IS 14962-1 (2001): ISO General Purpose Metric Screw Threads - Tolerances, Part 1: Principle and Basic Data [PGD 20: Production and General Engineering]

IS 14962 (Part 1) : 2001
ISO 965-1 : 1998

भारतीय मानक

आई॰ एस॰ ओ॰ सामान्य प्रयोजन की मीटरी पेंच चूड़ियाँ — छूटें

भाग 1 सिद्धांत और मूल डाटा

Indian Standard

ISO GENERAL PURPOSE METRIC SCREW THREADS — TOLERANCES

PART 1 PRINCIPLES AND BASIC DATA

ICS 21.040.10

BUREAU OF INDIAN STANDARDS
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Price Group 8

NATIONAL FOREWORD

This Indian Standard (Part 1) which is identical with ISO 965-1 : 1998 'ISO general purpose metric screw threads — Tolerances — Part 1: Principles and basic data' issued by the International Organization for Standardization (ISO) was adopted by the Bureau of Indian Standards on the recommendation of the Engineering Standards Sectional Committee and approval of the Basic and Production Engineering Division Council.

This Committee, responsible for the preparation of Indian Standards on Screw Threads, decided to revise all the six Parts of IS 4218 in the following manner:

a) The revised IS 4218 to be published in four parts that is (Parts 1 to 4) by adopting ISO 68-1 : 1998, ISO 261 : 1998, ISO 724 : 1993 and ISO 262 : 1998 respectively covering the various requirements of ISO general purpose metric screw threads except tolerances;

b) For tolerances on ISO general purpose metric screw threads a new standard, that is IS 14962 to be published in five parts, that is (Parts 1 to 5) by adopting ISO 965 (Part 1) : 1998, ISO 965 (Part 2) : 1998, ISO 965 (Part 3) : 1998, ISO 965 (Part 4) : 1998 and ISO 965 (Part 5) :1998 respectively; and

c) After the publication of above standards IS 4218 (Part 5) : 1979 and IS 4218 (Part 6) : 1978 stand withdrawn.

The text of ISO Standard has been approved as suitable for publication as an Indian Standard without deviations. In the adopted standard, certain conventions are not identical to those used in Indian Standard. Attention is especially drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a full point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 68-1 : 1998	IS 4218 (Part 1) : 2001 ISO general purpose metric screw threads: Part 1 Basic profile (*second revision*)	Identical
ISO 261 : 1998	IS 4218 (Part 2) : 2001 ISO general purpose metric screw threads: Part 2 General plan (*second revision*)	do
ISO 262 : 1998	IS 4218 (Part 4) : 2001 ISO general purpose metric screw threads: Part 4 Selected sizes for screws, bolts and nuts (*second revision*)	do
ISO 724 : 1993	IS 4218 (Part 3) : 1999 ISO general purpose metric screw threads: Part 3 Basic dimensions (*second revision*)	do
ISO 898-1 :[1)]	IS 1367 (Part 3) [2)] Technical supply conditions for threaded steel fasteners : Part 3 Mechanical properties of fasteners made of carbon steel and alloy steel — Bolts, screws and studs (*fourth revision*)	do

[1)] To be published (Revision of ISO 898-1 : 1988).

[2)] To be published [Revision of IS 1367 (Part 3) : 1991].

(*Continued on third cover*)

Indian Standard

ISO GENERAL PURPOSE METRIC SCREW THREADS — TOLERANCES

PART 1 PRINCIPLES AND BASIC DATA

1 Scope

This part of ISO 965 specifies the basic profile for ISO general purpose metric screw threads (M) conforming to ISO 261.

The tolerance system refers to the basic profile in accordance with ISO 68-1.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 965. At the time of publication the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 965 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 68-1:1998, *ISO general purpose screw threads — Basic profile — Part 1: Metric screw threads.*

ISO 261:1998, *ISO general purpose metric screw threads — General plan.*

ISO 262:1998, *ISO general purpose metric screw threads — Selected sizes for screws, bolts and nuts.*

ISO 724:1993, *ISO general purpose metric screw threads — Basic dimensions.*

ISO 898-1:—[1)], *Mechanical properties of fasteners made of carbon steel and alloy steel — Part 1: Bolts, screws and studs.*

ISO 965-2:1998, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose bolt and nut threads — Medium quality.*

ISO 965-3:1998, *ISO general purpose metric screw threads — Tolerances — Part 3: Deviations for constructional screw threads.*

ISO 1502:1996, *ISO general purpose metric screw threads — Gauges and gauging.*

ISO 5408:1983, *Cylindrical screw threads — Vocabulary.*

1) To be published. (Revision of ISO 898-1:1988)

3 Definitions and symbols

3.1 Definitions

For the purpose of this part of ISO 965 the definitions given in ISO 5408 apply.

