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## Gear hobs — Accuracy requirements

*Fraises-mères — Exigences d'exactitude*

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## 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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

This third edition cancels and replaces the second edition (ISO 4468:2009), which has been technically revised. It also incorporates the Technical Corrigendum ISO 4468:2009/Cor 1:2009.

The main changes compared to the previous edition are as follows:

- oversize tolerances: when the hob outside diameter exceeds the recommended size given in ISO 2490, the standard tolerances shall be increased by a factor of one-half of the percent oversize;
- hob sizes: the standard hob sizes from ISO 2490 were added as [Annex A](#).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at [www.iso.org/members.html](http://www.iso.org/members.html).

# Gear hobs — Accuracy requirements

## 1 Scope

This document 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 document 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 document 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 can 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 document 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 document.

## 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 286-2, *Geometrical product specifications (GPS) — ISO code system for tolerances on linear sizes — Part 2: Tables of standard tolerance classes and limit deviations for holes and shafts*

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

ISO 2768-1, *General tolerances — Part 1: Tolerances for linear and angular dimensions without individual tolerance indications*

### 3 Terms, definitions and symbols

#### 3.1 Terms and definitions

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

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

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

##### 3.1.1

##### **radial runout of hub diameter**

total deviation in radial distance of the hub periphery from the axis

##### 3.1.2

##### **axial runout of hub face**

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

##### 3.1.3

##### **radial runout of tips of teeth**

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

##### 3.1.4

##### **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

##### 3.1.5

##### **adjacent spacing of cutting face of gashes**

maximum deviation between any two consecutive cutting face measurements

##### 3.1.6

##### **total spacing of cutting face of gashes**

maximum deviation between any two cutting face measurements

##### 3.1.7

##### **gash lead deviation per 100 mm**

maximum deviation as the probe contacts the tooth faces within the axial region of the gash

Note 1 to entry: Allowable values for deviations are given per 100 mm of cutting face width.

##### 3.1.8

##### **tooth profile deviation**

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

##### 3.1.9

##### **tooth thickness**

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

Note 1 to entry: Tooth thickness is negative only.

##### 3.1.9.1

##### **addendum**

radial distance between the top of the hob tooth and the reference cylinder.

**3.1.9.2****tooth thickness difference along one gash**

difference between the maximum and minimum nominal *tooth thickness* (3.1.9) along one gash at the reference cylinder

Note 1 to entry: Test 9B is used for tooth thickness difference along one gash. This test is only valid for quality Grades 4A, 3A and 2A (see Table 6).

**3.1.10****lead deviation on adjacent teeth**

maximum lead deviation between any two consecutive teeth

**3.1.11****lead deviation in one axial pitch**

maximum deviation between any two teeth within any group of consecutive teeth contained in one axial pitch

Note 1 to entry: 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 2 to entry: Hobs having one thread:

Measuring distance = one axial pitch = one revolution

Hobs having two threads:

Measuring distance = one axial pitch = 1/2 revolution

Hobs having three threads:

Measuring distance = one axial pitch = 1/3 revolution, etc.

Note 3 to entry: 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.

Note 4 to entry: Test 11A is used for lead deviation in one axial pitch when the line of action test is used.

**3.1.12****lead deviation in three axial pitches**

maximum lead deviation between any two teeth contained in three axial pitches

Note 1 to entry: The number of teeth in three distance of three axial pitches of the hob 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 2 to entry: 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.

**3.1.13****adjacent deviation along line of action**

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

Note 1 to entry: 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.

**3.1.14****total deviation along line of action**

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

### 3.1.15

#### axial pitch deviation from thread to thread

maximum axial pitch deviation between any two consecutive teeth contained within two gashes

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

### 3.1.16

#### 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 to entry: For an odd number of threads, the angle between the gashes is approximately 90°. For an even number of threads, it is approximately 120°.

## 3.2 Symbols

$D$  hob outside diameter given by [Annex A](#) for the given module

$D_o$  hob oversize outside diameter

$K_e$  ratio for test element (see [Table 3](#))

$K_m$  ratio for division of module (see [Table 4](#))

$K_g$  ratio for grade (see [Table 3](#))

$K_t$  ratio for number of threads (see [Table 5](#))

$K_{tol}$  standard tolerance for the test

$K_i$  calculated value for test  $i$

$K_{9d}$  deviation test 9

$\alpha_h$  hob normal pressure angle

## 4 Allowable deviations

Hobs shall conform to the requirements of [Tables 2](#) and [4](#), as appropriate. The hob sizes shall be in accordance with [Annex A](#).

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 document 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 document, 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 <sup>a</sup>	
		Elemental test	Composite test <sup>b</sup>
<a href="#">3.1.1</a>	Radial runout of hub diameter	1	1
<a href="#">3.1.2</a>	Axial runout of hub face	2	2
<a href="#">3.1.3</a>	Radial runout of tips of teeth	3	3
<a href="#">3.1.4</a>	Straightness and radial alignment over cutting depth	4	4
<a href="#">3.1.5</a>	Adjacent spacing of cutting face of gashes	5	5
<a href="#">3.1.6</a>	Total spacing of cutting face of gashes	6	6
<a href="#">3.1.7</a>	Gash lead deviation per 100 mm	7	7
<a href="#">3.1.8</a>	Tooth profile deviation	8	8A
<a href="#">3.1.9</a>	Tooth thickness	9	9
<a href="#">3.1.9.1</a>	Addendum difference of values related to the designed normal tooth thickness	9A	9A
<a href="#">3.1.9.2</a>	Tooth thickness difference along one gash	9B	9B
<a href="#">3.1.10</a>	Lead deviation on adjacent teeth	10	10
<a href="#">3.1.11</a>	Lead deviation in one axial pitch	11	11A
<a href="#">3.1.12</a>	Lead deviation in three axial pitches	12	—
<a href="#">3.1.13</a>	Adjacent deviation along line of action (measured at the cutting edge)	Not applicable	13
<a href="#">3.1.14</a>	Total deviation along line of action (measured at the cutting edge)	Not applicable	14
<a href="#">3.1.15</a>	Axial pitch deviation from thread to thread	15	15
<a href="#">3.1.16</a>	Axial pitch deviation in any three axial pitches over all threads	16	16

<sup>a</sup> See [Clause 5](#).

