

AMERICAN NATIONAL STANDARD

*Bores and Keyways for Flexible Couplings
(Metric Series)*

ANSI/AGMA 9112-A04



AGMA STANDARD

American National Standard

Bores and Keyways for Flexible Couplings (Metric Series)

ANSI/AGMA 9112-A04

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Approved May 5, 2005

ABSTRACT

This standard describes sizes and tolerances for straight and tapered bores and the associated keys and keyways, as furnished in flexible couplings. The data in the standard considers commercially standard coupling bores and keyways, not special coupling bores and keyways that may require special tolerances.

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Foreword

[The foreword, footnotes and annexes, if any, in this document are provided for informational purposes only and are not to be construed as a part of ANSI/AGMA 9112-A04, *Bores and Keyways for Flexible Couplings (Metric Series)*.]

This standard incorporates information from the following International Organization for Standardization (ISO) and American National standards Institute (ANSI) standards:

- ISO 286-1, *ISO System of limits and fits - Bases of tolerances, deviations and fits*
- ISO 286-2, *ISO System of limits and fits - Tables of standard tolerance grades and limit deviations for holes and shafts*
- ISO R773 (withdrawn 1998), *Rectangular or Square Parallel Keys and their Corresponding Keyways*
- ISO R775 (withdrawn 1998), *Cylindrical and 1/10 Conical Shaft Ends*
- ANSI/AGMA 9002-B04, *Bores and Keyways for Flexible Couplings (Inch Series)*

The intent of this document is to offer designers and users of flexible couplings preferred dimensions, tolerances and fits for metric bores and keyways.

This standard incorporates a small portion of the numerous variations of shaft/bore fits. These fits and tolerances have been determined to be the preferred fits and tolerances that most closely relate to the bore and keyway fit classes from ANSI/AGMA 9002-A86. A study of the existing metric standards indicated that the many possible combinations of shaft/bore fits would be impractical to adopt as an all encompassing standard. Therefore, this standard does not intend to replace any existing metric standards, but to define what is preferred.

The first draft of ANSI/AGMA 9112-A04 was made in May, 2001. It was approved by the AGMA membership in October 23, 2004. It was approved as an American National Standard on May 5, 2005.

Suggestions for improvement of this standard will be welcome. They should be sent to the American Gear Manufacturers Association, 500 Montgomery Street, Suite 350, Alexandria, Virginia 22314.

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American National Standard –

Bores and Keyways for Flexible Couplings (Metric Series)

1 Scope

This standard presents metric dimensions, tolerances, sizes and fits for straight bores, tapered bores, keys and keyways for unmounted industrial flexible couplings. The keys and keyways followed the recommendations of ISO R773:1969 and shaft tolerances followed ISO R775:1969. Shaft keyseat dimensions and tolerances were given in ISO R773:1969. This specification includes index tolerances for multiple keyways.

Inspection methods for straight and tapered bores and keyways are included in the annexes. The annexes also include the recommended design practice for tapered shafts for use with flexible couplings.

1.1 Application area

This standard is applicable to couplings as defined in ANSI/AGMA 9009-D02, *Nomenclature for Flexible Couplings*, with metric bores and keyways.

1.2 Excluded area

This standard does not apply to couplings attached to shafts without keys (see ANSI/AGMA 9003-A91), shafts and bores with tapered keys, inch bores with metric keyways, metric bores with inch keyways, inch bores with inch keyways, or shaft keyseat tolerances. See ANSI/AGMA 9002-B04 for inch bores with inch keyways.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this American National Standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on the American National Standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed.

ANSI/AGMA 9009-D02, *Flexible Couplings – Nomenclature for Flexible Couplings*

3 Symbols and definitions

3.1 Symbols

The symbols used in this standard are shown in table 1.

NOTE: The symbols and terms contained in this document may vary from those used in other AGMA standards. Users of this standard should assure themselves that they are using these symbols and terms in the manner indicated herein.

