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INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO RECOMMENDATION

R 965 / I

ISO GENERAL PURPOSE METRIC SCREW THREADS

TOLERANCES

PRINCIPLES AND BASIC DATA

1st EDITION

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BRIEF HISTORY

The ISO Recommendation R 965/I, *ISO general purpose metric screw threads – Tolerances – Principles and basic data,* was drawn up by Technical Committee ISO/TC 1, *Screw threads,* the Secretariat of which is held by the Sveriges Standardiseringskommission (SIS).

Work on this question by the Technical Committee led, in 1964, to the adoption of the proposed tolerance system for ISO metric screw threads.

In September 1966, a Draft ISO Recommendation (No. 979) was circulated to all the ISO Member Bodies for enquiry. It was approved, subject to a few modifications of an editorial nature, by the following Member Bodies :

Argentina	Germany	South Africa, Rep. of
Australia	Greece	Spain
Austria	India	Sweden
Belgium	Israel	Switzerland
Brazil	Italy	Turkey
Canada	Japan	U.A.R.
Chile	Korea, Rep. of	United Kingdom
Czechoslovakia	Netherlands	U.S.A.
Denmark	New Zealand	Yugoslavia
Finland	Norway	
France	Romania	

No Member Body opposed the approval of the Draft.

The Draft ISO Recommendation was then submitted by correspondence to the ISO Council, which decided, in February 1969, to accept it as an ISO RECOMMENDATION.

FOREWORD

This document is one of a number of ISO Recommendations determining tolerances for ISO metric screw threads.

The complete set of these ISO Recommendations is made up as follows :

ISO/R 965/I (this document), *ISO general purpose metric screw threads – Tolerances – Principles and basic data;*

ISO/R 965/II, *ISO general purpose metric screw threads – Tolerances – Limits of sizes for commercial bolt and nut threads – Medium quality;*

ISO/R 965/III, *ISO general purpose metric screw threads – Tolerances Deviations for constructional threads;*

ISO/R . . .*, *ISO miniature screw threads.*

* At present Draft ISO Recommendation No. 1501.

ISO Recommendation | R 965/I | February 1969

ISO GENERAL PURPOSE METRIC SCREW THREADS

TOLERANCES

PRINCIPLES AND BASIC DATA

1. SCOPE

This ISO Recommendation specifies a tolerance system for screw threads according to ISO Recommendation R 261*. The tolerance system refers to the basic profile according to ISO Recommendation R 68**.

2. 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*) Series of *tolerance grades* for each of the four screw thread diameters (D_1, d, D_2, d_2) as follows :

	Tolerance grade
Minor diameter of nut threads	4, 5, 6, 7, 8
Major diameter of bolt threads	4, 6, 8
Pitch diameter of nut threads	4, 5, 6, 7, 8
Pitch diameter of bolt threads	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 an order of preference, are shown in section 11.

(*b*) Series of *tolerance positions*, G and H for nut threads and e, g and h for bolt threads. The established tolerance positions conform with the need of current coating thicknesses 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 section 11 are not recommended and should only be used for special cases.

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* At present under revision, under the new title, *ISO general purpose metric screw threads – General plan* (Draft ISO Recommendation No. 1499).

** At present under revision, under the new title, *ISO general purpose screw threads – Basic profile* (Draft ISO Recommendation No. 1498).

4. DESIGNATIONS

A complete designation for a screw thread comprises a designation for the thread system and size and a designation for the thread tolerance class.

The thread designations appear in the ISO Recommendations for ISO general purpose metric screw threads.

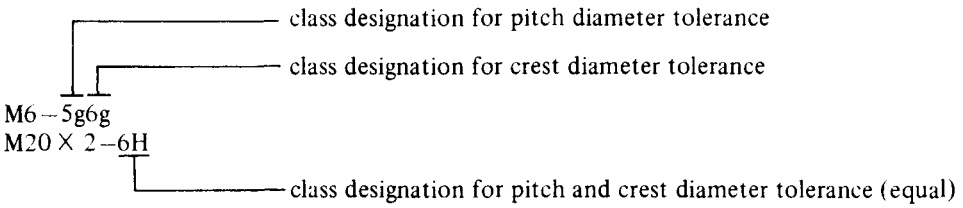
The tolerance class designation comprises a class designation for the pitch diameter tolerance followed by a class designation for the crest diameter tolerance.

Each class designation consists of

- a figure indicating the tolerance grade,
- a letter indicating the tolerance position, capital for nuts, small for bolts.

If the two class designations for a thread are equal it is not necessary to repeat the symbols.

Examples :



If considered necessary, the designation for the group of length of thread engagement may be added to the class designation.

A fit between threaded parts is indicated by the nut thread tolerance class followed by the bolt thread tolerance class separated by a stroke.

Examples :

M6 – 6H/6g

M20 × 2 – 6H/5g6g

For coated threads the tolerances apply to the parts *before* coating unless otherwise stated. After coating, the actual thread profile should not in any point transgress the maximum material limits for position H or h respectively.

5. TOLERANCE GRADES

For each of the two main elements, pitch diameter and crest diameter, a number of tolerance grades have been established. In each case, grade 6 should 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 lengths 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.

