
**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*



STANDARDSISO.COM : Click to view the full PDF of ISO 965-1:2013



COPYRIGHT PROTECTED DOCUMENT

© ISO 2013

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

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

Published in Switzerland

Contents

	Page
Foreword	iv
1 Scope	1
2 Normative references	1
3 Terms, definitions and symbols	1
3.1 Terms and definitions	1
3.2 Symbols	1
4 Tolerance system	2
5 Tolerance positions	2
6 Tolerance grades	5
7 Lengths of thread engagement	9
8 Recommended tolerance classes	10
8.1 General	10
8.2 Tolerance quality	10
8.3 Preference order	11
8.4 Combination of internal threads and external threads	11
8.5 Coated threads	11
9 Multiple-start threads	12
10 Formulae	12
10.1 General	12
10.2 Fundamental deviations	12
10.3 Crest diameter tolerances	13
10.4 Pitch diameter tolerances	14
10.5 Length of thread engagement	15
11 Root contours	15
12 Designation	17
12.1 General	17
12.2 Designation of single-start screw threads	17
12.3 Designation of multiple-start screw threads	19
12.4 Designation of left-hand threads	19
Bibliography	20

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

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

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 Figure 6)
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 Figure 1)
es, ES	upper limit deviations (see Figure 1)
R	root radius of external thread (see Figure 6)
C	root truncation of external thread (see Figure 6)

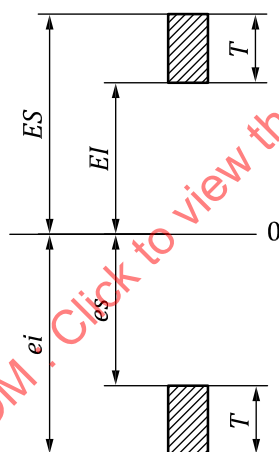


Figure 1 — Position of tolerances with respect to zero line (basic size)

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:

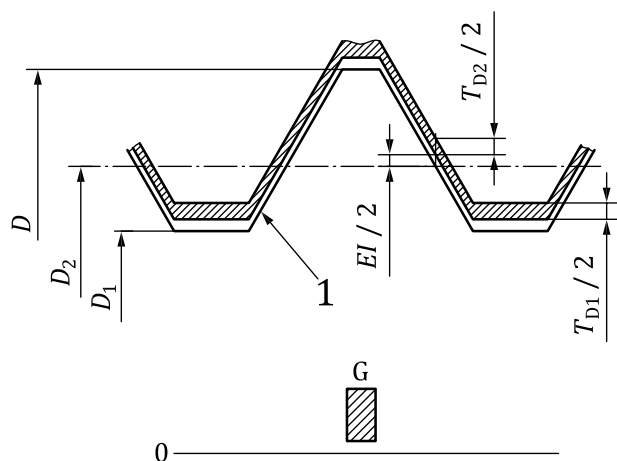
- for internal threads:
- G with positive fundamental deviation (EI), shown in Figure 2;

- 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](#).

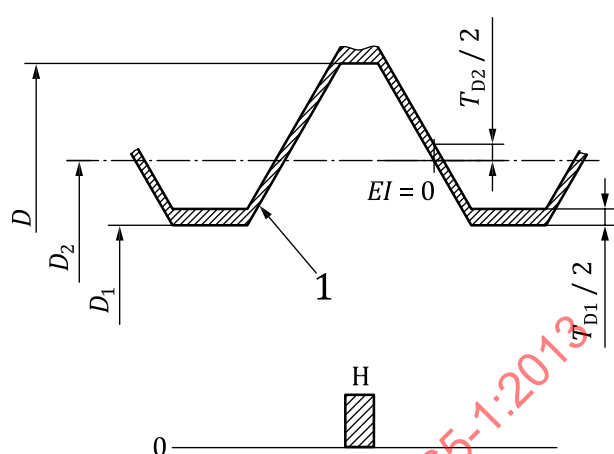
STANDARDSISO.COM : Click to view the full PDF of ISO 965-1:2013



Key

1 basic profile

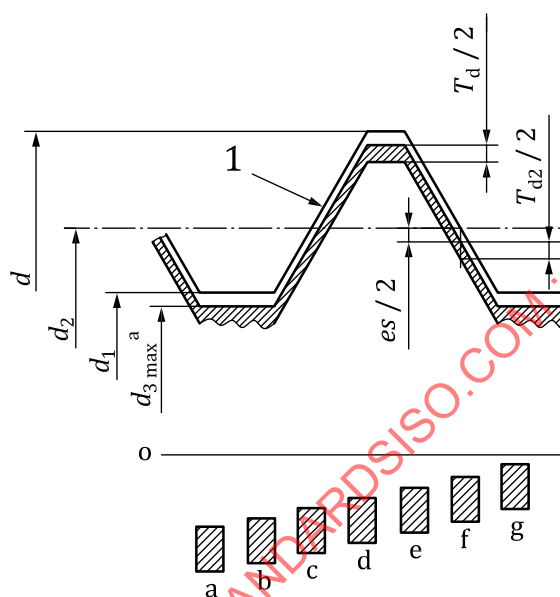
Figure 2 — Internal threads with tolerance position G