3.2 Symbols

The following symbols are used:

Symbol	Explanation
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
P	pitch
Ph	lead
H	height of fundamental triangle
S	designation for thread engagement group "short"
N	designation for thread engagement group "normal"
L	designation for thread engagement group "long"
T	tolerance
T_{D1}, T_{D2} T_{d1}, T_{d2}	tolerances for D_1, D_2, d, d_2
ei, EI	lower deviations (see figure 1)
es, ES	upper deviations (see figure 1)
R	root radius of external thread
C	root truncation of external thread

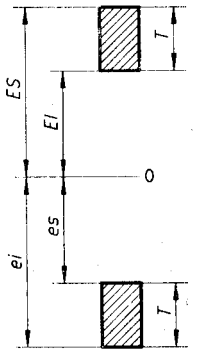


Figure 1 — Position of tolerances with respect to zero line (basic size)

4 Structure of the tolerance system

The system gives tolerances defined by tolerance grades and tolerance positions and a selection of grades and positions.

The system provides for:

a) a series of tolerance grades for each of the four screw thread diameters, as follows:

	Tolerance grades
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

Details of tolerance grades and combinations of tolerance grades for pitch and crest diameters according to tolerance quality and length of engagement group required, with order of preference, are shown in clause 12.

b) Series of tolerance positions:

— G and H for internal threads;

— e, f, g and h for external threads.

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

c) Selection of recommended combinations of grades and positions (tolerance classes) giving the commonly used tolerance qualities fine, medium and coarse for the three groups of length of thread engagement short, normal and long. Moreover a further selection of tolerance classes is given for commercial bolt and nut threads. Tolerance classes other than those shown in clause 12 are not recommended and shall only be used for special cases.

5 Designation

5.1 General

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

5.2 Designation of single-start screw threads

A screw thread complying with the requirements of the International Standards for ISO general purpose metric screw threads according to ISO 68-1, ISO 261, ISO 262, ISO 724, ISO 965-2 and ISO 965-3 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 sign "×".

EXAMPLE: M8 × 1,25

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

EXAMPLE: 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

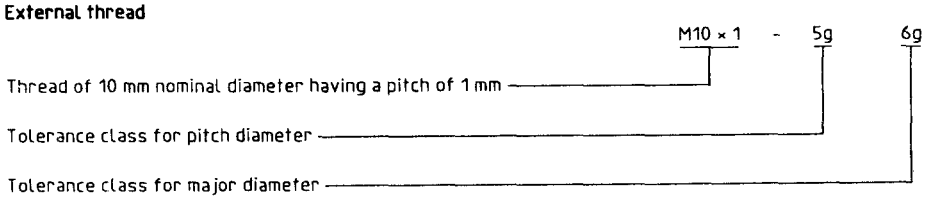
— a figure indicating the tolerance grade;

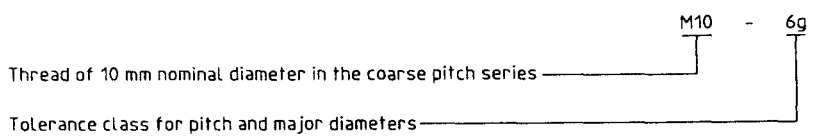
— a letter indicating the tolerance position, capital for internal threads, small for external threads.

