

BS ISO 965-1:2013



BSI Standards Publication

# ISO general purpose metric screw threads — Tolerances

Part 1: Principles and basic data

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**National foreword**

This British Standard is the UK implementation of ISO 965-1:2013. It supersedes BS ISO 965-1:1998 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee FME/9, Fasteners.

A list of organizations represented on this committee can be obtained on request to its secretary.

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**ISO general purpose metric screw  
threads — Tolerances —**

Part 1:  
**Principles and basic data**

*Filetages métriques ISO pour usages généraux — Tolérances —  
Partie 1: Principes et données fondamentales*



Reference number  
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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. [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. [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.

The committee responsible for this document is ISO/TC ISO 965-1 was prepared by Technical Committee ISO/TC 1, *Screw Threads*.

This fourth edition cancels and replaces the third edition (ISO 965-1:1998), which has been technically revised. It also incorporates the Technical Corrigendum ISO 965-1:1998/Cor.1:2009.

ISO 965 consists of the following parts, under the general title *ISO general purpose metric screw threads — Tolerances*:

- *Part 1: Principles and basic data*
- *Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*
- *Part 3: Deviations for constructional screw threads*
- *Part 4: Limits of sizes for hot-dip galvanized external threads to mate with internal screw threads tapped with tolerance position H or G after galvanizing*
- *Part 5: Limits of sizes for internal screw threads to mate with hot-dip galvanized external screw threads with maximum size of tolerance position h before galvanizing*

# ISO general purpose metric screw threads — Tolerances —

## Part 1: Principles and basic data

### 1 Scope

This part of ISO 965 specifies a tolerance system for ISO general purpose metric screw threads (M) according to ISO 261.

The tolerance system refers to the basic profile according to ISO 68-1.

### 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 68-1, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads*

ISO 261, *ISO general purpose metric screw threads — General plan*

ISO 1502, *ISO general-purpose metric screw threads — Gauges and gauging*

ISO 5408, *Screw threads — Vocabulary*

### 3 Terms, definitions and symbols

#### 3.1 Terms and definitions

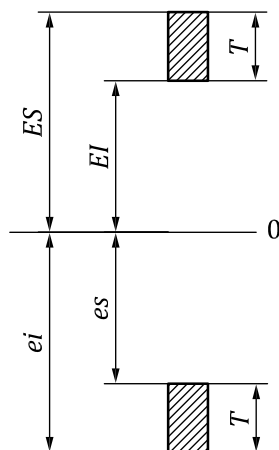
For the purposes of this document, the terms and definitions given in ISO 5408 apply.

#### 3.2 Symbols

For the purposes of this document, the following symbols apply.

Symbol	Meaning
$D$	basic major diameter of internal thread
$D_1$	basic minor diameter of internal thread
$D_2$	basic pitch diameter of internal thread
$d$	basic major diameter of external thread
$d_1$	basic minor diameter of external thread
$d_2$	basic pitch diameter of external thread
$d_3$	minor diameter of external thread (see <a href="#">Figure 6</a> )
$P$	pitch

$Ph$	lead
$H$	height of fundamental triangle
$S$	designation for “short” thread engagement group
$N$	designation for “normal” thread engagement group
$L$	designation for “long” thread engagement group
$T$	tolerance
$T_{D1}, T_{D2}, T_d, T_{d2}$	tolerances for $D_1, D_2, d$ and $d_2$
$ei, EI$	lower limit deviations (see <a href="#">Figure 1</a> )
$es, ES$	upper limit deviations (see <a href="#">Figure 1</a> )
$R$	root radius of external thread (see <a href="#">Figure 6</a> )
$C$	root truncation of external thread (see <a href="#">Figure 6</a> )



**Figure 1 — Position of tolerances with respect to zero line (basic size)**

## 4 Tolerance system

The tolerance system consists of tolerance grades and tolerance positions. The tolerance grades are expressed by number, such as 4, 6 and 8. The tolerance positions are expressed by letter, such as H, G, h and g. The tolerance class designation shall be the combination of the number and the letter, for example 6H and 6g.

## 5 Tolerance positions

The following tolerance positions are standardized:

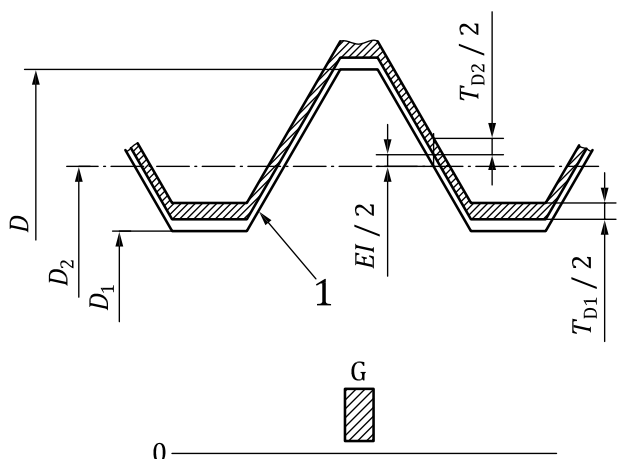
- for internal threads:
  - G with positive fundamental deviation ( $EI$ ), shown in [Figure 2](#);



- H with zero fundamental deviation ( $EI$ ), shown in Figure 3.
- for external threads:
  - a, b, c, d, e, f and g with negative fundamental deviation ( $es$ ), shown in Figure 4;
  - h with zero fundamental deviation ( $es$ ), shown in Figure 5.

