SLOVENSKI STANDARD
SIST ISO 286-2:1999

01-marec-1999

Sistem mejnih mer in ujemov ISO - 2. del: Preglednice standardnih toleranč nih razredov in mejnih odstopkov za luknje in gredi

ISO system of limits and fits -- Part 2: Tables of standard tolerance grades and limit deviations for holes and shafts

Système ISO de tolérances et d'ajustements -- Partie 2: Tables des degrés de tolérance normalisés et des écarts limites des alésages et des arbres

Ta slovenski standard je istoveten z: **ISO 286-2:1988**

ICS:

17.040.10 Tolerance in ujemi Limits and fits

SIST ISO 286-2:1999 **en**

INTERNATIONAL STANDARD

ISO 286-2

First edition
1988-06-01

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
ORGANISATION INTERNATIONALE DE NORMALISATION
МЕЖДУНАРОДНАЯ ОРГАНИЗАЦИЯ ПО СТАНДАРТИЗАЦИИ

ISO system of limits and fits —

Part 2:
Tables of standard tolerance grades and limit deviations for holes and shafts

Système ISO de tolérances et d'ajustements —

Partie 2: Tables des degrés de tolérance normalisés et des écarts limites des alésages et des arbres

Reference number
ISO 286-2: 1988 (E)

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.

Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

This part of ISO 286 has been prepared by ISO/TC 3, *Limits and fits*, and, together with ISO 286-1, completes the revision of ISO/R 286, *ISO system of limits and fits*. ISO/R 286 was first published in 1962 and subsequently confirmed in November 1964; it was based on ISA Bulletin 25 first published in 1940.

The major changes incorporated in this part of ISO 286 are as follows:

a) The presentation of the information has been modified so that ISO 286 can be used directly in both the design office and the workshop. This has been achieved by separating the material dealing with the bases of the system, and the calculated values of standard tolerances and fundamental deviations, from the tables giving specific limits of the most commonly used tolerances and deviations.

b) The new symbols js and JS replace the former symbols j_s and J_S (i.e. s and S are no longer placed as subscripts) to facilitate the use of the symbols on equipment with limited character sets, e.g. computer graphics. The letters "s" and "S" stand for "symmetrical deviation".

c) Limit deviations have been included for basic sizes from 500 to 3 150 mm as standard requirements (these were previously included on an experimental basis only).

d) Limit deviations have been extended for holes H and JS, for shafts h and js, by including tolerance grades IT17 and IT18 in all basic sizes, and, for experimental purposes only, by including tolerance grades IT1 to IT5 in basic sizes over 500 mm up to 3 150 mm.

e) Limit deviations have been extended for some tolerance classes used in fine mechanisms and horology, in basic sizes up to 50 mm.

f) Inch values have been deleted.

g) The principles, terminology and symbols have been aligned with those required by contemporary technology.

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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ISO system of limits and fits —

Part 2:
Tables of standard tolerance grades and limit deviations for holes and shafts

0 Introduction

The need for limits and fits for machined workpieces was brought about mainly by the inherent inaccuracy of manufacturing methods, coupled with the fact that "exactness" of size was found to be unnecessary for most workpieces. In order that function could be satisfied, it was found sufficient to manufacture a given workpiece so that its size lay within two permissible limits, i.e. a tolerance, this being the variation in size acceptable in manufacture.

Similarly, where a specific fit condition is required between mating workpieces, it is necessary to ascribe an allowance, either positive or negative, to the basic size to achieve the required clearance or interference, i.e. a "deviation".

With developments in industry and international trade, it became necessary to develop formal systems of limits and fits, firstly at the industrial level, then at the national level and later at the international level.

This International Standard therefore gives the internationally accepted system of limits and fits.

A general graphical representation of the relationship between the respective tolerance classes and their deviations is given in the annex.

1 Scope

This part of ISO 286 gives values of the limit deviations for commonly used tolerance classes (zones) for holes and shafts calculated from the information given in ISO 286-1. This part of ISO 286 covers values for the upper deviations *ES* (for holes) and *es* (for shafts), and the lower deviations *EI* (for holes) and *ei* (for shafts) (see figure 1).