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

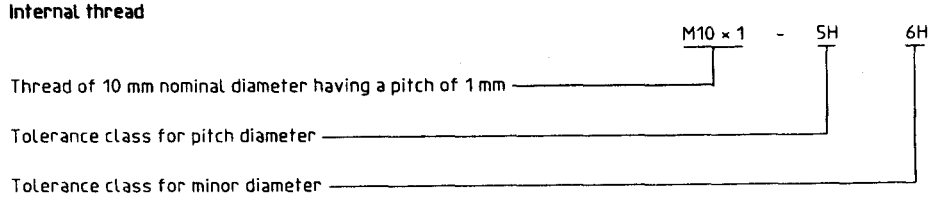
EXAMPLES:

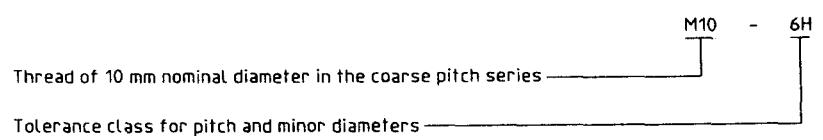
External thread





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 stroke.

EXAMPLE:

M6 – 6H/6g

M20 × 2 – 6H/5g6g

The absence of tolerance class designation means that tolerance quality "medium" with the following tolerance classes are specified:

Internal threads

— 5H for threads up to and including M1,4;

— 6H for threads M1,6 and larger.

NOTE Except for threads with pitch P = 0,2 mm for which the tolerance grade 4 is defined only (see tables 3 and 5).

External threads

— 6h for threads up to and including M1,4;

— 6g for threads M1,6 and larger.

The designation for the group of length of thread engagement "short" S and "long" L should be added to the tolerance class designation separated by a dash.

EXAMPLE: M20 × 2 – 5H – S

M6 – 7H/7g6g – L

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

5.3 Designation of multiple-start screw threads

Multiple-start metric screw threads shall be designated by the letter M followed by the value of the nominal diameter, the sign ×, the letters Ph and the value of the lead, the letter P and the value of the pitch (axial distance between two neighbouring flanks in the same direction) a dash, and the tolerance class. Nominal diameter, lead and pitch are expressed in millimetres.

EXAMPLE: M16 × Ph3P1,5 – 6H

For extra clarity the number of starts i.e. the value of $\frac{Ph}{P}$ may be added in verbal form and in paranthesis.

EXAMPLE: M16 × Ph3P1,5 (two starts) – 6H

5.4 Designation of the left hand threads

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

EXAMPLES: M8 × 1 – LH

M6 × 0,75 – 5h6h – S – LH

M14 × Ph6P2 – 7H – L – LH

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

6 Tolerance grades

For each of the two elements, pitch diameter and crest diameter, a number of tolerance grades have been established. In each case, grade 6 shall be used for tolerance quality medium and normal length of thread engagement. The grades below 6 are intended for tolerance quality fine and/or short length of thread engagement. The grades above 6 are intended for tolerance quality coarse and/or long lengths of thread engagement. In some grades, certain tolerance values for small pitches are not shown because of insufficient thread overlap or the requirement that the pitch diameter tolerance shall not exceed the crest diameter tolerance.

7 Tolerance positions

The following tolerance positions are standardized:

— for internal threads: G with positive fundamental deviation

H with zero fundamental deviation

— for external threads: e, f and g with negative fundamental deviation

h with zero fundamental deviation

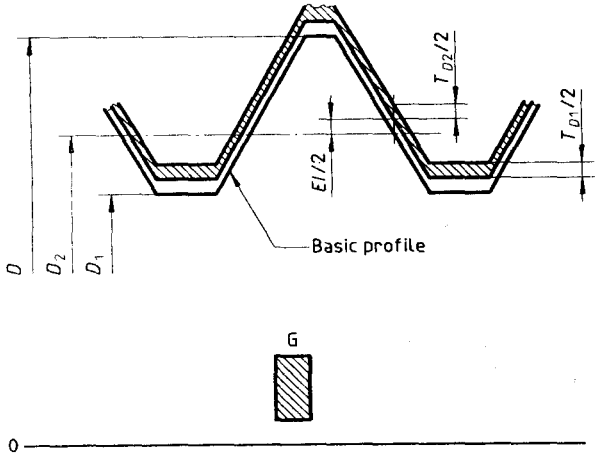


Figure 2 — Internal threads with tolerance position G

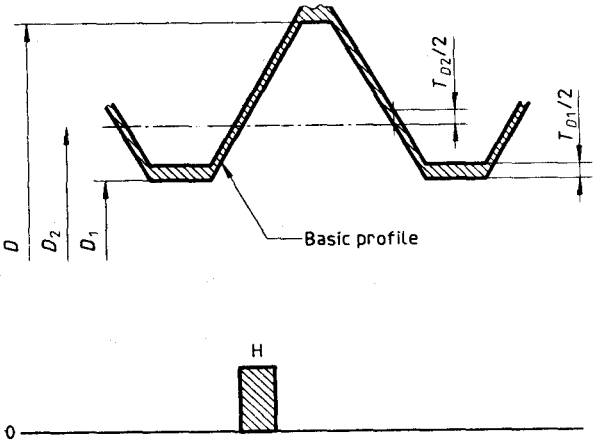
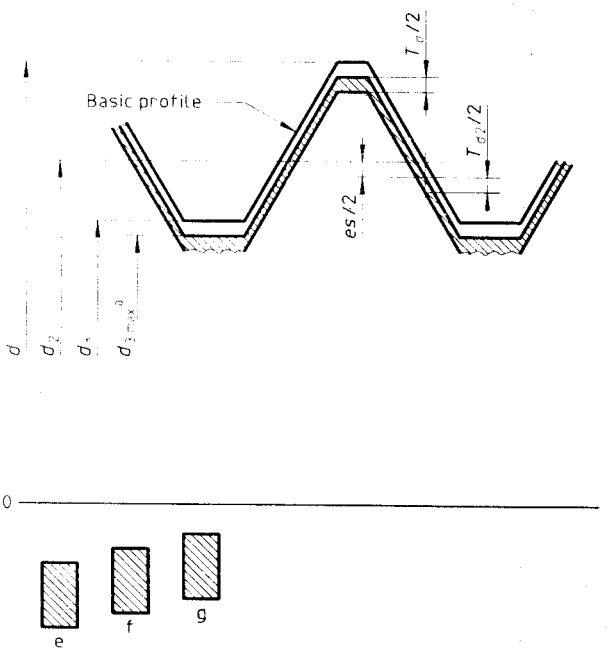
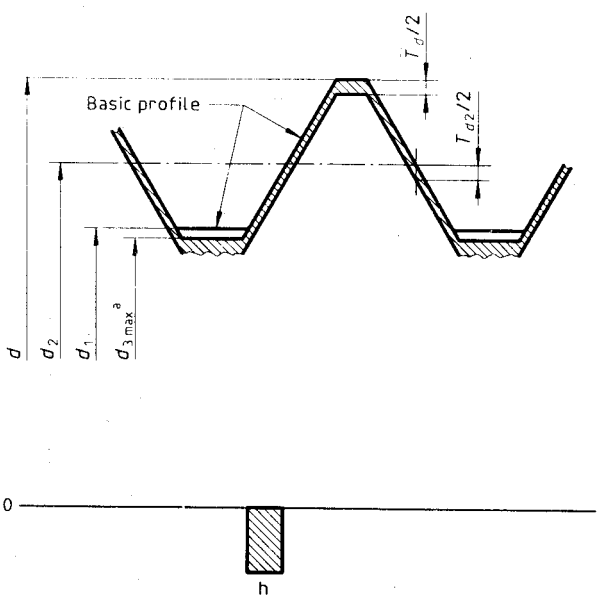


Figure 3 — Internal threads with tolerance position H



a Application only in connection with minimum material limits ($d_{2\,min}$), see clause 11, figure 6.

Figure 4 — External threads with tolerance positions e, f and g



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	Fundamental deviation					
	Internal thread		External thread			
	D_2, D_1		d, d_2			
	G	H	e		g	h
	EI	*EI*	*es*	*es*	*es*	*es*
mm	µm	µm	µm	µm	µm	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	− 60	− 40	− 26	0
1,25	+ 28	0	− 63	− 42	− 28	0
1,5	+ 32	0	− 67	− 45	− 32	0
1,75	+ 34	0	− 71	− 48	− 34	0
2	+ 38	0	− 71	− 52	− 38	0
2,5	+ 42	0	− 80	− 58	− 42	0
3	+ 48	0	− 85	− 63	− 48	0
3,5	+ 53	0	− 90	− 70	− 53	0
4	+ 60	0	− 95	− 75	− 60	0
4,5	+ 63	0	− 100	− 80	− 63	0
5	+ 71	0	− 106	− 85	− 71	0
5,5	+ 75	0	− 112	− 90	− 75	0
6	+ 80	0	− 118	− 95	− 80	0
8	+ 100	0	− 140	− 118	− 100	0

8 Lengths of thread engagement

The length of thread engagement is classified into one of three groups S, N or L, in accordance with table 2.