TABLE 1 – **Fundamental deviations for nut threads and bolt threads**

Pitch P	Fundamental deviation				
	Nut thread D_2, D_1		Bolt thread d, d_2		
	G EI	H EI	e es	g es	h es
mm	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		− 19	0
0.4	+ 19	0		− 19	0
0.45	+ 20	0		− 20	0
0.5	+ 20	0	− 50	− 20	0
0.6	+ 21	0	− 53	− 21	0
0.7	+ 22	0	− 56	− 22	0
0.75	+ 22	0	− 56	− 22	0
0.8	+ 24	0	− 60	− 24	0
1	+ 26	0	− 60	− 26	0
1.25	+ 28	0	− 63	− 28	0
1.5	+ 32	0	− 67	− 32	0
1.75	+ 34	0	− 71	− 34	0
2	+ 38	0	− 71	− 38	0
2.5	+ 42	0	− 80	− 42	0
3	+ 48	0	− 85	− 48	0
3.5	+ 53	0	− 90	− 53	0
4	+ 60	0	− 95	− 60	0
4.5	+ 63	0	− 100	− 63	0
5	+ 71	0	− 106	− 71	0
5.5	+ 75	0	− 112	− 75	0
6	+ 80	0	− 118	− 80	0

8. CREST DIAMETER TOLERANCES

8.1 Minor diameter tolerance of nut thread (T_{D_1})

For the minor diameter tolerance of nut thread, T_{D_1}, there are five tolerance grades, 4, 5, 6, 7 and 8, in accordance with Table 3.

TABLE 3 – **Minor diameter tolerances of nut thread (T_{D_1})**

Pitch P	Tolerance grade				
	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	1060
5	450	560	710	900	1120
5.5	475	600	750	950	1180
6	500	630	800	1000	1250

9. PITCH DIAMETER TOLERANCES

For the pitch diameter tolerance of nut thread, T_{D_2}, there are five tolerance grades, 4, 5, 6, 7 and 8 in accordance with Table 5.

For the pitch diameter tolerance of bolt thread, T_{d_2}, there are seven tolerance grades, 3, 4, 5, 6, 7, 8 and 9 in accordance with Table 6.

TABLE 5 – **Pitch diameter tolerance of nut thread (T_{D_2})**

Basic major diameter *d*		Pitch *P*	Tolerance grade				
over	up to and incl.		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
180	355	3	212	265	335	425	530
		4	236	300	375	475	600
		6	265	335	425	530	670

10. ROOT CONTOURS

For nut threads as well as bolt threads, the actual root contours should not in any point transgress the basic profile.

For bolt threads it is recommended to specify that the root profile should not present a radius of curvature R less than 0.1 P (see Table 7), which corresponds approximately to a maximum truncation of 3 $H/16$ for the upper limiting profile and a minimum truncation of $H/8$ for the lower limiting profile.

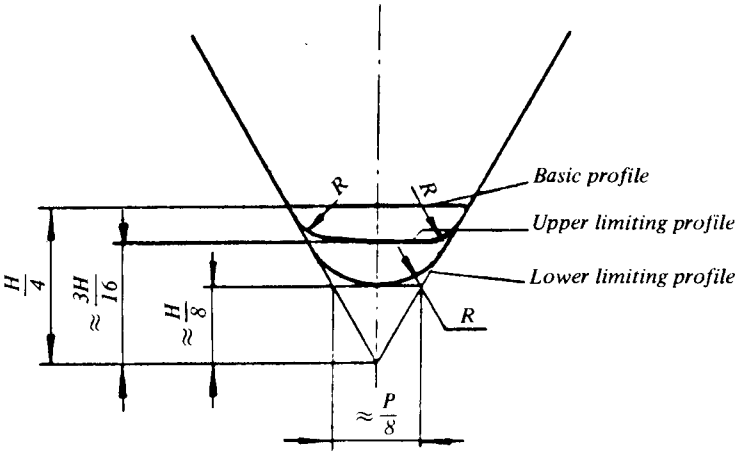


FIG. 6 **Bolt root profile**

TABLE 7 – **Minimum root radii**

Pitch P	R min.
mm	μm
0.2	20
0.25	25
0.35	35
0.4	40
0.45	45
0.5	50
0.6	60
0.7	70
0.75	75
0.8	80
1	100
1.25	125
1.5	150
1.75	175
2	200
2.5	250
3	300
3.5	350
4	400
4.5	450
5	500
5.5	550
6	600

12. FORMULAE

The values given in this ISO Recommendation are based on experience. In order to get 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.

These rules of rounding off have, in order to reproduce a smooth progression, not always been used.

The root radii specified in Table 7 are equal to 0.1 P.

12.1 Fundamental deviations

The fundamental deviations for nut and bolt threads have been calculated according to the following formulae :

$$EI_G = +(15 + 11\,P) \qquad es_e = -(50 + 11\,P)^*$$

$$EI_H = 0 \qquad es_g = -(15 + 11\,P)$$

$$es_h = 0$$

EI and es are expressed in micrometres;

P is expressed in millimetres.

12.2 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**.

$$l_{N\ min.} = 2.24\,P\,d^{0.2}$$

$$l_{N\ max.} = 6.7\ \ P\,d^{0.2}$$

l_N, P, and d are expressed in millimetres.

12.3 Crest diameter tolerances

12.3.1 *Tolerances for major diameter of bolt thread (T_d), grade 6*

$$T_d\,(6) = 180\,\sqrt[3]{P^2} - \frac{3.15}{\sqrt{P}}$$

T_d is expressed in micrometres;

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)

* Exceptions are values for threads with $P \leqslant 0.75$ mm.

** See ISO Recommendation R 261, at present under revision under the new title, *ISO general purpose metric screw threads – General plan* (Draft ISO Recommendation No. 1499).