The established tolerance positions comply with the needs of coating thickness and with the demands of easy assembly.

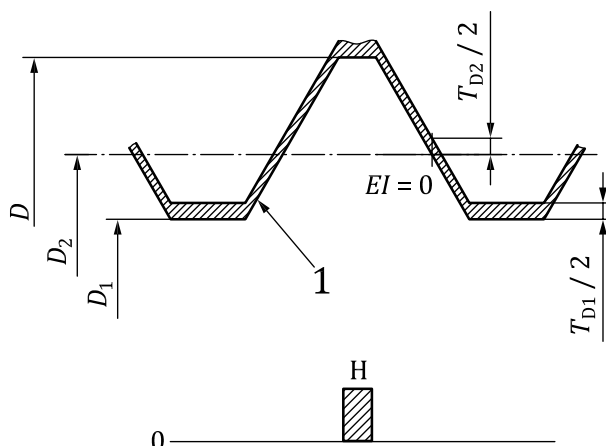
The fundamental deviations for internal threads and external threads are given in [Table 1](#).



**Key**

1 basic profile

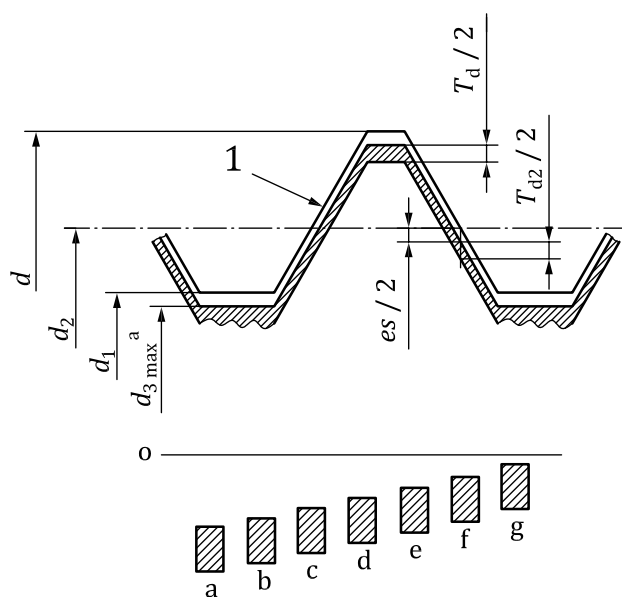
**Figure 2 — Internal threads with tolerance position G**



**Key**

1 basic profile

**Figure 3 — Internal threads with tolerance position H**

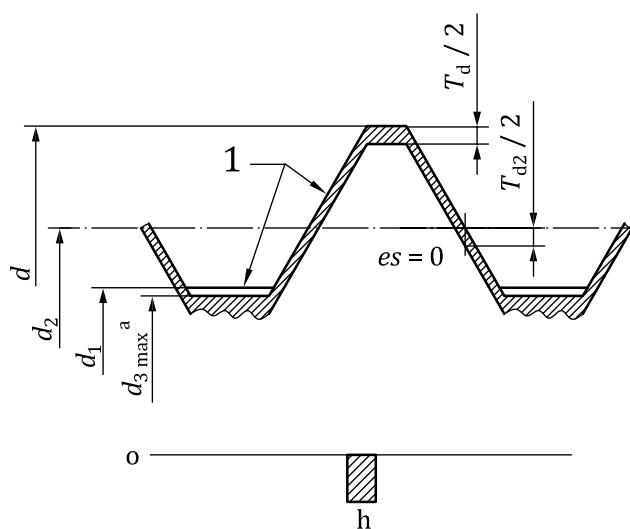


**Key**

1 basic profile

<sup>a</sup> Application only in connection with minimum material limits ( $d_{2 \min}$ ); see [Clause 11, Figure 6](#).

**Figure 4 — External threads with tolerance positions a, b, c, d, e, f and g**



**Key**

1 basic profile

<sup>a</sup> Application only in connection with minimum material limits ( $d_{2 \min}$ ); see [Clause 11, Figure 6](#).