NOTE — In the tables of limit deviations, the values for the upper deviation *ES* or *es* are shown above the values for the lower deviation *EI* or *ei* except for tolerance class JS and js which is symmetrical about the zero line.

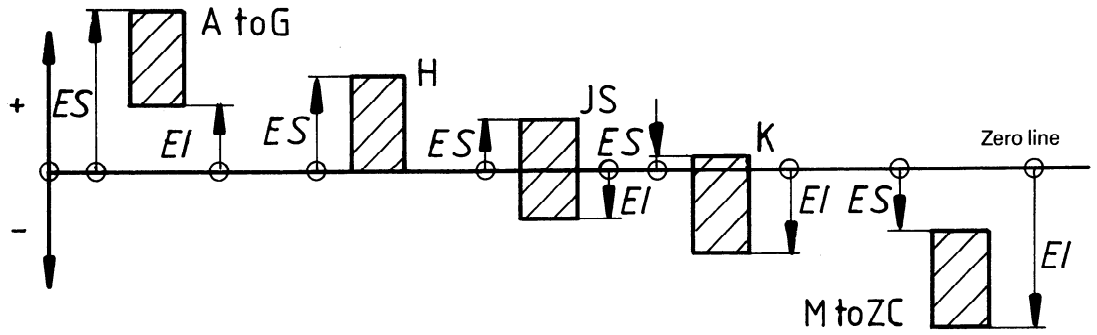
2 Field of application

The ISO system of limits and fits provides a system of tolerances and deviations suitable for plain workpieces.

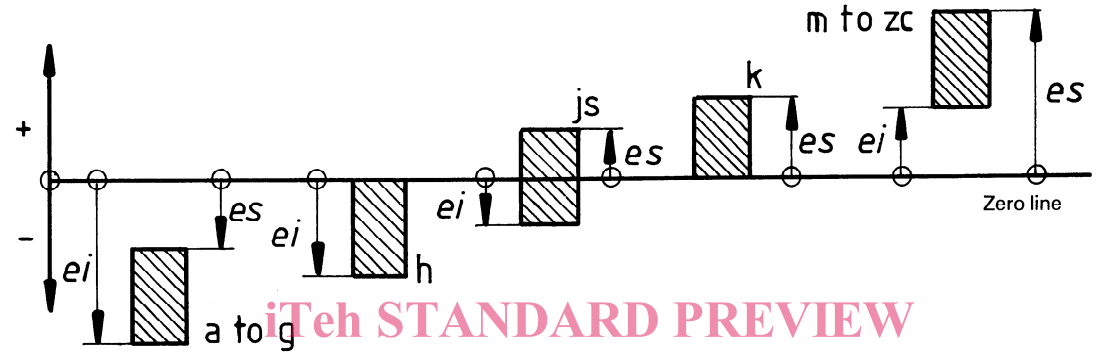
It should be noted that the general term "hole" or "shaft" used in this International Standard can be taken as referring to the space contained by (or containing) the two parallel faces (or tangent planes) of any workpiece, such as the width of a slot or the thickness of a key (see also ISO 286-1). Similarly, the term "commonly used holes and shafts" shall be interpreted as providing a very wide choice of limit deviations suitable for a wide variety of requirements.

For further information on terminology, symbols, bases of the system, etc., see ISO 286-1.

Notes on the presentation of tables 2 to 32 are given on page 7.



a) **Holes** (internal features)



b) **Shafts** (external features)

Figure 1 — Upper and lower deviations

3 References

NOTE — See also clause 7.

ISO 286-1, *ISO system of limits and fits — Part 1: Bases of tolerances, deviations and fits.*

ISO 1829, *Selection of tolerance zones for general purposes.*

4 Standard tolerances

The values of standard tolerance grades IT1 to IT18 inclusive are given in table 1.