Table 2 — Lengths of thread engagement

Dimensions in millimetres

Basic major diameter D, d		Pitch P	Lengths 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
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

9 Crest diameter tolerances

9.1 Minor diameter tolerances of internal threads (T_{D1})

For the minor diameter tolerance of internal thread (T_{D1}) there are five tolerance grades 4, 5, 6, 7 and 8, in accordance with table 3.

9.2 Major diameter tolerance of external thread (T_d)

For the major diameter tolerance of external thread (T_d) there are three tolerance grades 4, 6 and 8, in accordance with table 4.

The tolerance grades 5 and 7 do not exist for the major diameter of external threads.

Table 3 — Minor diameter tolerance of internal thread (T_{D1})

Pitch	Tolerance grades				
P	4	5	6	7	8
mm	µm	µm	µm	µm	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

Table 4 — Major diameter tolerance of external thread (T_d)

Pitch P	Tolerance grades		
	4	6	8
mm	µm	µm	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

10 Pitch diameter tolerances

For the pitch diameter tolerance of internal thread (T_{D2}), there are five tolerance grades 4, 5, 6, 7 and 8, in accordance with table 5.

For the pitch diameter tolerance of external thread (T_{d2}) there are seven tolerance grades 3, 4, 5, 6, 7, 8 and 9, in accordance with table 6.

Table 5 — Pitch diameter tolerance of internal thread (T_{D2})

Basic major diameter D		Pitch P	Tolerance grades				
over	up to and including		4	5	6	7	8
mm	mm	mm	µm	µm	µm	µm	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	—	—
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 6 — Pitch diameter tolerance of external thread (T_{d2})

Basic major diameter d		Pitch P	Tolerance grades						
over	up to and including		3	4	5	6	7	8	9
mm	mm	mm	µm	µm	µm	µm	µm	µm	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
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

11 Root contours

For internal threads as well as for external threads, the actual root contours shall not at any point transgress the basic profile.

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 0,125 × P (see table 7).

In the maximum minor diameter position, d_3, 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 according to ISO 1502 and blend tangentially into the minimum material flanks.

The maximum truncation, C_{max}, is calculated according to the following formula:

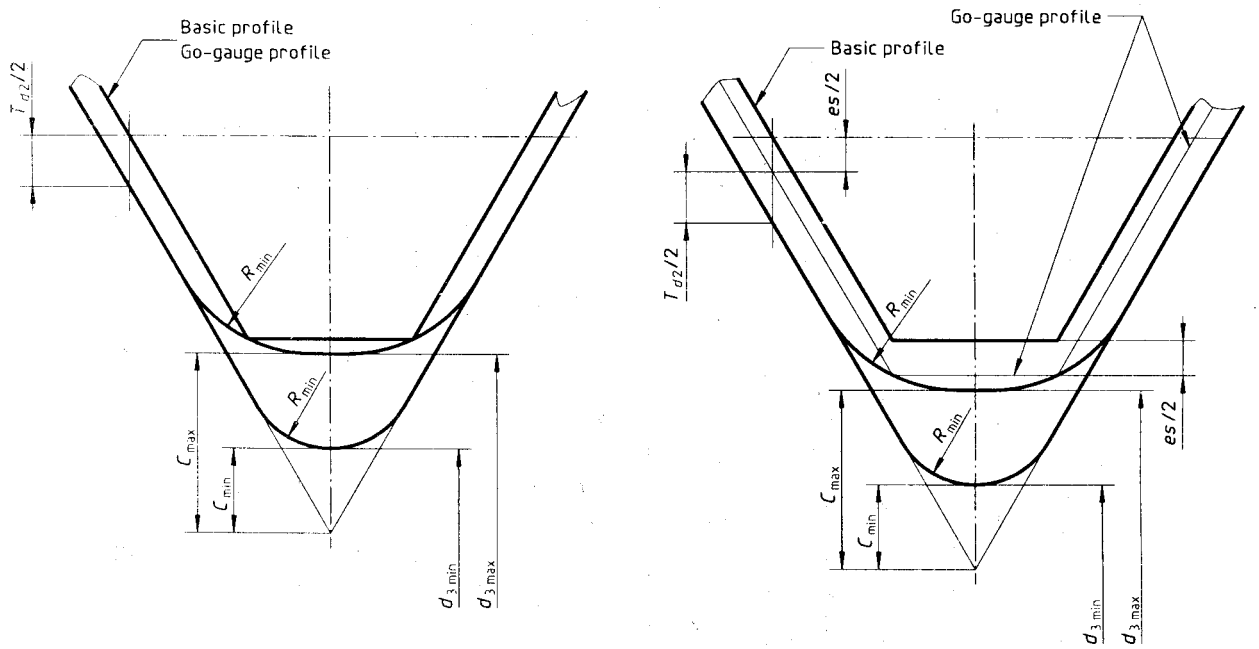
$$C_{max} = \frac{H}{4} - R_{min}\left\{1 - \cos\left[\frac{\pi}{3} - \arccos\left(1 - \frac{T_{d2}}{4 \cdot R_{min}}\right)\right]\right\} + \frac{T_{d2}}{2}$$