**Figure 5 — External threads with tolerance position h**

**Table 1 — Fundamental deviations for internal threads and external threads**

Pitch <i>P</i>  mm	Fundamental deviation									
	Internal thread		External thread							
	G <i>EI</i> μm	H <i>EI</i> μm	a <i>es</i> μm	b <i>es</i> μm	c <i>es</i> μm	d <i>es</i> μm	e <i>es</i> μm	f <i>es</i> μm	g <i>es</i> μm	h <i>es</i> μm
0,2	+17	0	-	-	-	-	-	-	-17	0
0,25	+18	0	-	-	-	-	-	-	-18	0
0,3	+18	0	-	-	-	-	-	-	-18	0
0,35	+19	0	-	-	-	-	-	-34	-19	0
0,4	+19	0	-	-	-	-	-	-34	-19	0
0,45	+20	0	-	-	-	-	-	-35	-20	0
0,5	+20	0	-	-	-	-	-50	-36	-20	0
0,6	+21	0	-	-	-	-	-53	-36	-21	0
0,7	+22	0	-	-	-	-	-56	-38	-22	0
0,75	+22	0	-	-	-	-	-56	-38	-22	0
0,8	+24	0	-	-	-	-	-60	-38	-24	0
1	+26	0	-290	-200	-130	-85	-60	-40	-26	0
1,25	+28	0	-295	-205	-135	-90	-63	-42	-28	0
1,5	+32	0	-300	-212	-140	-95	-67	-45	-32	0
1,75	+34	0	-310	-220	-145	-100	-71	-48	-34	0
2	+38	0	-315	-225	-150	-105	-71	-52	-38	0
2,5	+42	0	-325	-235	-160	-110	-80	-58	-42	0
3	+48	0	-335	-245	-170	-115	-85	-63	-48	0
3,5	+53	0	-345	-255	-180	-125	-90	-70	-53	0
4	+60	0	-355	-265	-190	-130	-95	-75	-60	0
4,5	+63	0	-365	-280	-200	-135	-100	-80	-63	0
5	+71	0	-375	-290	-212	-140	-106	-85	-71	0
5,5	+75	0	-385	-300	-224	-150	-112	-90	-75	0
6	+80	0	-395	-310	-236	-155	-118	-95	-80	0
8	+100	0	-425	-340	-265	-180	-140	-118	-100	0

## 6 Tolerance grades

The tolerance grades for the following screw thread diameters are standardized:

	Tolerance grade
$D_1$	4, 5, 6, 7, 8
$d$	4, 6, 8
$D_2$	4, 5, 6, 7, 8
$d_2$	3, 4, 5, 6, 7, 8, 9

[Clause 8](#) shows details of tolerance grades and combinations of tolerance grades for pitch and crest diameters according to the tolerance quality and length of engagement group required, with the order of preference.

In some grades, certain tolerance values for small pitches are not shown in tolerance tables because of insufficient thread overlap or the requirement that the pitch diameter tolerance not exceed the crest diameter tolerance.

The minor diameter tolerances of internal thread,  $T_{D1}$ , are given in [Table 2](#).

**Table 2 — Minor diameter tolerances of internal thread ( $T_{D1}$ )**

Pitch <i>P</i> mm	Tolerance grade				
	4 µm	5 µm	6 µm	7 µm	8 µm
0,2	38	–	–	–	–
0,25	45	56	–	–	–
0,3	53	67	85	–	–
0,35	63	80	100	–	–
0,4	71	90	112	–	–
0,45	80	100	125	–	–
0,5	90	112	140	180	–
0,6	100	125	160	200	–
0,7	112	140	180	224	–
0,75	118	150	190	236	–
0,8	125	160	200	250	315
1	150	190	236	300	375
1,25	170	212	265	335	425
1,5	190	236	300	375	475
1,75	212	265	335	425	530
2	236	300	375	475	600
2,5	280	355	450	560	710
3	315	400	500	630	800
3,5	355	450	560	710	900
4	375	475	600	750	950
4,5	425	530	670	850	1 060
5	450	560	710	900	1 120
5,5	475	600	750	950	1 180
6	500	630	800	1 000	1 250
8	630	800	1 000	1 250	1 600

The major diameter tolerances of external thread,  $T_d$ , are given in [Table 3](#). The tolerance grades 5 and 7 do not exist for them.

**Table 3 — Major diameter tolerances of external thread ( $T_d$ )**

Pitch $P$ mm	Tolerance grade		
	4 $\mu\text{m}$	6 $\mu\text{m}$	8 $\mu\text{m}$
0,2	36	56	–
0,25	42	67	–
0,3	48	75	–
0,35	53	85	–
0,4	60	95	–
0,45	63	100	–
0,5	67	106	–
0,6	80	125	–
0,7	90	140	–
0,75	90	140	–
0,8	95	150	236
1	112	180	280
1,25	132	212	335
1,5	150	236	375
1,75	170	265	425
2	180	280	450
2,5	212	335	530
3	236	375	600
3,5	265	425	670
4	300	475	750
4,5	315	500	800
5	335	530	850
5,5	355	560	900
6	375	600	950
8	450	710	1 180

The pitch diameter tolerances of internal thread,  $T_{D2}$ , are given in [Table 4](#).

The pitch diameter tolerances of external thread,  $T_{d2}$ , are given in [Table 5](#).

**Table 4 — Pitch diameter tolerances of internal thread ( $T_{D2}$ )**

Basic major diameter $D$		Pitch $P$ mm	Tolerance grade				
over mm	up to and including mm		4 $\mu\text{m}$	5 $\mu\text{m}$	6 $\mu\text{m}$	7 $\mu\text{m}$	8 $\mu\text{m}$
0,99	1,4	0,2	40	–	–	–	–
		0,25	45	56	–	–	–
		0,3	48	60	75	–	–
1,4	2,8	0,2	42	–	–	–	–
		0,25	48	60	–	–	–
		0,35	53	67	85	–	–
		0,4	56	71	90	–	–
		0,45	60	75	95	–	–