Table 1 – Symbols

Symbol	Description	Units	First used
b	Key width	mm	Table 3
D_b	Large end diameter of hub bore	mm	Figure 1
D_g	Gauge line diameter of hub bore	mm	Figure 2
D_{se}	Small end diameter of hub bore	mm	5.3
d	Cylindrical shaft diameter	mm	Table 3
h	Key height	mm	Table 3
I_{kw}	Multiple keyway index tolerance	mm	7.3.7
L_{kw}	Maximum keyway lead	mm	7.3.5
l	Axial length of the tapered feature	mm	5.3

(continued)

Table 1 (concluded)

Symbol	Description	Units	First used
N	Keyway offset tolerance	mm	7.3.4
r	Keyway or keyseat fillet radius	mm	Figure 4
s	Key chamfer	mm	Table 4
t_1	Nominal shaft keyseat depth from top of nominal shaft at centerline	mm	Figure 4
t_2	Nominal hub keyway depth from top of nominal bore at centerline	mm	Figure 4
α	Included angle	degrees	5.3

4 Straight (finished) bored hubs

4.1 Standard bores

Standard finished bore sizes and preferred tolerances are shown in table 2. Keyway tolerances are in accordance with clause 7.

NOTE: A bore size shown in table 2 may or may not be a stock bore size for each coupling manufacturer.

4.1.1 Shaft-to-hub fit

Shaft-to-hub fit is the responsibility of the purchaser. Table 2 shows the resulting fits of the preferred shaft/bore combinations.

4.1.2 Standard shaft-to-hub fits

This standard covers three classes of fits, clearance, transitional and interference as shown in table 2. Additional combinations of shaft/bore tolerancing and resulting fits, found in various specifications, are given in annex E. Use of the annex E combinations (or others) shall be approved by the coupling manufacturer. The type of shaft-to-hub fit selected is dependent on the type of coupling and service in which the coupling will be used. If a particular type of fit is desired, it shall be specified by the purchaser of the coupling.

4.1.2.1 Clearance fits

Clearance fits are normally used to facilitate assembly and disassembly of coupling hub(s). Factors to be considered when using clearance fits include:

- axial positioning and securing of coupling hub(s) during operation;
- when couplings are used for axial location of connected equipment (limited end float);
- the effect of hub-to-shaft clearance on coupling balance and coupling life;
- fretting of shaft and hub bore.

4.1.2.2 Transitional fits

Transitional fits result in the possibility of a clearance or interference fit as a result of the tolerances of both shaft and hub bore. The average fit is "size on size".

Transitional fits result when H7 bore tolerances are used in conjunction with the shaft tolerances from ISO R775:1969.

4.1.2.3 Interference fits

Interference fits are normally used to:

- maintain positive axial location of the hub(s) on the shaft(s) during operation;
- preserve the inherent balance quality of the coupling;
- minimize fretting of the shaft and bore.

Nominal interference fit rate is 0.0005 mm/mm of diameter. Some applications may require greater interference fit. The coupling purchaser shall advise the coupling manufacturer when a heavier interference fit is required. Heavier fits can influence the coupling design and materials selected.

4.1.3 Unspecified hub-to-shaft fits

When the purchaser does not specify the hub-to-shaft fit required, the coupling manufacturer will bore the coupling to their standard tolerance in accordance with one of the fits given in table 2. The purchaser is responsible for the resulting fit.

4.2 Non-standard bores

Non-standard bores are produced to dimensions and tolerances which are outside this standard.

4.3 Set screws

Set screws, when furnished for use with keys, shall be in accordance with each coupling manufacturer's standard, unless otherwise specified by the purchaser.

4.4 Bore surface finish

Machine finished bores shall have a surface finish normally in the range of 1.6 to 3.2 Ra micrometers. For finishes better than 3.2 Ra micrometers, additional processes may be necessary.