For information on the bases of the system and its application, see ISO 286-1; for values of standard tolerances IT0 and IT01, see ISO 286-1, annex A, table 5.

5 Limit deviations for holes

A synoptic representation of the tolerance classes for holes, given in this part of ISO 286, is shown in figures 2 and 3.

Attention is drawn to the fact that the tolerance classes shown in figures 2 and 3, and their limit deviations, given in tables 2 to 16, are not intended to give detailed directives on the selection of tolerance classes for any purpose. Recommendations for the selection of tolerance classes are given in ISO 1829.

NOTE — Some tolerance classes are only provided for a restricted range of basic size steps. For further information, see note 1 on page 7.

6 Limit deviations for shafts

A synoptic representation of the tolerance classes for shafts, given in this part of ISO 286, is shown in figures 4 and 5.

Attention is drawn to the fact that the tolerance classes shown in figures 4 and 5, and their limit deviations, given in tables 17 to 32, are not intended to give detailed directives on the selection of tolerance classes for any purpose. Recommendations for the selection of tolerance classes are given in ISO 1829.

NOTE — Some tolerance classes are only provided for a restricted range of basic size steps. For further information, see note 1 on page 7.

7 Bibliography

The following International Standards on tolerancing and tolerance systems will be useful with regard to the application of this part of ISO 286:

ISO 406, *Technical drawings — Linear and angular toleranc-ing — Indications on drawings.*

ISO 1101, *Technical drawings — Geometrical tolerancing — Tolerancing of form, orientation, location and run-out — Generalities, definitions, symbols, indications on drawings.*

ISO/R 1938, *ISO system of limits and fits — Inspection of plain workpieces.* [1)]

ISO 2692, *Technical drawings — Geometrical tolerancing — Maximum material principle.*

ISO 2768-1, *General tolerances for dimensions without tolerance indications — Part 1: Tolerances for linear and angular dimensions.* [2)]

ISO 5166, *System of cone fits for cones from* C = 1 : 3 *to* 1 : 500, *lengths from* 6 *to* 630 mm *and diameters up to* 500 mm.

ISO 8015, *Technical drawings — Fundamental tolerancing principle.*

ISO 8062, *Castings — System of dimensional tolerances.*

1) At present under revision.

2) At present at the stage of draft. (Revision, in part, of ISO 2768 : 1973.)

Table 1 — Numerical values of standard tolerance grades IT for basic sizes up to 3 150 mm [1]

NOTE — This table, taken from ISO 286-1, has been included in this part of ISO 286 to facilitate understanding and use of the system.