**Table 4 (continued)**

Basic major diameter <i>D</i>		Pitch <i>P</i> mm	Tolerance grade				
over mm	up to and including mm		4 µm	5 µm	6 µm	7 µm	8 µm
2,8	5,6	0,35	56	71	90	–	–
		0,5	63	80	100	125	–
		0,6	71	90	112	140	–
		0,7	75	95	118	150	–
		0,75	75	95	118	150	–
		0,8	80	100	125	160	200
5,6	11,2	0,75	85	106	132	170	–
		1	95	118	150	190	236
		1,25	100	125	160	200	250
		1,5	112	140	180	224	280
11,2	22,4	1	100	125	160	200	250
		1,25	112	140	180	224	280
		1,5	118	150	190	236	300
		1,75	125	160	200	250	315
		2	132	170	212	265	335
		2,5	140	180	224	280	355
22,4	45	1	106	132	170	212	–
		1,5	125	160	200	250	315
		2	140	180	224	280	355
		3	170	212	265	335	425
		3,5	180	224	280	355	450
		4	190	236	300	375	475
45	90	4,5	200	250	315	400	500
		1,5	132	170	212	265	335
		2	150	190	236	300	375
		3	180	224	280	355	450
		4	200	250	315	400	500
		5	212	265	335	425	530
90	180	5,5	224	280	355	450	560
		6	236	300	375	475	600
		2	160	200	250	315	400
		3	190	236	300	375	475
		4	212	265	335	425	530
		6	250	315	400	500	630
180	355	8	280	355	450	560	710
		3	212	265	335	425	530
		4	236	300	375	475	600
		6	265	335	425	530	670
		8	300	375	475	600	750

**Table 5 — Pitch diameter tolerances of external thread ( $T_{d2}$ )**

Basic major diameter <i>d</i>		Pitch <i>P</i> mm	Tolerance grade						
over mm	up to and including mm		3 µm	4 µm	5 µm	6 µm	7 µm	8 µm	9 µm
0,99	1,4	0,2	24	30	38	48	–	–	–
		0,25	26	34	42	53	–	–	–
		0,3	28	36	45	56	–	–	–
1,4	2,8	0,2	25	32	40	50	–	–	–
		0,25	28	36	45	56	–	–	–
		0,35	32	40	50	63	80	–	–
		0,4	34	42	53	67	85	–	–
		0,45	36	45	56	71	90	–	–
2,8	5,6	0,35	34	42	53	67	85	–	–
		0,5	38	48	60	75	95	–	–
		0,6	42	53	67	85	106	–	–
		0,7	45	56	71	90	112	–	–
		0,75	45	56	71	90	112	–	–
		0,8	48	60	75	95	118	150	190

Table 5 (continued)

Basic major diameter <i>d</i>		Pitch <i>P</i> mm	Tolerance grade						
over mm	up to and including mm		3 µm	4 µm	5 µm	6 µm	7 µm	8 µm	9 µm
5,6	11,2	0,75	50	63	80	100	125	–	–
		1	56	71	90	112	140	180	224
		1,25	60	75	95	118	150	190	236
		1,5	67	85	106	132	170	212	265
11,2	22,4	1	60	75	95	118	150	190	236
		1,25	67	85	106	132	170	212	265
		1,5	71	90	112	140	180	224	280
		1,75	75	95	118	150	190	236	300
		2	80	100	125	160	200	250	315
		2,5	85	106	132	170	212	265	335
22,4	45	1	63	80	100	125	160	200	250
		1,5	75	95	118	150	190	236	300
		2	85	106	132	170	212	265	335
		3	100	125	160	200	250	315	400
		3,5	106	132	170	212	265	335	425
		4	112	140	180	224	280	355	450
		4,5	118	150	190	236	300	375	475
45	90	1,5	80	100	125	160	200	250	315
		2	90	112	140	180	224	280	355
		3	106	132	170	212	265	335	425
		4	118	150	190	236	300	375	475
		5	125	160	200	250	315	400	500
		5,5	132	170	212	265	335	425	530
		6	140	180	224	280	355	450	560
90	180	2	95	118	150	190	236	300	375
		3	112	140	180	224	280	355	450
		4	125	160	200	250	315	400	500
		6	150	190	236	300	375	475	600
		8	170	212	265	335	425	530	670
180	355	3	125	160	200	250	315	400	500
		4	140	180	224	280	355	450	560
		6	160	200	250	315	400	500	630
		8	180	224	280	355	450	560	710

## 7 Lengths of thread engagement

The lengths of thread engagement are classified into one of three groups: short (S), normal (N) or long (L), in accordance with [Table 6](#).

Table 6 — Length groups of thread engagement

Dimensions in millimetres

Basic major diameter <i>D, d</i>		Pitch <i>P</i>	Length group of thread engagement			
over	up to and including		S	N		L
			up to and including	over	up to and including	over
0,99	1,4	0,2	0,5	0,5	1,4	1,4
		0,25	0,6	0,6	1,7	1,7
		0,3	0,7	0,7	2	2
1,4	2,8	0,2	0,5	0,5	1,5	1,5
		0,25	0,6	0,6	1,9	1,9
		0,35	0,8	0,8	2,6	2,6
		0,4	1	1	3	3
		0,45	1,3	1,3	3,8	3,8

