth contained in three axial pitches when the line of action test is used

NOTE Test 12A is used for lead deviation in three axial pitches when the line of action test is used.

3.13
adjacent deviation along line of action
maximum deviation between any two consecutive teeth of a given line of action test

NOTE 1 Adjacent hob line of action allowable deviation can be applied to adjacent line of action test results in those cases where the hob has been specified to be manufactured with involute helicoid geometry.

NOTE 2 Adjacent deviation along the line of action is measured at the cutting edge.

3.14
total deviation along line of action
total maximum deviation between any two teeth of a given line of action test

NOTE 1 Total hob line of action allowable deviation can be applied to total line of action test results in those cases where the hob has been specified to be manufactured with involute helicoid geometry.

NOTE 2 Total deviation along the line of action is measured at the cutting edge.

3.15
axial pitch deviation from thread to thread
maximum axial pitch deviation between any two consecutive teeth contained within two gashes

NOTE 1 For an odd number of threads, the angle between the gashes is approximately 90°. For an even number of threads, it is approximately 120°.

NOTE 2 The minimum requirement is to inspect the number of axial pitches equal to the number of threads.

3.16
axial pitch deviation in any three axial pitches over all threads
maximum axial pitch deviation over any three adjacent teeth contained within two gashes

NOTE 1 For an odd number of threads, the angle between the gashes is approximately 90°. For an even number of threads, it is approximately 120°.

NOTE 2 The minimum requirement is to inspect the number of axial pitches equal to the number of threads.

4 Accuracy requirements

Hobs shall conform to the requirements of Tables 2 and 4, as appropriate.

When prior agreement between the hob manufacturer and purchaser specifies measurement of hobs, the manufacturer should select:

— the measurement method to be used from among the applicable methods described in this International Standard and summarized in Table 1;

— the piece of measurement equipment to be used by the selected measurement method, provided it is in proper calibration;

— the individual teeth to be measured, as long as they are approximately equally spaced.

No particular method of measurement or documentation is considered mandatory. When applications require measurements beyond those recommended in this International Standard, it is recommended to negotiate special measurement methods prior to manufacturing the hob.

Table 1 — Reference for measurement methods

Test method definition	Test description	Test number [a]	
		Elemental test	Composite test [b]
3.1	Radial runout of hub diameter	1	1
3.2	Axial runout of hub face	2	2
3.3	Radial runout of tips of teeth	3	3
3.4	Straightness and radial alignment over cutting depth	4	4
3.5	Adjacent spacing of cutting face of gashes	5	5
3.6	Total spacing of cutting face of gashes	6	6
3.7	Gash lead deviation per 100 mm	7	7
3.8	Tooth profile deviation	8	8A
3.9	Tooth thickness	9 or 9A and 9B	9 or 9A and 9B
3.10	Lead deviation on adjacent teeth	10	10
3.11	Lead deviation in one axial pitch	11	11A
3.12	Lead deviation in three axial pitches	12	12A
3.13	Adjacent deviation along line of action (measured at the cutting edge)	— [c]	13
3.14	Total deviation along line of action (measured at the cutting edge)	— [c]	14
3.15	Axial pitch deviation from thread to thread	15	15
3.16	Axial pitch deviation in any three axial pitches over all threads	16	16

[a] See Clause 5.

[b] Select the composite test when the line of action test is used.

[c] Test does not apply to the elemental method.

5 Derivation of allowable values

5.1 General

Test 7 does not conform to a datum value and is not among the statements in Clause 5 concerning grade relationships.

With the exception of Test 7, the datum from which all the values in Table 6 are derived is the value of 45 µm Test 14 Grade A modules 16 to 25.

5.2 Tests 1-7

For tests 1 to 7, use Equation (1):

$$\text{Calculated value} = 45\ K_e\ K_m\ K_g \tag{1}$$

K_t is not used.