Basic size mm		Standard tolerance grades																	
		IT1 [2]	IT2 [2]	IT3 [2]	IT4 [2]	IT5 [2]	IT6	IT7	IT8	IT9	IT10	IT11	IT12	IT13	IT14 [3]	IT15 [3]	IT16 [3]	IT17 [3]	IT18 [3]
Above	Up to and including	Tolerances																	
		μm											mm						
—	3 [3]	0,8	1,2	2	3	4	6	10	14	25	40	60	0,1	0,14	0,25	0,4	0,6	1	1,4
3	6	1	1,5	2,5	4	5	8	12	18	30	48	75	0,12	0,18	0,3	0,48	0,75	1,2	1,8
6	10	1	1,5	2,5	4	6	9	15	22	36	58	90	0,15	0,22	0,36	0,58	0,9	1,5	2,2
10	18	1,2	2	3	5	8	11	18	27	43	70	110	0,18	0,27	0,43	0,7	1,1	1,8	2,7
18	30	1,5	2,5	4	6	9	13	21	33	52	84	130	0,21	0,33	0,52	0,84	1,3	2,1	3,3
30	50	1,5	2,5	4	7	11	16	25	39	62	100	160	0,25	0,39	0,62	1	1,6	2,5	3,9
50	80	2	3	5	8	13	19	30	46	74	120	190	0,3	0,46	0,74	1,2	1,9	3	4,6
80	120	2,5	4	6	10	15	22	35	54	87	140	220	0,35	0,54	0,87	1,4	2,2	3,5	5,4
120	180	3,5	5	8	12	18	25	40	63	100	160	250	0,4	0,63	1	1,6	2,5	4	6,3
180	250	4,5	7	10	14	20	29	46	72	115	185	290	0,46	0,72	1,15	1,85	2,9	4,6	7,2
250	315	6	8	12	16	23	32	52	81	130	210	320	0,52	0,81	1,3	2,1	3,2	5,2	8,1
315	400	7	9	13	18	25	36	57	89	140	230	360	0,57	0,89	1,4	2,3	3,6	5,7	8,9
400	500	8	10	15	20	27	40	63	97	155	250	400	0,63	0,97	1,55	2,5	4	6,3	9,7
500	630 [2]	9	11	16	22	32	44	70	110	175	280	440	0,7	1,1	1,75	2,8	4,4	7	11
630	800 [2]	10	13	18	25	36	50	80	125	200	320	500	0,8	1,25	2	3,2	5	8	12,5
800	1000 [2]	11	15	21	28	40	56	90	140	230	360	560	0,9	1,4	2,3	3,6	5,6	9	14
1000	1250 [2]	13	18	24	33	47	66	105	165	260	420	660	1,05	1,65	2,6	4,2	6,6	10,5	16,5
1250	1600 [2]	15	21	29	39	55	78	125	195	310	500	780	1,25	1,95	3,1	5	7,8	12,5	19,5
1600	2000 [2]	18	25	35	46	65	92	150	230	370	600	920	1,5	2,3	3,7	6	9,2	15	23
2000	2500 [2]	22	30	41	55	78	110	175	280	440	700	1100	1,75	2,8	4,4	7	11	17,5	28
2500	3150 [2]	26	36	50	68	96	135	210	330	540	860	1350	2,1	3,3	5,4	8,6	13,5	21	33

1) Values for standard tolerance grades IT01 and IT0 for basic sizes less than or equal to 500 mm are given in ISO 286-1, annex A, table 5.

2) Values for standard tolerance grades IT1 to IT5 (incl.) for basic sizes over 500 mm are included for experimental use.

3) Standard tolerance grades IT14 to IT18 (incl.) shall not be used for basic sizes less than or equal to 1 mm.

2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
B8 C8 A9 B9 C9 A10 B10 C10 A11 B11 C11 A12 B12 C12 A13 B13 C13	E5 CD6 D6 E6 CD7 D7 E7 CD8 D8 E8 CD9 D9 E9 CD10 D10 E10 D11 D12 D13	EF3 F3 EF4 F4 EF5 F5 EF6 F6 EF7 F7 EF8 F8 EF9 F9 EF10 F10	FG3 G3 FG4 G4 FG5 G5 FG6 G6 FG7 G7 FG8 G8 FG9 G9 FG10 G10	H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 H11 H12 H13 H14 H15 H16 H17 H18	JS1 JS2 JS3 JS4 JS5 JS6 JS7 JS8 JS9 JS10 JS11 JS12 JS13 JS14 JS15 JS16 JS17 JS18	K3 K4 K5 J6 K6 J7 K7 J8 K8 K9 K10	M3 N3 M4 N4 M5 N5 M6 N6 M7 N7 M8 N8 M9 N9 M10 N10 N11	P3 P4 P5 P6 P7 P8 P9 P10	R3 R4 R5 R6 R7 R8 R9 R10	S3 S4 S5 S6 S7 S8 S9 S10	T5 U5 T6 U6 T7 U7 T8 U8 U9 U10	V5 X5 V6 X6 Y6 V7 X7 Y7 V8 X8 Y8 X9 Y9 X10 Y10	Z6 ZA6 Z7 ZA7 Z8 ZA8 Z9 ZA9 Z10 ZA10 Z11 ZA11	ZB7 ZC7 ZB8 ZC8 ZB9 ZC9 ZB10 ZC10 ZB11 ZC11

Tables

Figure 2 — Synoptic representation of tolerance classes for holes for basic sizes less than or equal to 500 mm