Table 2 - Recommended bores for metric shafts from ISO/R775:1969, mm

Nominal diameter	Shaft diameter		Clearance fit		Transitional fit		Interference fit	
			Hub bore	Fit ¹⁾	Hub bore	Fit ¹⁾	Hub bore	Fit ¹⁾
--	j6		F7	0.008	H7	-0.008	M6	-0.023
	0.008	/ -0.003	0.016 / 0.034	0.037	0.000 / 0.018	0.021	-0.015 / -0.004	-0.001
12	12.008	/ 11.997	12.016 / 12.034	↓	12.000 / 12.018	↓	11.985 / 11.996	↓
14	14.008	/ 13.997	14.016 / 14.034		14.000 / 14.018		13.985 / 13.996	
16	16.008	/ 15.997	16.016 / 16.034		16.000 / 16.018		15.985 / 15.996	
18	18.008	/ 17.997	18.016 / 18.034		18.000 / 18.018		17.985 / 17.996	
>18	j6		F7	0.011	H7	-0.009	M6	-0.026
	0.009	/ -0.004	0.020 / 0.041	0.045	0.000 / 0.021	0.025	-0.017 / -0.004	0.000
19	19.009	/ 18.996	19.020 / 19.041	↓	19.000 / 19.021	↓	18.983 / 18.996	↓
20	20.009	/ 19.996	20.020 / 20.041		20.000 / 20.021		19.983 / 19.996	
22	22.009	/ 21.996	22.020 / 22.041		22.000 / 22.021		21.983 / 21.996	
24	24.009	/ 23.996	24.020 / 24.041		24.000 / 24.021		23.983 / 23.996	
25	25.009	/ 24.996	25.020 / 25.041		25.000 / 25.021		24.983 / 24.996	
28	28.009	/ 27.996	28.020 / 28.041		28.000 / 28.021		27.983 / 27.996	
30	30.009	/ 29.996	30.020 / 30.041		30.000 / 30.021		29.983 / 29.996	
>30	k6		F7	0.007	H7	-0.018	K6	-0.031
	0.018	/ 0.002	0.025 / 0.050	0.048	0.000 / 0.025	0.023	-0.013 / 0.003	0.001
32	32.018	/ 32.002	32.025 / 32.050	↓	32.000 / 32.025	↓	31.987 / 32.003	↓
35	35.018	/ 35.002	35.025 / 35.050		35.000 / 35.025		34.987 / 35.003	
38	38.018	/ 38.002	38.025 / 38.050		38.000 / 38.025		37.987 / 38.003	
40	40.018	/ 40.002	40.025 / 40.050		40.000 / 40.025		39.987 / 40.003	
42	42.018	/ 42.002	42.025 / 42.050		42.000 / 42.025		41.987 / 42.003	
45	45.018	/ 45.002	45.025 / 45.050		45.000 / 45.025		44.987 / 45.003	
48	48.018	/ 48.002	48.025 / 48.050		48.000 / 48.025		47.987 / 48.003	
50	50.018	/ 50.002	50.025 / 50.050		50.000 / 50.025		49.987 / 50.003	
>50	m6		F7	0.000	H7	-0.030	K7	-0.051
	0.030	/ 0.011	0.030 / 0.060	0.049	0.000 / 0.030	0.019	-0.021 / 0.009	-0.002
55	55.030	/ 55.011	55.030 / 55.060	↓	55.000 / 55.030	↓	54.979 / 55.009	↓
56	56.030	/ 56.011	56.030 / 56.060		56.000 / 56.030		55.979 / 56.009	
60	60.030	/ 60.011	60.030 / 60.060		60.000 / 60.030		59.979 / 60.009	
63	63.030	/ 63.011	63.030 / 63.060		63.000 / 63.030		62.979 / 63.009	
65	65.030	/ 65.011	65.030 / 65.060		65.000 / 65.030		64.979 / 65.009	
70	70.030	/ 70.011	70.030 / 70.060		70.000 / 70.030		69.979 / 70.009	
71	71.030	/ 71.011	71.030 / 71.060		71.000 / 71.030		70.979 / 71.009	
75	75.030	/ 75.011	75.030 / 75.060		75.000 / 75.030		74.979 / 75.009	
80	80.030	/ 80.011	80.030 / 80.060		80.000 / 80.030		79.979 / 80.009	
>80	m6		F7	0.001	H7	-0.035	M7	-0.070
	0.035	/ 0.013	0.036 / 0.071	0.058	0.000 / 0.035	0.022	-0.035 / 0.000	-0.013
85	85.035	/ 85.013	85.036 / 85.071	↓	85.000 / 85.035	↓	84.965 / 85.000	↓
90	90.035	/ 90.013	90.036 / 90.071		90.000 / 90.035		89.965 / 90.000	
95	95.035	/ 95.013	95.036 / 95.071		95.000 / 95.035		94.965 / 95.000	
100	100.035	/ 100.013	100.036 / 100.071		100.000 / 100.035		99.965 / 100.000	
>100	m6		F7	↓	H7	↓	P7	-0.094
	0.035	/ 0.013	0.036 / 0.071		0.000 / 0.035		-0.059 / -0.024	-0.037
110	110.035	/ 110.013	110.036 / 110.071	↓	110.000 / 110.035	↓	109.941 / 109.976	↓
120	120.035	/ 120.013	120.036 / 120.071		120.000 / 120.035		119.941 / 119.976	
>120	m6		F7	0.003	H7	-0.040	P7	-0.108
	0.040	/ 0.015	0.043 / 0.083	0.068	0.000 / 0.040	0.025	-0.068 / -0.028	-0.043
125	125.040	/ 125.015	125.043 / 125.083	↓	125.000 / 125.040	↓	124.932 / 124.972	↓
130	130.040	/ 130.015	130.043 / 130.083		130.000 / 130.040		129.932 / 129.972	
140	140.040	/ 140.015	140.043 / 140.083		140.000 / 140.040		139.932 / 139.972	
150	150.040	/ 150.015	150.043 / 150.083		150.000 / 150.040		149.932 / 149.972	
160	160.040	/ 160.015	160.043 / 160.083		160.000 / 160.040		159.932 / 159.972	
170	170.040	/ 170.015	170.043 / 170.083		170.000 / 170.040		169.932 / 169.972	
180	180.040	/ 180.015	180.043 / 180.083		180.000 / 180.040		179.932 / 179.972	