**Table 6** (continued)

Basic major diameter <i>D, d</i>		Pitch <i>P</i>	Length group of thread engagement			
			S	N		L
over	up to and including		up to and including	over	up to and including	over
2,8	5,6	0,35	1	1	3	3
		0,5	1,5	1,5	4,5	4,5
		0,6	1,7	1,7	5	5
		0,7	2	2	6	6
		0,75	2,2	2,2	6,7	6,7
		0,8	2,5	2,5	7,5	7,5
5,6	11,2	0,75	2,4	2,4	7,1	7,1
		1	3	3	9	9
		1,25	4	4	12	12
		1,5	5	5	15	15
11,2	22,4	1	3,8	3,8	11	11
		1,25	4,5	4,5	13	13
		1,5	5,6	5,6	16	16
		1,75	6	6	18	18
		2	8	8	24	24
		2,5	10	10	30	30
22,4	45	1	4	4	12	12
		1,5	6,3	6,3	19	19
		2	8,5	8,5	25	25
		3	12	12	36	36
		3,5	15	15	45	45
		4	18	18	53	53
		4,5	21	21	63	63
45	90	1,5	7,5	7,5	22	22
		2	9,5	9,5	28	28
		3	15	15	45	45
		4	19	19	56	56
		5	24	24	71	71
		5,5	28	28	85	85
		6	32	32	95	95
90	180	2	12	12	36	36
		3	18	18	53	53
		4	24	24	71	71
		6	36	36	106	106
		8	45	45	132	132
180	355	3	20	20	60	60
		4	26	26	80	80
		6	40	40	118	118
		8	50	50	150	150

## 8 Recommended tolerance classes

### 8.1 General

In order to reduce the number of gauges and tools, the tolerance classes should preferably be chosen from [Tables 7](#) and [8](#).

The tolerance class should be selected according to the tolerance quality (fine, medium and coarse) and the length group of thread engagement (S, N and L).

If the actual length of thread engagement is unknown (as in the manufacturing of standard bolts), group N is recommended.

### 8.2 Tolerance quality

The following general rules can be formulated for the choice of tolerance quality:

- fine: for precision threads, where little variation of fit character is needed;



- medium: for general use;
- coarse: for cases where manufacturing difficulties can arise, for example when threading hot-rolled bars and long blind holes.

### 8.3 Preference order

Tolerance classes within broad frames shall be selected for commercial internal and external threads.

The tolerance classes given in [Tables 7](#) and [8](#) in bold typeface, normal typeface and parentheses shall be the first, second and third choices, respectively.

**Table 7 — Recommended tolerance classes for internal threads**

Tolerance quality	Tolerance position G			Tolerance position H		
	S	N	L	S	N	L
Fine	–	–	–	4H	5H	6H
Medium	(5G)	<b>6G</b>	(7G)	<b>5H</b>	<b>6H</b>	<b>7H</b>
Coarse	–	(7G)	(8G)	–	7H	8H

**Table 8 — Recommended tolerance classes for external threads**

Tolerance quality	Tolerance position e			Tolerance position f			Tolerance position g			Tolerance position h		
	S	N	L	S	N	L	S	N	L	S	N	L
Fine	–	–	–	–	–	–	–	(4g)	(5g4g)	(3h4h)	<b>4h</b>	(5h4h)
Medium	–	<b>6e</b>	(7e6e)	–	<b>6f</b>	–	(5g6g)	<b>6g</b>	(7g6g)	(5h6h)	6h	(7h6h)
Coarse	–	(8e)	(9e8e)	–	–	–	–	8g	(9g8g)	–	–	–

### 8.4 Combination of internal threads and external threads

Any of the recommended tolerance classes for internal threads may be combined with any of the recommended tolerance classes for external threads. However, in order to guarantee sufficient overlap, the finished components should preferably be made to form the H/g, H/h or G/h fits. For thread sizes M1,4 and smaller, the combinations 5H/6h, 4H/6h or finer shall be chosen.

### 8.5 Coated threads

For coated threads, the tolerances apply to the parts before coating, unless otherwise stated. After coating, the actual thread profile shall not at any point transgress the maximum material limits for positions H or h.

## 9 Multiple-start threads

With the same pitch, the tolerances for multiple-start threads are the same as for single-start threads, with the exception of the pitch diameter tolerances which are enlarged.

For multiple-start threads, the tolerance values for pitch diameter ( $T_{D2}$  and  $T_{d2}$ ), specified in [Tables 4](#) and [5](#), shall be multiplied by a factor according to [Table 9](#).

**Table 9 — Factors for multiple-start threads**

Number of starts	2	3	4	5 and larger
Factor	1,12	1,25	1,4	1,6

## 10 Formulae

### 10.1 General

The tolerance values given in this part of ISO 965 are based on experience. In order to obtain a consistent system, mathematical formulae have been developed.

The values for pitch and crest diameter tolerances and for fundamental deviations have been calculated from the formulae and then rounded off to the nearest value in the R40 series of preferred numbers. However, when decimals appear, the value has been further rounded off to the nearest whole number.

In order to reproduce a smooth progression, the rules of rounding off are not always used.

When the tolerance values calculated from the formulae are different from the values specified by the tolerance tables, the values in the tolerance tables shall be used.

### 10.2 Fundamental deviations

The fundamental deviations for threads are calculated as given by Formulae (1) to (10):

$$EI_G = +(15 + 11P) \quad (1)$$

$$EI_H = 0 \quad (2)$$

$$es_a = -(270 + 19P) \quad (3)$$

NOTE 1 This is not applicable to threads with  $P \leq 0,8$  mm.

$$es_b = -(185 + 19P) \quad (4)$$

NOTE 2 This is not applicable to threads with  $P \leq 0,8$  mm.

$$es_c = -(115 + 19P) \quad (5)$$

NOTE 3 This is not applicable to threads with  $P \leq 0,8$  mm.

$$es_d = -(65 + 19P) \quad (6)$$

NOTE 4 This is not applicable to threads with  $P \leq 0,8$  mm.

$$es_e = -(50 + 11P) \quad (7)$$

NOTE 5 This is not applicable to threads with  $P \leq 0,45$  mm.

$$es_f = -(30 + 11P) \quad (8)$$

NOTE 6 This is not applicable to threads with  $P \leq 0,3$  mm.

$$es_g = -(15 + 11P) \quad (9)$$

$$es_h = 0 \quad (10)$$

where

$EI$  and  $es$  are expressed in micrometres;

$P$  is expressed in millimetres.