It is, however, advisable to aspire to a truncation of $\frac{H}{6}$ ($R = 0{,}144\,34 \times P$) and to take $\frac{H}{6}$ 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 according to the following formula:

$$C_{min} = 0{,}125\,P \approx \frac{H}{7}$$

External threads on 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 according to ISO 1502.



a) Position h **b) Positions e, f and g**

Figure 6 — External root profile

Table 7 — Minimum root radii

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

12 Recommended tolerance classes

In order to reduce the number of gauges and tools, the tolerance classes should preferably be chosen from tables 8 and 9.

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

— fine: for precisions threads, when 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.

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

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

Tolerance classes in bold print are first choice.

Tolerance classes in ordinary print are second choice.

Tolerance classes in parentheses are third choice.

Any of the recommended tolerance classes for internal threads can 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 fits H/g, H/h or G/h. For thread sizes M1,4 and smaller the combinations 5H/6h, 4H/6h or finer shall be chosen.

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.

NOTE These provisions are intended for thin coatings, e.g. those obtained by electroplating.

Table 8 — 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 9 — 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)	–	–	–

13 Formulae

The 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 R 40 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, these rules of rounding off have not always been used.

The root radii specified in table 7 are equal to 0,125 P.

13.1 Fundamental deviations

The fundamental deviations for internal and external threads have been calculated according to the following formulae:

$EI_G = +(15 + 11\,P)$

$EI_H = 0$

$es_e = -(50 + 11\,P)$ [2)]

$es_f = -(30 + 11\,P)$ [3)]

$es_g = -(15 + 11\,P)$

$es_h = 0$

where EI and es are expressed in micrometers and P is expressed in millimetres.

2) Exceptions are values for threads with $P \leq 0{,}45$ millimetres

3) Does not apply for $P \leq 0{,}3$ millimetres

13.2 Length of thread engagement

For the calculation of the limits of the normal length of thread engagement l_N in table 2, the following rule has been applied.

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

$l_{N\,min}$ (approximate) = 2,24 $P\,d^{0,2}$

$l_{N\,max}$ (approximate) = 6,7 $P\,d^{0,2}$

where l_N, P and d are expressed in millimetres.

13.3 Crest diameter tolerances

13.3.1 Tolerances for major diameter of external thread (T_d), grade 6

These tolerances have been calculated according to the following formula:

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

where T_d is expressed in micrometers *and* P is expressed in millimetres.

T_d -tolerances for the other grades are obtained from the $T_d(6)$-values (see table 4) according to the table below.

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

13.3.2 Tolerances for minor diameter of internal thread (T_{D1}), grade 6

T_{D1} -Tolerances for grade 6 are calculated according to the following formulae:

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

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

b) Pitch 1 mm and coarser

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

where T_{D1} is expressed in µm and P is expressed in mm.

The value for other grades are obtained from the $T_{D1}(6)$-values (in table 3) according to the table below.

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 $T_{D1}(6)$

13.4 Pitch diameter tolerances

13.4.1 Tolerances for pitch diameter of external thread (T_{d2})

$T_{d2}(6)$-values in table 6 are calculated according to the following formulae (d being equal to the geometrical mean value of the diameter range limits):

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

where

$T_{d2}(6)$ is expressed in micrometers and P and d are expressed in millimetres.