<sup>b</sup> Select the composite test when the line of action test is used

## 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. See [3.2](#) for the explanations of symbols used.

## 5.2 Tests 1-6, 9, 12, 13 and 14

For tests 1 to 6, 9, 12, 13 and 14, use [Formula \(1\)](#):

$$K_{1 \text{ to } 6, 9, 12, 13, 14} = 45 K_e K_m K_g \quad (1)$$

## 5.3 Test 7

For test 7, use [Formula \(2\)](#):

$$K_7 = 80 K_g \quad (2)$$

## 5.4 Test 9A

For test 9A, use [Formula \(3\)](#):

$$K_{9A} = K_{9d} / [2 \times \tan \alpha_h] \quad (3)$$

## 5.5 Tests 10

For test 10, use [Formula \(4\)](#):

$$K_{10} = 45 K_e K_m K_g \sqrt{K_t} \quad (4)$$

## 5.6 Tests 8, 8A, 9B, 11, 11A, 12, 15 and 16

For tests 8, 8A, 9B, 11, 11A, 12, 15 and 16, use [Formula \(5\)](#):

$$K_{8, 8A, 9B, 11, 11A, 12, 15, 16} = 45 K_e K_m K_g K_t \quad (5)$$

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

Tests 8, 8A, 9B, 10, 11, 11A, 15 and 16 are only valid for the following:

- a) 1-thread, all module ranges;
- b) 2-threads, module range  $0,5 \leq m \leq 16$ ;
- c) 3- and 4-threads, module range  $0,5 \leq m \leq 6$ ;
- d) 5-, 6- and 7-threads, module range  $0,5 \leq m \leq 3,5$ .

## 5.7 Oversize tolerances

When the hob outside diameter exceeds the size given in [Annex A](#), the following will apply. The standard tolerances shall be increased by a factor of one-half of the percent oversize.

For tests 4, 5, 6, 10, 11, 11A, 12, 13, 14, 15 and 16, use [Formula \(6\)](#):

$$K_{4, 5, 6, 10, 11, 11A, 12, 13, 14, 15, 16} = K_{tol} [(D_o - D) / D / 2] + K_{tol} \quad (6)$$

## 5.8 All tests

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

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 <sup>a</sup>										
	Datum diameter mm										
	8	10	13	16	22	27	32	40	50	60	80
4A	H3										
3A	H3			H4							
2A	H3			H4							
A	H4			H5							
B	H5										
C	H6										
D	H6										

<sup>a</sup> The tolerance shall be 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							
4	1,25					1,8	1,8	2,38
5	1,4							
6	2,6							
7	No relationship to test 14							
8	0,5					2	4	5,28
8A	0,85							
9	1,5							
9A	As by <a href="#">Table 4</a>	0,71	0,71	1		2	2,54	

<sup>a</sup> The tolerance shall be in accordance with ISO 286-2.

Table 3 (continued)

Test number	Ratio of test element $K_e$	Ratio of grade $K_g$						
		4A	3A	2A	A	B	C	D
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							
13	0,4							
14	1							
15	0,45							
16	0,8							

<sup>a</sup> The tolerance shall be in accordance with ISO 286-2.

The ratio for division of module  $s$  are defined in [Table 4](#).

Table 4 — Ratio for division of module

Module range $m$	Ratio for module range $K_m$	Multiplication factor
$0,5 \leq m \leq 1$	0,33	1,12
$1 < m \leq 2$	0,37	
$2 < m \leq 3,5$	0,41	1,12
$3,5 < m \leq 6$	0,51	1,25
$6 < m \leq 10$	0,64	1,25
$10 < m \leq 16$	0,8	1,25
$16 < m \leq 25$	1	1,25
$25 < m \leq 40$	1,32	1,32

The ratio for number of threads are defined in [Table 5](#).

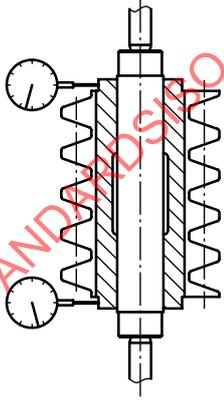
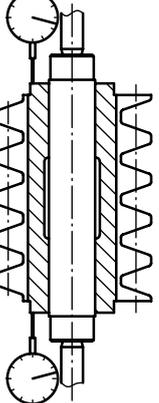
Table 5 — Ratio for number of threads

Number of threads	Ratio for number of threads $K_t$	Multiplication factor
1	1	1,25
2	1,25	1,25
3,4	1,56	1,25
5,6,7	1,95	1,25

The accuracy requirements are defined in [Table 6](#).

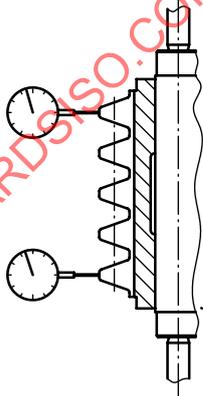
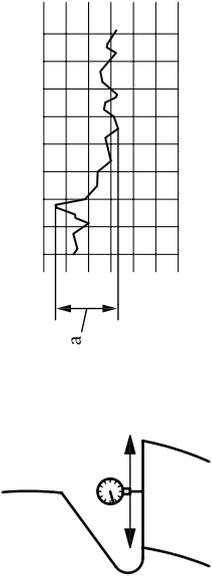
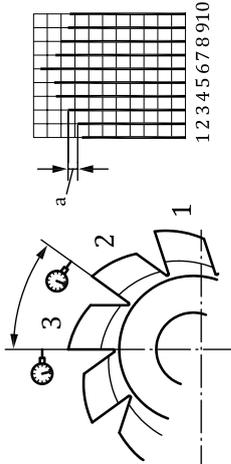
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Table 6 — Accuracy requirements