### 10.3 Crest diameter tolerances

#### 10.3.1 Tolerances for major diameter of external thread ( $T_d$ )

The tolerances for grade 6 are calculated as given by Formula (11):

$$T_d(6) = 180 \sqrt[3]{P^2} - \frac{3,15}{\sqrt{P}} \quad (11)$$

where

$T_d$  is expressed in micrometres;

$P$  is expressed in millimetres.

The tolerances for the other grades shall be obtained from the  $T_d(6)$  values given in [Table 10](#).

**Table 10 —  $T_d$  tolerances for the other grades**

Tolerance grade		
4	6	8
0,63 $T_d(6)$	$T_d(6)$	1,6 $T_d(6)$

#### 10.3.2 Tolerances for minor diameter of internal thread ( $T_{D1}$ )

The tolerances for grade 6 are calculated as given by Formulae (12) and (13):

a) Pitches 0,2 mm to 0,8 mm:

$$T_{D1}(6) = 433P - 190P^{1,22} \quad (12)$$

b) Pitches 1 mm and coarser:

$$T_{D1}(6) = 230P^{0,7} \quad (13)$$

where

$T_{D1}$  is expressed in micrometres;

$P$  is expressed in millimetres.

The tolerances for the other grades shall be obtained from the  $T_{D1}(6)$  values given in [Table 11](#).

**Table 11 —  $T_{D1}$  tolerances for the other grades**

Tolerance grade				
4	5	6	7	8
0,63 $T_{D1}(6)$	0,8 $T_{D1}(6)$	$T_{D1}(6)$	1,25 $T_{D1}(6)$	1,6 $T_{D1}(6)$

## 10.4 Pitch diameter tolerances

### 10.4.1 Tolerances for pitch diameter of external thread ( $T_{d2}$ )

The tolerances for grade 6 are calculated as given by Formula (14):

$$T_{d2}(6) = 90P^{0,4} d^{0,1} \quad (14)$$

where

$T_{d2}$  is expressed in micrometres;

$P$  and  $d$  are expressed in millimetres;

$d$  is equal to the geometrical mean value of the diameter range limits.

The tolerances for the other grades shall be obtained from the  $T_{d2}(6)$  values given in [Table 12](#).

**Table 12 —  $T_{d2}$  tolerances for the other grades**

Tolerance grade						
3	4	5	6	7	8	9
0,5 $T_{d2}(6)$	0,63 $T_{d2}(6)$	0,8 $T_{d2}(6)$	$T_{d2}(6)$	1,25 $T_{d2}(6)$	1,6 $T_{d2}(6)$	2 $T_{d2}(6)$

No  $T_{d2}$  values are given when values calculated according to the given formulae exceed the  $T_d$  values in the tolerance grades which are combined for recommended tolerance classes; see the dashes in [Table 5](#).

### 10.4.2 Tolerances for pitch diameter of internal thread ( $T_{D2}$ )

$T_{D2}$  values shall be obtained from the  $T_{d2}(6)$  values given in [Table 13](#).

**Table 13 —  $T_{D2}$  tolerances**

Tolerance grade				
4	5	6	7	8
0,85 $T_{d2}(6)$	1,06 $T_{d2}(6)$	1,32 $T_{d2}(6)$	1,7 $T_{d2}(6)$	2,12 $T_{d2}(6)$

No  $T_{D2}$  values are given when values calculated according to the given formulae exceed  $0,25P$ ; see the dashes in [Table 4](#).

## 10.5 Length of thread engagement

For the calculation of the limits of the normal length of thread engagement,  $l_N$ , the following rule is applied.

For each pitch within a certain diameter range,  $d$  is set equal to the smallest diameter (within the range) which appears in the general plan (conforming to ISO 261).

$$l_{N,\min} \approx 2,24Pd^{0,2} \quad (15)$$

$$l_{N,\max} \approx 6,7Pd^{0,2} \quad (16)$$

where  $l_N$ ,  $P$  and  $d$  are expressed in millimetres.

## 11 Root contours

For internal threads as well as external threads, the actual root contours shall not at any point transgress the maximum material limit which is decided by the basic profile and the tolerance position. For the root of external threads, see [Figure 6](#).

For external threads on fasteners of property class 8.8 and higher (see ISO 898-1), the root profile shall have a non-reversing curvature, no portion of which shall have a radius of less than  $0,125P$ . The minimum radius,  $R_{\min}$ , is given in [Table 14](#).

In the maximum minor diameter position,  $d_{3\max}$ , the two radii  $R_{\min} = 0,125 P$  will go through the points of intersection between the maximum material flanks and the minor diameter cylinder of the Go-gauges in accordance with ISO 1502 and blend tangentially into the minimum material flanks.