The value for the other grades are obtained from the $T_{d2}(6)$-values (see table 6) according to the table below.

Tolerance grades						
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 in table 6 when values calculated according to the given formulae exceed the T_d-values in the tolerance grades which are combined in the tables for recommended tolerance classes.

13.4.2 Tolerances for pitch diameter of internal thread (T_{D2})

T_{D2}-values are obtained from the T_{d2} (6)-values (see table 6) according to the table below.

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 in table 5 when values calculated according to the given formulae exceed 0,25 P.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
ISO 965-2 : 1998	IS 14962 (Part 2) : 2001 ISO general purpose metric screw threads — Tolerances : Part 2 Limits of sizes for general purposes external and internal screw threads — Medium quality	Identical
ISO 965-3 : 1998	IS 14962 (Part 3) : 2001 ISO general purpose metric screw threads — Tolerances : Part 3 Deviations for constructional screw threads	do
ISO 1502 : 1996	IS 2334[1)] ISO general purpose metric screw threads — Gauges and gauging (*second revision*)	do
ISO 5408 : 1983	IS 10587 : 1983 Terminology for screw threads	Modified

This standard (Part 1) covers the 'Principles and basic data of tolerances for ISO general purpose metric screw threads'. The other four parts of the standard are listed below:

IS No.	*Title*
IS 14962 (Part 2) : 2001 ISO 965-2 : 1998	ISO general purpose metric screw threads — Tolerances: Part 2 Limits of sizes for general purposes external and internal screw threads — Medium quality
IS 14962 (Part 3) : 2001 ISO 965-3 : 1998	ISO general purpose metric screw threads — Tolerances: Part 3 Deviations for constructional screw threads
IS 14962 (Part 4) : 2001 ISO 965-4 : 1998	ISO general purpose metric screw threads — Tolerances: Part 4 Limits of sizes for hot-dip galvanized external screw threads to mate with internal screw threads tapped with tolerance position H or G after galvanizing
IS 14962 (Part 5) : 2001 ISO 965-5 : 1998	ISO general purpose metric screw threads — Tolerances: 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

Indian Standards covering the various requirements of ISO general purpose metric screw threads except tolerances are listed below:

IS No.	*Title*
IS 4218 (Part 1) : 2001 ISO 68-1 : 1998	ISO general purpose metric screw threads : Part 1 Basic profile (*second revision*)
IS 4218 (Part 2) : 2001 ISO 261 : 1998	ISO general purpose metric screw threads : Part 2 General plan (*second revision*)
IS 4218 (Part 3) : 1999 ISO 724 : 1993	ISO general purpose metric screw threads : Part 3 Basic dimensions (*second revision*)
IS 4218 (Part 4) : 2001 ISO 262 : 1998	ISO general purpose metric screw threads : Part 4 Selected sizes for screws, bolts and nuts (*second revision*)

In reporting the results of a test or analysis made in accordance with this standard, if the final value, observed or calculated, is to be rounded off, it shall be done in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'.

[1)] To be published (Revision of IS 8999 : 1979).

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This Indian Standard has been developed from Doc: No. BP 20 (0462).

Amendments Issued Since Publication

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TO
IS 14962 (Part 1) : 2001/ISO 965-1 : 1998
ISO GENERAL PURPOSE METRIC SCREW THREADS — TOLERANCES
PART 1 PRINCIPLE AND BASIC DATA

Page 1, Scope

Replace the first paragraph with the following:

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

Page 1, Normative references

Replace all the dated references with undated references.

Delete the reference to ISO 898-1, thus deleting footnote 1.

Replace the references to ISO 965-2 and ISO 5408 with the following:

ISO 965-2, *ISO general purpose metric screw threads — Tolerances — Part 2: Limits of sizes for general purpose external and internal screw threads — Medium quality*

ISO 5408, *Screw threads — Vocabulary*

Page 2, 3.2

In the first column of the table, 15th row, replace *Td*1 with *Td*.

Page 4, 5.2

In the first paragraph, second line, replace “according to” with “in accordance with”.

Page 18

Add the following bibliography at the end of the document after 13.4.2:

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*

(PGD 20)

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