5.3 Tests 9, 11, 11A, 12, 12A

For tests 9, 11, 11A, 12, 12A, use Equation (2):

$$\text{Calculated value} = 45\ K_e\ K_m\ K_g\ K_t \quad (2)$$

where

K_e is the ratio for test element (see Table 3);

K_m is the ratio for division of module (see Table 4);

K_g is the ratio for grade (see Table 3);

K_t is the ratio for number of threads (see Table 5).

5.4 Test 9B

Test 9B is only valid for quality Grades 4A, 3A and 2A.

5.5 Tests 8, 8A, 9B, 10, 13, 14, 15 and 16

Tests 8, 8A, 9B, 10, 13, 14, 15 and 16 are only valid for the following:

a) 1-thread, all Module ranges;

b) 2-threads, Module range $0{,}5 \leqslant m \leqslant 16$;

c) 3- and 4-threads, Module range $0{,}5 \leqslant m \leqslant 6$;

d) 5-, 6- and 7-threads, Module range $0{,}5 \leqslant m \leqslant 3{,}5$.

The value of the allowable deviations has been rounded to the nearest whole value after calculation. The minimum value of allowable deviations is 2 µm.

Standard bores shall be finished straight and parallel within the tolerances given in Table 2 for 75 % of each bearing length for Grades 4A, 3A, 2A, A and B hobs and 50 % for Grades C and D hobs.

A reference mandrel of nominal bore diameter shall pass through the bore as a check of alignment.

The tolerances on bore diameter are specified in Table 2.

Table 2 — Tolerance on bores

Grade of hob	Tolerance [a]									
	Datum diameter mm									
	8	10	13	22	27	32	40	50	60	80
4A	H3									
3A	H3			H4						
2A										
A	H4			H5						
B	H5									
C	H6									
D										

[a] In accordance with ISO 286-2.

Table 3 — Ratio for test element and grade

Test number	Ratio of test element K_e	Ratio of grade K_g						
		4A	3A	2A	A	B	C	D
1	0,3	0,35	0,5	0,71	1	1,6	1,6	2,11
2	0,25							
3	1,6					1,8	3,6	4,75
4	1,25						1,8	2,38
5	1,4							
6	2,6							
7	No relationship to test 14					1,25		2,31
8	0,5					2	4	5,28
8A	0,85							
9	1,5	0,71	0,71	1			2	2,54
9A	As by Table 4							
9B	0,8	0,35	0,5	0,71	—	—	—	—
10	0,4				1	2	4	5,28
11	0,7							
11A	0,8							
12	1,3							
12A	1,8							
13	0,4							
14	1							
15	0,45							
16	0,8							

Table 4 — Ratio for division of module

<table>
<tr><th>Module range

m</th><th>Ratio for module range

K_m</th><th>Multiplication factor</th></tr>
<tr><td>0,5 ⩽ m ⩽ 1</td><td>0,33</td><td rowspan="2">1</td></tr>
<tr><td rowspan="2">1 < m ⩽ 2</td><td rowspan="2">0,33</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">2 < m ⩽ 3,5</td><td rowspan="2">0,41</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">3,5 < m ⩽ 6,0</td><td rowspan="2">0,51</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">6,0 < m ⩽ 10</td><td rowspan="2">0,64</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">10 < m ⩽ 16</td><td rowspan="2">0,8</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">16 < m ⩽ 25</td><td rowspan="2">1</td></tr>
<tr><td rowspan="2">1,32</td></tr>
<tr><td>25 < m ⩽ 40</td><td>1,32</td></tr>
</table>

Table 5 — Ratio for number of threads

<table>
<tr><th>Number of threads</th><th>Ratio for number of threads

K_t</th><th>Multiplication factor</th></tr>
<tr><td>1</td><td>1</td><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td rowspan="2">3, 4</td><td rowspan="2">1,56</td></tr>
<tr><td rowspan="2">1,25</td></tr>
<tr><td>5, 6, 7</td><td>1,95</td></tr>
</table>