Test No	Element	Drawing  (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$ Grade						
					4A	3A	2A	A	B	C	D
1	Hub diameter		Radial runout	$0,5 \leq m \leq 1$	2	3	4	7	9		
				$1 < m \leq 2$	2	4	5	8	11		
				$2 < m \leq 3,5$	2	3	4	9	12		
				$3,5 < m \leq 6$	2	3	5	7	11	15	
				$6 < m \leq 10$	3	4	6	9	14	18	
				$10 < m \leq 16$	4	5	8	11	17	23	
2	Hub face		Axial runout	$16 < m \leq 25$	5	7	10	14	22	28	
				$25 < m \leq 40$	6	9	13	18	29	38	
				$0,5 \leq m \leq 1$	2	2	3	4	6	8	
				$1 < m \leq 2$	2	2	3	4	7	9	
				$2 < m \leq 3,5$	2	2	3	5	7	10	
				$3,5 < m \leq 6$	2	3	4	6	9	12	
				$6 < m \leq 10$	3	4	5	7	12	15	
				$10 < m \leq 16$	3	5	6	9	14	19	
				$16 < m \leq 25$	4	6	8	11	18	24	
				$25 < m \leq 40$	5	7	11	15	24	31	

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Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
3	Outside diameter		Radial runout of tips of teeth	$0,5 \leq m \leq 1$	8	12	17	24	43	86	113	
				$1 < m \leq 2$	9	13	19	27	48	96	127	
				$2 < m \leq 3,5$	10	15	21	30	53	106	140	
				$3,5 < m \leq 6$	13	18	26	37	66	132	174	
				$6 < m \leq 10$	16	23	33	46	83	166	219	
4	Cutting face of gashes		Straightness and radial alignment over cutting depth	$10 < m \leq 16$	20	29	41	58	104	207	274	
				$16 < m \leq 25$	25	36	51	72	130	259	342	
				$25 < m \leq 40$	33	48	67	95	171	342	451	
				$0,5 \leq m \leq 1$	6	9	13	19	33	33	44	
				$1 < m \leq 2$	7	10	15	21	37	37	50	
5	Cutting face of gashes		Adjacent spacing	$2 < m \leq 3,5$	10	14	20	29	52	68		
				$3,5 < m \leq 6$	13	18	26	36	65	86		
				$6 < m \leq 10$	16	23	32	45	81	107		
				$16 < m \leq 25$	20	28	40	56	101	134		
				$25 < m \leq 40$	26	37	53	74	134	177		
					7	10	15	21	37	49		
					8	12	17	23	42	55		
					9	13	18	26	46	61		
					11	16	23	32	58	76		
					14	20	29	40	73	96		
					18	25	36	50	91	120		
					22	32	45	63	113	150		
					29	42	59	83	150	198		

NOTE The numbers 1, 2, 3, etc. refer to the cutting teeth on the hob.

Table 6 (continued)

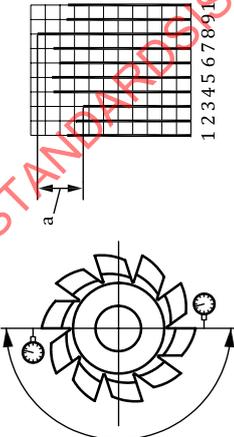
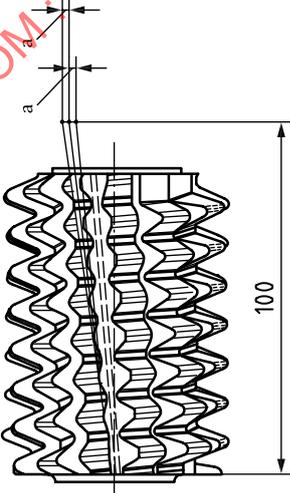
Test No	Element	Drawing	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
					4A	3A	2A	A	B	C	D
6	Cutting face of gashes	 <p>(See the end of this table for the key to the drawings.)</p>	Total spacing	$0,5 \leq m \leq 1$	14	19	27	39	69	69	92
				$1 < m \leq 2$	15	22	31	43	78	78	103
				$2 < m \leq 3,5$	17	24	34	48	86	86	114
				$3,5 < m \leq 6$	21	30	42	60	107	107	142
				$6 < m \leq 10$	26	37	53	75	135	135	178
				$10 < m \leq 16$	33	47	66	94	168	168	223
7	Cutting face of gashes	 <p>NOTE: The numbers 1, 2, 3, etc. refer to the cutting teeth on the hob.</p>	Gash lead deviation per 100 mm	$0,5 \leq m \leq 40$	28	40	57	80	100	144	185
				$16 < m \leq 25$	41	59	83	117	211	211	278
				$25 < m \leq 40$	54	77	110	154	278	278	368

Table 6 (continued)

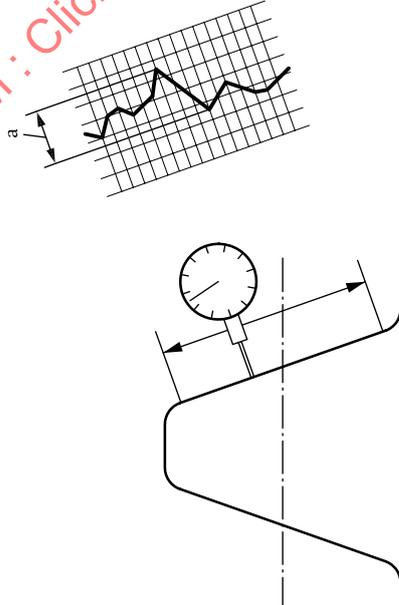
Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
8	Tooth		Tooth profile 1-thread	$0,5 \leq m \leq 1$	3	4	5	7	15	30	39	
				$1 < m \leq 2$	3	4	6	8	17	33	44	
				$2 < m \leq 3,5$	3	5	7	9	18	37	49	
				$3,5 < m \leq 6$	4	6	8	11	23	46	61	
				$6 < m \leq 10$	5	7	10	14	29	58	76	
				$10 < m \leq 16$	6	9	13	18	36	72	95	
				$16 < m \leq 25$	8	11	16	23	45	90	119	
				$25 < m \leq 40$	10	15	21	30	59	119	157	
			2-threads	$0,5 \leq m \leq 1$	3	5	7	9	19	37	49	
				$1 < m \leq 2$	4	5	7	10	21	42	55	
				$2 < m \leq 3,5$	4	6	8	12	23	46	61	
				$3,5 < m \leq 6$	5	7	10	14	29	57	76	
				$6 < m \leq 10$	6	9	13	18	36	72	95	
				$10 < m \leq 16$	8	11	16	23	45	90	119	
				$16 < m \leq 25$	—	—	—	—	—	—	—	
				$25 < m \leq 40$	—	—	—	—	—	—	—	
3-, 4-threads	$0,5 \leq m \leq 1$	4	6	8	12	23	46	61				
	$1 < m \leq 2$	5	6	9	13	26	52	69				
	$2 < m \leq 3,5$	5	7	10	14	29	58	76				
	$3,5 < m \leq 6$	6	9	13	18	36	72	95				
	$6 < m \leq 10$	—	—	—	—	—	—	—				
	$10 < m \leq 16$	—	—	—	—	—	—	—				
	$16 < m \leq 25$	—	—	—	—	—	—	—				
	$25 < m \leq 40$	—	—	—	—	—	—	—				