3	4	5	6	7	8	9	10	11	12	13
D6 E6 D7 E7 D8 E8 D9 E9 D10 E10 D11 D12 D13	F6 F7 F8 F9	G6 G7 G8	H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 H11 H12 H13 H14 H15 H16 H17 H18	JS1 JS2 JS3 JS4 JS5 JS6 JS7 JS8 JS9 JS10 JS11 JS12 JS13 JS14 JS15 JS16 JS17 JS18	K6 K7 K8	M6 N6 M7 N7 M8 N8 N9	P6 P7 P8 P9	R6 R7 R8	S6 S7 S8	T6 U6 T7 U7 T8 U8

Tables

NOTE — The tolerance classes in the frame are given for experimental use.

Figure 3 — Synoptic representation of tolerance classes for holes for basic sizes greater than 500 mm and less than or equal to 3 150 mm

17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
					h1	js1									
					h2	js2									
			ef3	f3 fg3	g3 h3	js3	k3	m3 n3	p3	r3	s3				
			ef4	f4 fg4	g4 h4	js4	k4	m4 n4	p4	r4	s4				
		cd5 d5	e5 ef5	f5 fg5	g5 h5	js5	j5 k5	m5 n5	p5	r5	s5	t5 u5	v5 x5		
		cd6 d6	e6 ef6	f6 fg6	g6 h6	js6	j6 k6	m6 n6	p6	r6	s6	t6 u6	v6 x6 y6	z6 za6	
		cd7 d7	e7 ef7	f7 fg7	g7 h7	js7	j7 k7	m7 n7	p7	r7	s7	t7 u7	v7 x7 y7	z7 za7	zb7 zc7
	c8	cd8 d8	e8 ef8	f8 fg8	g8 h8	js8	j8 k8	m8 n8	p8	r8	s8	t8 u8	v8 x8 y8	z8 za8	zb8 zc8
a9 b9	c9	cd9 d9	e9 ef9	f9 fg9	g9 h9	js9	k9	m9 n9	p9	r9	s9	u9	x9 y9	z9 za9	zb9 zc9
a10 b10	c10	cd10 d10	e10 ef10	f10 fg10	g10 h10	js10	k10		p10	r10	s10		x10 y10	z10 za10	zb10 zc10
a11 b11	c11	d11			h11	js11	k11							z11 za11	zb11 zc11
a12 b12	c12	d12			h12	js12	k12								
a13 b13		d13			h13	js13	k13								
					h14	js14									
					h15	js15									
					h16	js16									
					h17	js17									
					h18	js18									

Tables

Figure 4 — Synoptic representation of tolerance classes for shafts for basic sizes less than or equal to 500 mm

18	19	20	21	22	23	24	25	26	27	28	29
				h1	js1						
				h2	js2						
				h3	js3						
				h4	js4						
				h5	js5						
	e6	f6	g6	h6	js6	k6	m6 n6	p6	r6	s6	t6 u6
d7	e7	f7	g7	h7	js7	k7	m7 n7	p7	r7	s7	t7 u7
d8	e8	f8	g8	h8	js8	k8		p8	r8	s8	u8
d9	e9	f9		h9	js9	k9					
d10	e10			h10	js10	k10					
d11				h11	js11	k11					
				h12	js12	k12					
				h13	js13	k13					
				h14	js14						
				h15	js15						
				h16	js16						
				h17	js17						
				h18	js18						

Tables

NOTE — The tolerance classes in the frame are given for experimental use.

Figure 5 — Synoptic representation of tolerance classes for shafts for basic sizes greater than 500 mm and less than or equal to 3 150 mm

Notes on the presentation of tables 2 to 32

1 Values may be calculated, from the bases given in ISO 286-1, for fundamental deviations used for tolerance classes, for which there is no entry in the tables, but for which the space has been left blank.

2 A small horizontal separation has been inserted in the tables, where appropriate, to distinguish between values for basic sizes less than or equal to 500 mm and those greater than 500 mm, which have been derived from different bases.