Key

1 basic profile

Figure 3 — Internal threads with tolerance position H

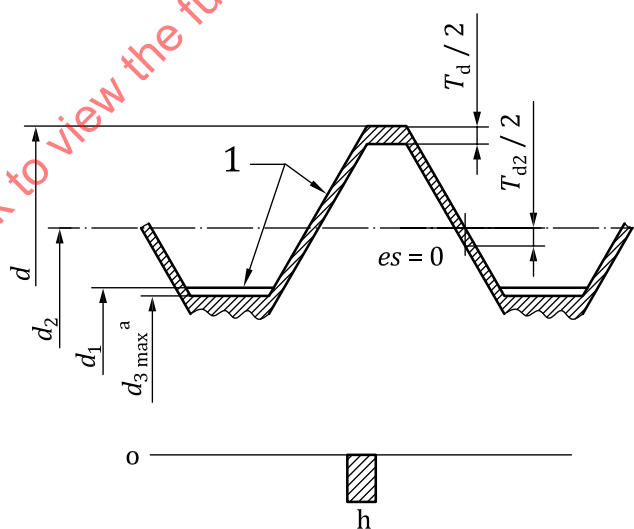


Key

1 basic profile

^a 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

^a 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 P 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 μm	6 μm	8 μm
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 μm	5 μm	6 μm	7 μm	8 μm
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
		4,5	200	250	315	400	500
45	90	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
		5,5	224	280	355	450	560
		6	236	300	375	475	600
90	180	2	160	200	250	315	400
		3	190	236	300	375	475
		4	212	265	335	425	530
		6	250	315	400	500	630
		8	280	355	450	560	710
180	355	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			
			S	N		L
over	up to and including		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)	6G	(7G)	5H	6H	7H
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)	4h	(5h4h)
Medium	–	6e	(7e6e)	–	6f	–	(5g6g)	6g	(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

El 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 $R_{\min} = 0,125P$ 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):

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

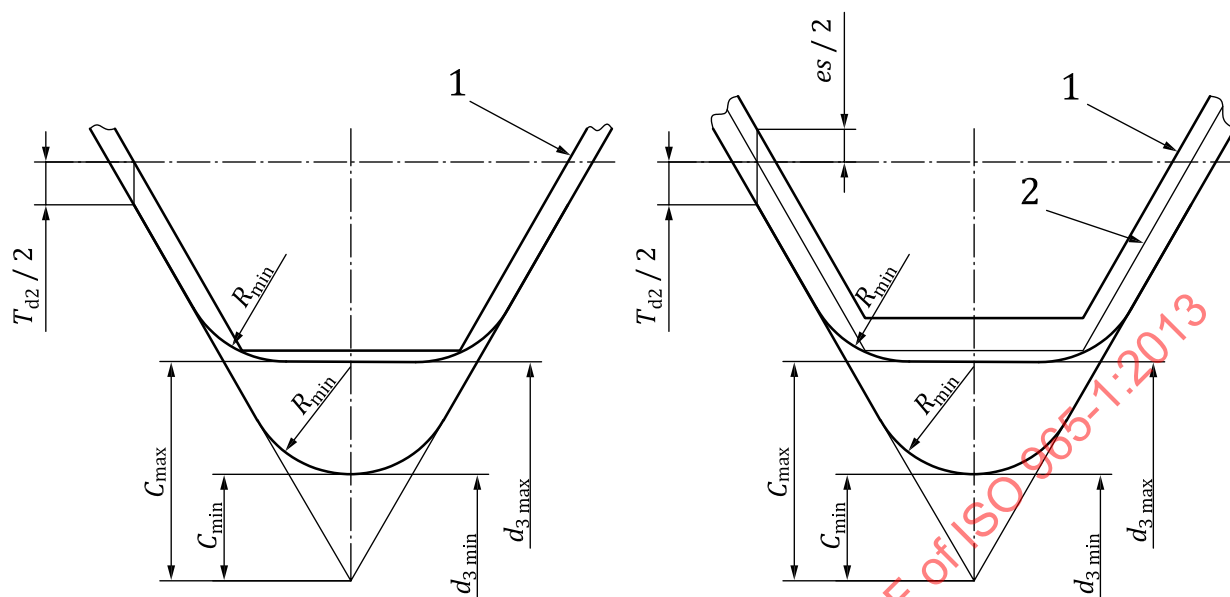
It is, however, advisable to aspire to a truncation of $H/6$ ($R = 0,144\ 34P$) and to take $H/6$ as the basis for stress calculation of the minor diameter, d_3 , of external threads (for corresponding values, see ISO 965-3).

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	$R_{\min}$ μm	Pitch P mm	$R_{\min}$ μm
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	—	—