The maximum truncation,  $C_{\max}$ , is calculated as given by Formula (17):

$$C_{\max} = \frac{H}{4} - R_{\min} \left\{ 1 - \cos \left[ \frac{\pi}{3} - \arccos \left( 1 - \frac{T_{d2}}{4R_{\min}} \right) \right] \right\} + \frac{T_{d2}}{2} \quad (17)$$

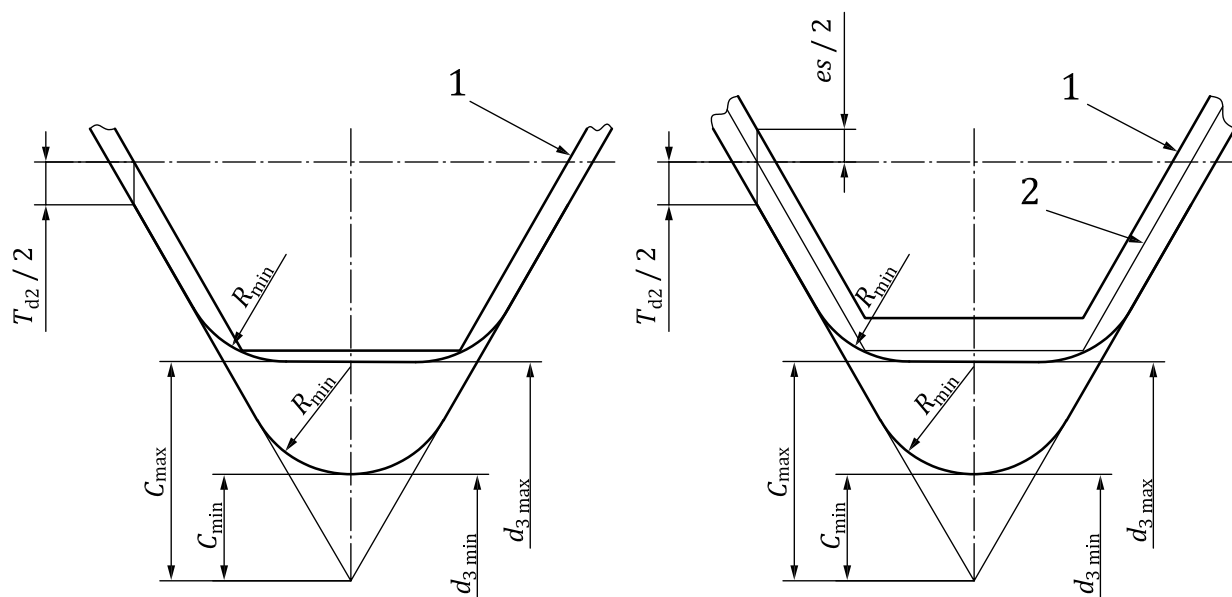
It is, however, advisable to aspire to a truncation of  $H/6$  ( $R = 0,144\ 34P$ ) and to take  $H/6$  as the basis for stress calculation of the minor diameter,  $d_3$ , of external threads (for corresponding values, see ISO 965-3).

The minimum truncation,  $C_{\min}$ , is calculated as given by Formula (18):

$$C_{\min} = 0,125P \approx \frac{H}{7} \quad (18)$$

External threads on the fasteners of property classes below 8.8 should preferably conform to the requirements stated above. This is particularly important for fasteners or other screwed connections which are subjected to fatigue or impact. However, there are in principle no restrictions other than

that the maximum minor diameter,  $d_{3\max}$ , of the external thread shall be less than the minimum minor diameter of the Go-gauges in accordance with ISO 1502.



**Key**

1 basic profile and Go-gauge profile

**Key**

1 basic profile  
 2 Go-gauge profile

**a) Position h**

**b) Positions a, b, c, d, e, f, g**

**Figure 6 — External thread root profile**

**Table 14 — Minimum root radii**

Pitch $P$ mm	$R_{\min}$ $\mu\text{m}$	Pitch $P$ mm	$R_{\min}$ $\mu\text{m}$
0,2	25	1,5	188
0,25	31	1,75	219
0,3	38	2	250
0,35	44	2,5	313
0,4	50	3	375
0,45	56	3,5	438
0,5	63	4	500
0,6	75	4,5	563
0,7	88	5	625
0,75	94	5,5	688
0,8	100	6	750
1	125	8	1 000
1,25	156	–	–

## 12 Designation

### 12.1 General

The complete designation for a screw thread comprises a designation for the thread system, the thread size and a designation for the thread tolerance class followed by further individual items, if necessary.

### 12.2 Designation of single-start screw threads

A screw thread complying with the requirements of the International Standards for ISO general purpose metric screw threads in accordance with ISO 68-1, ISO 261 and this part of ISO 965 shall be designated by the letter M followed by the value of the nominal diameter and of the pitch, expressed in millimetres, and separated by the “x” symbol.

EXAMPLE 1 M8 × 1,25

For coarse pitch threads listed in ISO 261, the pitch may be omitted.

EXAMPLE 2 M8

The tolerances class designation comprises a class designation for the pitch diameter tolerance, followed by a class designation for the crest diameter tolerance.