Table 6 (continued)

Test No	Element	Drawing  (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m  mm	Allowable deviation µm Grade						
					4A	3A	2A	A	B	C	D
8			5-, 6-, 7-threads	0,5 ≤ m ≤ 1	5	7	10	14	29	58	76
				1 < m ≤ 2	6	8	12	16	32	65	86
				2 < m ≤ 3,5	6	9	13	18	36	72	95
				3,5 < m ≤ 6	—	—	—	—	—	—	—
				6 < m ≤ 10	—	—	—	—	—	—	—
				10 < m ≤ 16	—	—	—	—	—	—	—
				16 < m ≤ 25	—	—	—	—	—	—	—
25 < m ≤ 40	—	—	—	—	—	—	—				

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Table 6 (continued)

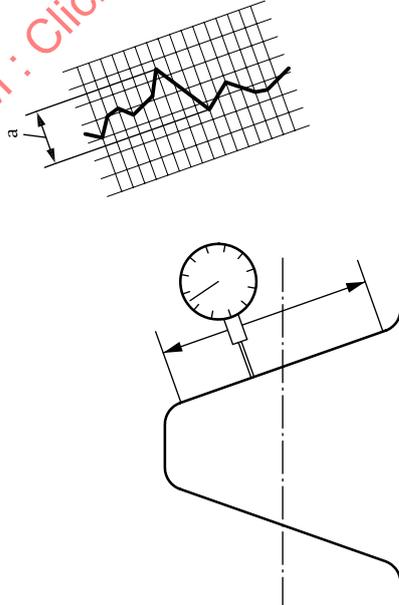
Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
8A	Tooth		Tooth profile (when line of action test is used) 1-thread  2-threads  3-, 4-threads	$0,5 \leq m \leq 1$	4	6	9	13	25	50	67	
				$1 < m \leq 2$	5	7	10	14	28	57	75	
				$2 < m \leq 3,5$	5	8	11	16	31	63	83	
				$3,5 < m \leq 6$	7	10	14	20	39	78	103	
				$6 < m \leq 10$	9	12	17	24	49	98	129	
				$10 < m \leq 16$	11	15	22	31	61	112	162	
				$16 < m \leq 25$	13	19	27	38	77	153	202	
				$25 < m \leq 40$	18	25	36	50	101	202	267	
				$0,5 \leq m \leq 1$	6	8	11	16	32	63	83	
				$1 < m \leq 2$	6	9	13	18	35	71	93	
				$2 < m \leq 3,5$	7	10	14	20	39	78	104	
				$3,5 < m \leq 6$	9	12	17	24	49	98	129	
				$6 < m \leq 10$	11	15	22	31	61	122	162	
				$10 < m \leq 16$	13	19	27	38	77	153	202	
				$16 < m \leq 25$	—	—	—	—	—	—	—	
				$25 < m \leq 40$	—	—	—	—	—	—	—	
$0,5 \leq m \leq 1$	7	10	14	20	39	79	104					
$1 < m \leq 2$	8	11	16	22	44	88	117					
$2 < m \leq 3,5$	9	12	17	24	49	98	129					
$3,5 < m \leq 6$	11	15	22	30	61	122	161					
$6 < m \leq 10$	—	—	—	—	—	—	—					
$10 < m \leq 16$	—	—	—	—	—	—	—					
$16 < m \leq 25$	—	—	—	—	—	—	—					
$25 < m \leq 40$	—	—	—	—	—	—	—					

Table 6 (continued)

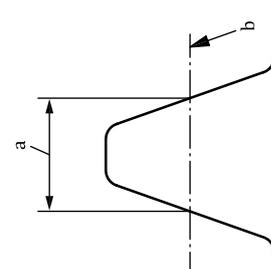
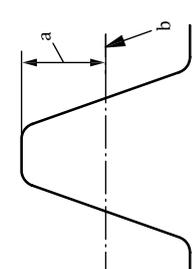
Test No	Element	Drawing	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
				mm	4A	3A	2A	A	B	C	D
8A		(See the end of this table for the key to the drawings.)	5-, 6-, 7-threads	$0,5 \leq m \leq 1$	9	12	17	25	49	98	130
				$1 < m \leq 2$	10	14	20	28	55	110	146
				$2 < m \leq 3,5$	11	15	22	31	61	122	161
				$3,5 < m \leq 6$	—	—	—	—	—	—	—
				$6 < m \leq 10$	—	—	—	—	—	—	—
				$10 < m \leq 16$	—	—	—	—	—	—	—
9	Tooth		Normal tooth thickness (negative only)	$0,5 \leq m \leq 1$	16	16	22	22	45	45	57
				$1 < m \leq 2$	18	18	25	25	50	50	63
				$2 < m \leq 3,5$	20	20	28	28	55	55	70
				$3,5 < m \leq 6$	24	24	34	34	69	69	87
				$6 < m \leq 10$	31	31	43	43	86	86	110
				$10 < m \leq 16$	38	38	54	54	108	108	137
9A	Tooth		Addendum (positive only)	$0,5 \leq m \leq 1$	63	63	89	89	178	178	226
				$1 < m \leq 2$	—	—	—	—	—	—	—
				$2 < m \leq 3,5$	—	—	—	—	—	—	—
				$3,5 < m \leq 6$	—	—	—	—	—	—	—
				$6 < m \leq 10$	—	—	—	—	—	—	—
				$10 < m \leq 16$	—	—	—	—	—	—	—
				Deviations from test 9 divided by $2 * \tan$ (pressure angle)							

Table 6 (continued)

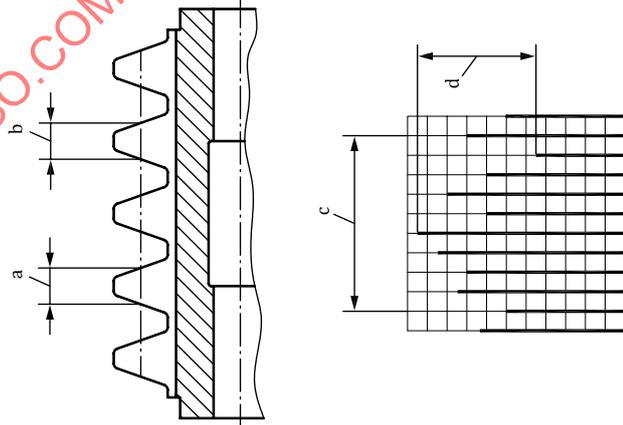
Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation µm						
					Grade						
					4A	3A	2A	A	B	C	D
9B	Tooth		<p>Difference between maximum and minimum normal tooth thickness along one gash</p> <p>1-thread</p> <p>2-threads</p> <p>3-, 4-threads</p>	0,5 ≤ m ≤ 1	4	6	8	Test 9B is only valid for quality grade 4A, 3A and 2A.			
				1 < m ≤ 2	5	7	9				
				2 < m ≤ 3,5	5	7	10				
				3,5 < m ≤ 6	6	9	13				
				6 < m ≤ 10	8	12	16				
				10 < m ≤ 16	10	14	20				
				16 < m ≤ 25	13	18	26				
				25 < m ≤ 40	17	24	34				
				0,5 ≤ m ≤ 1	5	7	11				
				1 < m ≤ 2	6	8	12				
				2 < m ≤ 3,5	6	9	13				
				3,5 < m ≤ 6	8	11	16				
				6 < m ≤ 10	10	14	20				
				10 < m ≤ 16	13	18	26				
				16 < m ≤ 25	—	—	—				
				25 < m ≤ 40	—	—	—				
0,5 ≤ m ≤ 1	6	9	13								
1 < m ≤ 2	7	10	15								
2 < m ≤ 3,5	8	12	16								
3,5 < m ≤ 6	10	14	20								
6 < m ≤ 10	—	—	—								
10 < m ≤ 16	—	—	—								
16 < m ≤ 25	—	—	—								
25 < m ≤ 40	—	—	—								

Table 6 (continued)

Test No	Element	Drawing  (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m  mm	Allowable deviation µm Grade						
					4A	3A	2A	A	B	C	D
9B			5-, 6-, 7-threads	0,5 ≤ m ≤ 1	8	12	16				
				1 < m ≤ 2	9	13	18				
				2 < m ≤ 3,5	10	14	20				
				3,5 < m ≤ 6	—	—	—				
				6 < m ≤ 10	—	—	—				
				10 < m ≤ 16	—	—	—				
				16 < m ≤ 25	—	—	—				
25 < m ≤ 40	—	—	—								

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Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
					4A	3A	2A	A	B	C	D
10	Thread lead		Lead deviation on adjacent teeth 1-thread	$0,5 \leq m \leq 1$	2	3	4	6	12	24	31
				$1 < m \leq 2$	2	3	5	7	13	27	35
				$2 < m \leq 3,5$	3	4	5	7	15	30	39
				$3,5 < m \leq 6$	3	5	7	9	18	37	48
				$6 < m \leq 10$	4	6	8	12	23	46	61
				$10 < m \leq 16$	5	7	10	14	29	58	76
			2-threads	$16 < m \leq 25$	6	9	13	18	36	72	95
				$25 < m \leq 40$	8	12	17	24	48	95	125
				$0,5 \leq m \leq 1$	2	3	5	7	13	27	35
				$1 < m \leq 2$	3	4	5	7	15	30	39
				$2 < m \leq 3,5$	3	4	6	8	17	33	44
				$3,5 < m \leq 6$	4	5	7	10	21	41	54
3-, 4-threads	$6 < m \leq 10$	5	6	9	13	26	52	68			
	$10 < m \leq 16$	6	8	11	16	32	64	85			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			
	$0,5 \leq m \leq 1$	3	4	5	7	15	30	39			
	$1 < m \leq 2$	3	4	6	8	17	33	44			
3-, 4-threads	$2 < m \leq 3,5$	3	5	7	9	18	37	49			
	$3,5 < m \leq 6$	4	6	8	11	23	46	61			
	$6 < m \leq 10$	—	—	—	—	—	—	—			
	$10 < m \leq 16$	—	—	—	—	—	—	—			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			

Table 6 (continued)

Test No	Element	Drawing	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
					4A	3A	2A	A	B	C	D
10		(See the end of this table for the key to the drawings.)	5-, 6-, 7-threads	0,5 ≤ m ≤ 1	3	4	6	8	17	33	44
				1 < m ≤ 2	3	5	7	9	19	37	49
				2 < m ≤ 3,5	4	5	7	10	21	41	54
				3,5 < m ≤ 6	—	—	—	—	—	—	—
				6 < m ≤ 10	—	—	—	—	—	—	—
				10 < m ≤ 16	—	—	—	—	—	—	—
				16 < m ≤ 25	—	—	—	—	—	—	—
25 < m ≤ 40	—	—	—	—	—	—	—				
11	Thread lead		Lead deviation in one axial pitch 1-thread	0,5 ≤ m ≤ 1	4	5	7	10	21	42	55
				1 < m ≤ 2	4	6	8	12	23	47	62
				2 < m ≤ 3,5	5	6	9	13	26	52	68
				3,5 < m ≤ 6	6	8	11	16	32	64	85
				6 < m ≤ 10	7	10	14	20	40	81	106
				10 < m ≤ 16	9	13	18	25	50	101	133
				16 < m ≤ 25	11	16	22	32	63	126	166
				25 < m ≤ 40	15	21	30	42	83	166	220
				0,5 ≤ m ≤ 1	5	6	9	13	26	52	69
				1 < m ≤ 2	5	7	10	15	29	58	77
				2 < m ≤ 3,5	6	8	11	16	32	65	85
3,5 < m ≤ 6	7	10	14	20	40	80	106				
6 < m ≤ 10	9	13	18	25	50	101	133				
10 < m ≤ 16	11	16	22	32	63	126	166				
16 < m ≤ 25	—	—	—	—	—	—	—				
25 < m ≤ 40	—	—	—	—	—	—	—				

Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
11	Thread lead		3-, 4-threads	$0,5 \leq m \leq 1$	6	8	12	16	32	65	86	
				$1 < m \leq 2$	6	9	13	18	36	73	96	
				$2 < m \leq 3,5$	7	10	14	20	40	81	106	
				$3,5 < m \leq 6$	9	13	18	25	50	100	132	
				$6 < m \leq 10$	—	—	—	—	—	—	—	
				$10 < m \leq 16$	—	—	—	—	—	—	—	
				$16 < m \leq 25$	—	—	—	—	—	—	—	
				$25 < m \leq 40$	—	—	—	—	—	—	—	
				$0,5 \leq m \leq 1$	7	10	14	20	41	81	107	
				$1 < m \leq 2$	8	11	16	23	45	91	120	
				$2 < m \leq 3,5$	9	13	18	25	50	101	133	
				$3,5 < m \leq 6$	—	—	—	—	—	—	—	
				$6 < m \leq 10$	—	—	—	—	—	—	—	
				$10 < m \leq 16$	—	—	—	—	—	—	—	
				$16 < m \leq 25$	—	—	—	—	—	—	—	
				$25 < m \leq 40$	—	—	—	—	—	—	—	

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Table 6 (continued)

Test No	Element	Drawing	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
					4A	3A	2A	A	B	C	D
11A	Thread lead		Lead deviation in one axial pitch (when line of action test is used) 1-thread	$0,5 \leq m \leq 1$	4	6	8	12	24	48	63
				$1 < m \leq 2$	5	7	9	13	27	53	70
				$2 < m \leq 3,5$	5	7	10	15	30	59	78
				$3,5 < m \leq 6$	6	9	13	18	37	73	97
				$6 < m \leq 10$	8	12	16	23	46	92	122
				$10 < m \leq 16$	10	14	20	29	58	115	152
			2-threads	$16 < m \leq 25$	13	18	26	36	72	144	190
				$25 < m \leq 40$	17	24	34	48	95	190	251
				$0,5 \leq m \leq 1$	5	7	11	15	30	59	78
				$1 < m \leq 2$	6	8	12	17	33	67	88
				$2 < m \leq 3,5$	6	9	13	18	37	74	97
				$3,5 < m \leq 6$	8	11	16	23	46	92	121
3-, 4-threads	$6 < m \leq 10$	10	14	20	29	58	115	152			
	$10 < m \leq 16$	13	18	26	36	72	144	190			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			
	$0,5 \leq m \leq 1$	6	9	13	19	37	74	98			
	$1 < m \leq 2$	7	10	15	21	42	83	110			
	$2 < m \leq 3,5$	8	12	16	23	46	92	122			
	$3,5 < m \leq 6$	10	14	20	29	57	115	151			
	$6 < m \leq 10$	—	—	—	—	—	—	—			
	$10 < m \leq 16$	—	—	—	—	—	—	—			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			

Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
				mm	4A	3A	2A	A	B	C	D
11A	Thread lead		5-, 6-, 7-threads	$0,5 \leq m \leq 1$	8	12	16	23	46	93	122
				$1 < m \leq 2$	9	13	18	26	52	104	137
				$2 < m \leq 3,5$	10	14	20	29	58	115	152
				$3,5 < m \leq 6$	—	—	—	—	—	—	—
				$6 < m \leq 10$	—	—	—	—	—	—	—
				$10 < m \leq 16$	—	—	—	—	—	—	—
				$16 < m \leq 25$	—	—	—	—	—	—	—
$25 < m \leq 40$	—	—	—	—	—	—	—	—	—	—	

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Table 6 (continued)

Test No	Element	Drawing  (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m  mm	Allowable deviation $\mu\text{m}$ Grade						
					4A	3A	2A	A	B	C	D
12	Thread lead		Lead deviation in three axial pitches 1-thread	$0,5 \leq m \leq 1$	7	10	14	19	39	77	102
				$1 < m \leq 2$	8	11	15	22	43	87	114
				$2 < m \leq 3,5$	8	12	17	24	48	96	127
				$3,5 < m \leq 6$	10	15	21	30	60	119	158
				$6 < m \leq 10$	13	19	27	37	75	150	198
				$10 < m \leq 16$	16	23	33	47	94	187	247
			2-threads	$16 < m \leq 25$	20	29	42	59	117	234	309
				$25 < m \leq 40$	27	39	55	77	154	309	408
				$0,5 \leq m \leq 1$	8	12	17	24	48	97	127
				$1 < m \leq 2$	9	14	19	27	54	108	143
				$2 < m \leq 3,5$	10	15	21	30	60	120	158
				$3,5 < m \leq 6$	13	19	26	37	75	149	197
3-, 4-threads	$6 < m \leq 10$	16	23	33	47	94	187	247			
	$10 < m \leq 16$	20	29	42	59	117	234	309			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			
	$0,5 \leq m \leq 1$	11	15	21	30	60	120	159			
	$1 < m \leq 2$	12	17	24	34	68	135	178			

Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
12	Thread lead		5-, 6-, 7-threads	$0,5 \leq m \leq 1$	13	19	27	38	75	151	199	
				$1 < m \leq 2$	15	21	30	42	84	169	223	
				$2 < m \leq 3,5$	16	23	33	47	94	187	247	
				$3,5 < m \leq 6$	—	—	—	—	—	—	—	
				$6 < m \leq 10$	—	—	—	—	—	—	—	
				$10 < m \leq 16$	—	—	—	—	—	—	—	
13	Line of action		Adjacent deviation along line of action (measured at the cutting edge) 1-7 threads	$0,5 \leq m \leq 1$	2	3	4	6	12	24	31	
				$1 < m \leq 2$	2	3	5	7	13	27	35	
				$2 < m \leq 3,5$	3	4	5	7	15	30	39	
				$3,5 < m \leq 6$	3	5	7	9	18	37	48	
				$6 < m \leq 10$	4	6	8	12	23	46	61	
				$10 < m \leq 16$	5	7	10	14	29	58	76	
				$16 < m \leq 25$	6	9	13	18	36	72	95	
				$25 < m \leq 40$	8	12	17	24	48	95	125	

Table 6 (continued)

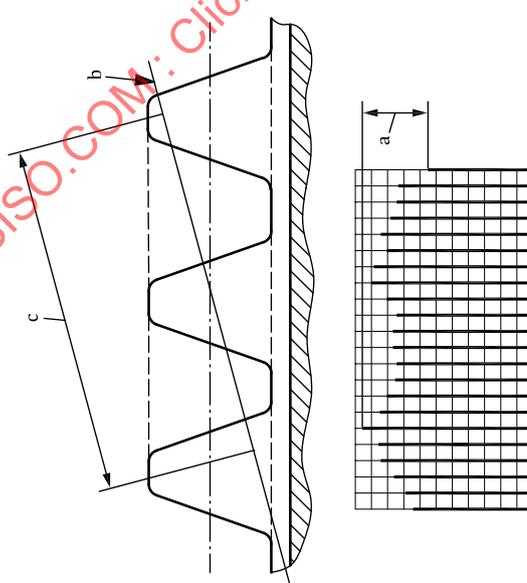
Test No	Element	Drawing  (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m  mm	Allowable deviation µm Grade							
					4A	3A	2A	A	B	C	D	
14	Line of action		Total deviation along line of action (Measured at the cutting edge)  1-7 threads	0,5 ≤ m ≤ 1	5	7	11	15	30	59	78	
				1 < m ≤ 2	6	8	12	17	33	67	88	
				2 < m ≤ 3,5	6	9	13	18	37	74	97	
				3,5 < m ≤ 6	8	11	16	23	46	92	121	
				6 < m ≤ 10	10	14	20	29	58	115	152	
				10 < m ≤ 16	13	18	26	36	72	144	190	
				16 < m ≤ 25	16	23	32	45*	90	180	238	
25 < m ≤ 40	21	30	42	59	119	238	314					
* Datum referred to in <a href="#">Clause 5</a> .												

Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$						
					Grade						
					4A	3A	2A	A	B	C	D
15	Thread spacing	<p> <math>\Delta_1 =  P_1 - P_2 </math>  <math>\Delta_2 =  P_2 - P_3 </math>  <math>\Delta_3 =  P_3 - P_4 </math>  <math>\Delta_n =  P_n - P_{n+1} </math>                      Deviation is maximum of all <math>\Delta</math> values                 </p>	Axial pitch deviation from thread to thread	$0,5 \leq m \leq 1$	3	4	6	8	17	33	44
			2-threads	$1 < m \leq 2$	3	5	7	9	19	37	49
			3-, 4-threads	$2 < m \leq 3,5$	4	5	7	10	21	42	55
				$3,5 < m \leq 6$	5	6	9	13	26	52	68
				$6 < m \leq 10$	6	8	12	16	32	65	86
				$10 < m \leq 16$	7	10	14	20	41	81	107
				$16 < m \leq 25$	—	—	—	—	—	—	—
				$25 < m \leq 40$	—	—	—	—	—	—	—
				$0,5 \leq m \leq 1$	4	5	7	10	21	42	55
				$1 < m \leq 2$	4	6	8	12	23	47	62
				$2 < m \leq 3,5$	5	6	9	13	26	52	68
				$3,5 < m \leq 6$	6	8	11	16	32	64	85
				$6 < m \leq 10$	—	—	—	—	—	—	—
				$10 < m \leq 16$	—	—	—	—	—	—	—
				$16 < m \leq 25$	—	—	—	—	—	—	—
	$25 < m \leq 40$	—	—	—	—	—	—	—			
	$0,5 \leq m \leq 1$	5	7	9	13	26	52	69			
	$1 < m \leq 2$	5	7	10	15	29	58	77			
	$2 < m \leq 3,5$	6	8	11	16	32	65	85			
	$3,5 < m \leq 6$	—	—	—	—	—	—	—			
	$6 < m \leq 10$	—	—	—	—	—	—	—			
	$10 < m \leq 16$	—	—	—	—	—	—	—			
	$16 < m \leq 25$	—	—	—	—	—	—	—			
	$25 < m \leq 40$	—	—	—	—	—	—	—			

Table 6 (continued)

Test No	Element	Drawing	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$							
					Grade							
					4A	3A	2A	A	B	C	D	
16	Thread spacing	<p> <math>\Delta_1 =  P_1 - 3P </math>  <math>\Delta_2 =  P_2 - 3P </math>  <math>\Delta_n =  P_n - 3P </math>                      Deviation is maximum of all <math>\Delta</math> values                 </p>	Axial pitch deviation in any three axial pitches over all threads	0,5 ≤ m ≤ 1	5	7	11	15	30	59	78	
			1 < m ≤ 2	6	8	12	17	33	67	88		
			2 < m ≤ 3,5	6	9	13	18	37	74	97		
			3,5 < m ≤ 6	8	11	16	23	46	92	121		
			6 < m ≤ 10	10	14	20	29	58	115	152		
			10 < m ≤ 16	13	18	26	36	72	144	190		
			16 < m ≤ 25	—	—	—	—	—	—	—		
			25 < m ≤ 40	—	—	—	—	—	—	—		
			0,5 ≤ m ≤ 1	6	9	13	19	37	74	98		
			1 < m ≤ 2	7	10	15	21	42	83	110		
			2 < m ≤ 3,5	8	12	16	23	46	92	122		
			3,5 < m ≤ 6	10	14	20	29	57	115	151		
			6 < m ≤ 10	—	—	—	—	—	—	—		
			10 < m ≤ 16	—	—	—	—	—	—	—		
			16 < m ≤ 25	—	—	—	—	—	—	—		
			25 < m ≤ 40	—	—	—	—	—	—	—		
0,5 ≤ m ≤ 1	8	12	16	23	46	93	122					
1 < m ≤ 2	9	13	18	26	52	104	137					
2 < m ≤ 3,5	10	14	20	29	58	115	152					
3,5 < m ≤ 6	—	—	—	—	—	—	—					
6 < m ≤ 10	—	—	—	—	—	—	—					
10 < m ≤ 16	—	—	—	—	—	—	—					
16 < m ≤ 25	—	—	—	—	—	—	—					
25 < m ≤ 40	—	—	—	—	—	—	—					