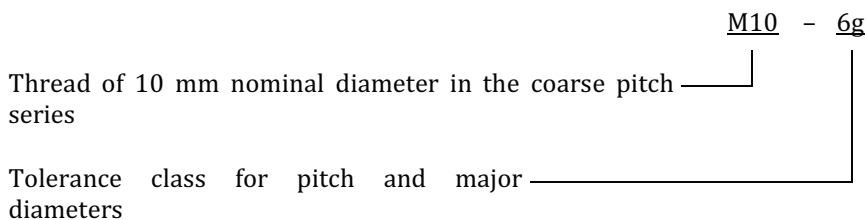
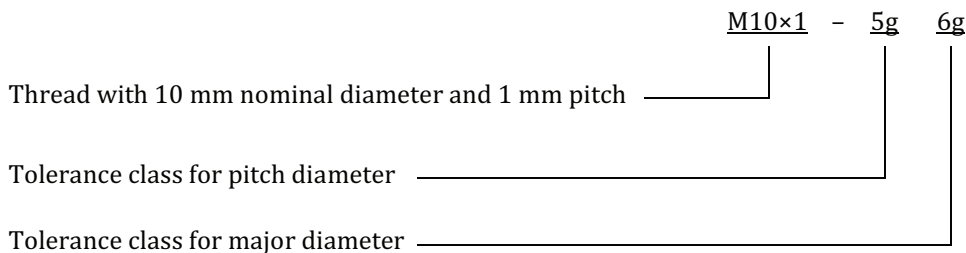
Each class designation consists of

- a figure indicating the tolerance grade;
- a letter indicating the tolerance position, upper case for internal threads, lower case for external threads.

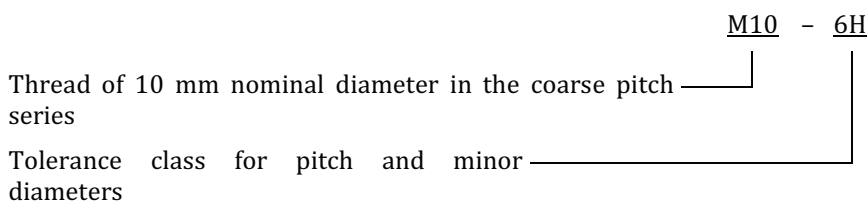
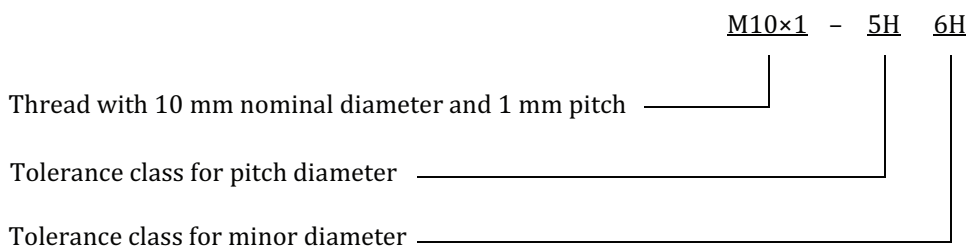
If the two class designations for the pitch diameter and crest diameter (minor or major diameter for internal and external threads, respectively) are the same, it is not necessary to repeat the symbols.

EXAMPLE 3 The following are examples:

**External thread**



**Internal thread**



A fit between threaded parts is indicated by the internal thread tolerance class, followed by the external thread tolerance class separated by a forward slash/stroke.

EXAMPLE 4 M6 - 6H/6g

M20 × 2 - 6H/5g6g

When the “medium” tolerance quality with the following tolerance classes are specified, the tolerance class designation may be omitted:

a) Internal threads:

- 5H for threads with nominal diameter up to and including 1,4 mm;
- 6H for threads with nominal diameter equal to 1,6 mm and larger.

NOTE Except for threads with pitch 0,2 mm for which tolerance grade 4 is defined only.



b) External threads:

- 6h for threads with nominal diameter up to and including 1,4 mm;
- 6g for threads with nominal diameter equal to 1,6 mm and larger.

The designation for the “short” S and “long” L length groups of thread engagement should be added following the tolerance class designation separated by a dash.

EXAMPLE 5 M20 × 2 - 5H - S

M6 - 7H/7g6g - L

The absence of the designation for the length group of thread engagement means that the “normal” N group is specified.

### 12.3 Designation of multiple-start screw threads

A multiple-start metric screw thread in accordance with this part of ISO 965 shall be designated by the letter M followed by the value of the nominal diameter, the “×” symbol, the letters Ph and the value of the lead, the letter P and the value of the pitch, a dash and the tolerance class. Nominal diameter, lead and pitch are expressed in millimetres.

EXAMPLE 6 M16 × Ph3P1,5 - 6H

The letters Ph may be omitted if there is no risk of misunderstanding.

EXAMPLE 7 M16 × 3P1,5 - 6H

For extra clarity, the number of starts, i.e. the value of *Ph/P*, may be added in verbal form and in parentheses.

EXAMPLE 8 M16 × Ph3P1,5 (two starts) - 6H

### 12.4 Designation of left-hand threads

When left-hand threads are specified the letters LH shall be added to the end of thread designation, separated by a dash.

EXAMPLE 9 M8 × 1 - LH

M6 × 0,75 - 5h6h - S - LH

M14 × Ph6P2 - 7H - L - LH

M14 × Ph6P2 (three starts) - 7H - L - LH

## Bibliography

- [1] ISO 898-1, *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs with specified property classes — Coarse thread and fine pitch thread*







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