Table 6 (continued)

Test No	Element	Drawing (See the end of this table for the key to the drawings.)	Object of test	Pitch range module, m	Allowable deviation $\mu\text{m}$ Grade					
					4A	3A	2A	A	B	C
Test No.	a	b	c		Key					
4	deviation			—						
5	deviation			—						
6	deviation			—						
7	deviation			—						
8	deviation			—						
8A	deviation			—						
9	thickness	reference cylinder		—						
9A	addendum	reference cylinder		—						
9B	thickness max.	thickness min.	one gash	—						max. difference
10	deviation	adjacent teeth		—						
11	deviation	one axial pitch	one tooth	—						
11A	deviation	one axial pitch	one tooth	—						
12	deviation	three axial pitches	one tooth	—						
12A	deviation	three axial pitches	one tooth	—						
13	deviation	line of action		—						
14	total deviation	line of action	active length	—						

## Annex A (normative)

### Nominal dimensions of general-purpose single-start solid (monobloc) gear hobs with axial keyway or tenon drive of 0,5 to 40 module

#### A.1 Purpose

This annex specifies the nominal dimensions of general-purpose single-start solid (monobloc) gear hobs with axial keyway or tenon drive of 0,5 to 40 module.

These hobs are intended for the production of gears which conform to ISO 54 and present a 20° pressure angle in conformity with ISO 53.

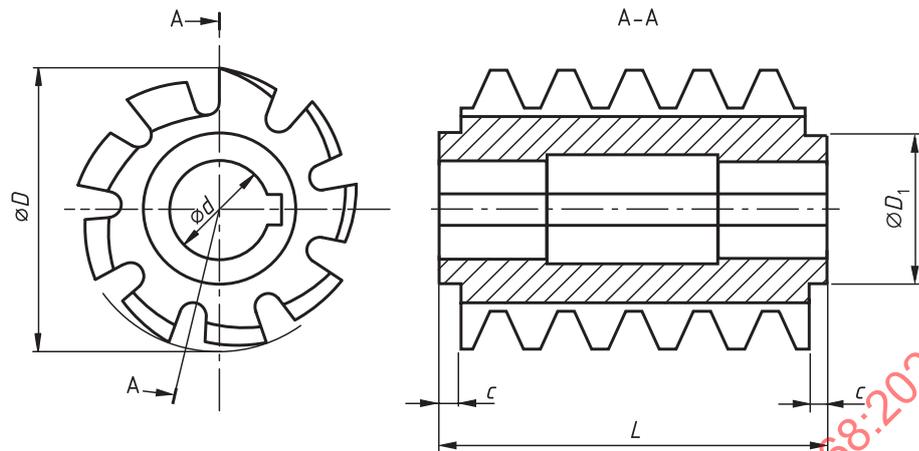
NOTE Solid hobs are those made from one solid piece of material as opposed to hobs which have inserted blades.

#### A.2 Nominal dimensions

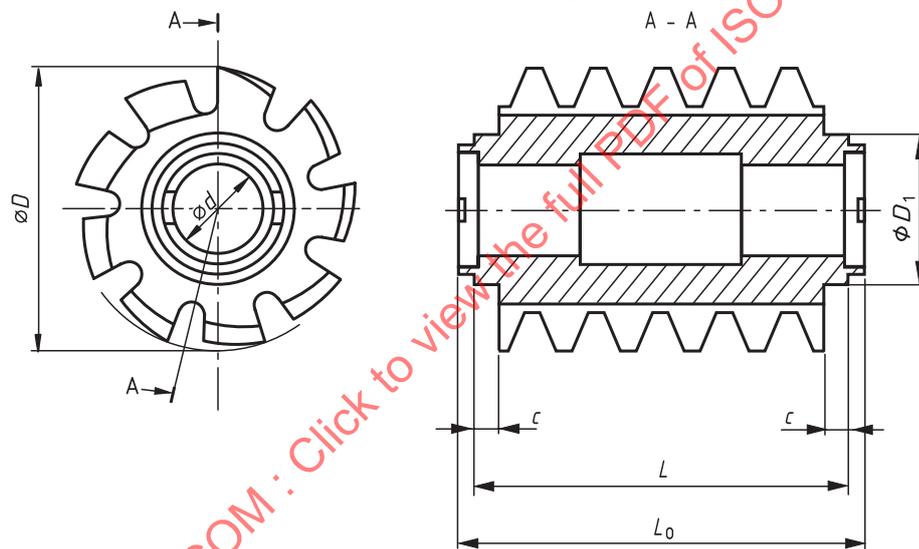
The nominal dimensions for single thread hobs shall be as shown in [Figure A.1](#) and given in [Tables A.1](#) and [A.2](#).

The nominal dimensions for small bore gear hob outside diameters and lead angles (multi-threads) shall be as shown in [Figure A.1](#) and given in [Table A.3](#).

The nominal dimensions for gear hob outside diameters and lead angles (multi-threads) shall be as shown in [Figure A.1](#) and given in [Table A.4](#).



a) Hob with axial keyway



b) Hob with tenon drive

**Key**

- $\varnothing D_1$  hub diameter (mm)
- $\varnothing D$  outside diameter (mm)
- $\varnothing d$  bore diameter (mm)
- $L$  overall length of hob with axial keyway (mm)
- $L_0$  overall length of hob with tenon drive (mm)
- $c$  minimum hub length (mm)

NOTE Keyway dimensions are specified in ISO 240 and tenonway dimensions are specified in ISO 2780.

**Figure A.1 — Gear hob dimensions**