(continued)

Table 2 (concluded)

Nominal diameter	Shaft diameter	Clearance fit		Transitional fit		Interference fit	
		Hub bore	Fit ¹⁾	Hub bore	Fit ¹⁾	Hub bore	Fit ¹⁾
>180	m6	F7	0.004	H7	-0.046	P7	-0.125
	0.046 / 0.017	0.050 / 0.096	0.079	0.000 / 0.046	0.029	-0.079 / -0.033	-0.050
190	190.046 / 190.017	190.050 / 190.096	↓	190.000 / 190.046	↓	189.921 / 189.967	↓
200	200.046 / 200.017	200.050 / 200.096		200.000 / 200.046		199.921 / 199.967	
>200	m6	F7	↓	H7	↓	R7	-0.155
	0.046 / 0.017	0.050 / 0.096		0.000 / 0.046		-0.109 / -0.063	-0.080
210	210.046 / 210.017	210.050 / 210.096	↓	210.000 / 210.046	↓	209.891 / 209.937	↓
220	220.046 / 220.017	220.050 / 220.096		220.000 / 220.046		219.891 / 219.937	
225	225.046 / 225.017	225.050 / 225.096	↓	225.000 / 225.046	↓	224.891 / 224.937	↓
>225	m6	F7		H7		R7	-0.159
	0.046 / 0.017	0.050 / 0.096		0.000 / 0.046		-0.113 / -0.067	-0.084
230	230.046 / 230.017	230.050 / 230.096	↓	230.000 / 230.046	↓	229.887 / 229.933	↓
240	240.046 / 240.017	240.050 / 240.096		240.000 / 240.046		239.887 / 239.933	
250	250.046 / 250.017	250.050 / 250.096	↓	250.000 / 250.046	↓	249.887 / 249.933	↓
>250	m6	F7		H7		R7	-0.178
	0.052 / 0.020	0.056 / 0.108		0.000 / 0.052		-0.126 / -0.074	-0.094
260	260.052 / 260.020	260.056 / 260.108	↓	260.000 / 260.052	↓	259.874 / 259.926	↓
270	270.052 / 270.020	270.056 / 270.108		270.000 / 270.052		269.874 / 269.926	
280	280.052 / 280.020	280.056 / 280.108	↓	280.000 / 280.052	↓	279.874 / 279.926	↓
>280	m6	F7		H7		R7	-0.182
	0.052 / 0.020	0.056 / 0.108		0.000 / 0.052		-0.130 / -0.078	-0.098
290	290.052 / 290.020	290.056 / 290.108	↓	290.000 / 290.052	↓	289.870 / 289.922	↓
300	300.052 / 300.020	300.056 / 300.108		300.000 / 300.052		299.870 / 299.922	
310	310.052 / 310.020	310.056 / 310.108	↓	310.000 / 310.052	↓	309.870 / 309.922	↓
315	315.052 / 315.020	315.056 / 315.108		315.000 / 315.052		314.870 / 314.922	
>315	m6	F7	↓	H7	↓	R7	-0.201
	0.057 / 0.021	0.062 / 0.119		0.000 / 0.057		-0.144 / -0.087	-0.108
320	320.057 / 320.021	320.062 / 320.119	↓	320.000 / 320.057	↓	319.856 / 319.913	↓
330	330.057 / 330.021	330.062 / 330.119		330.000 / 330.057		329.856 / 329.913	
340	340.057 / 340.021	340.062 / 340.119	↓	340.000 / 340.057	↓	339.856 / 339.913	↓
350	350.057 / 350.021	350.062 / 350.119		350.000 / 350.057		349.856 / 349.913	
355	355.057 / 355.021	355.062 / 355.119	↓	355.000 / 355.057	↓	354.856 / 354.913	↓
>355	m6	F7		H7		R8	-0.260
	0.057 / 0.021	0.062 / 0.119		0.000 / 0.057		-0.203 / -0.114	-0.135
360	360.057 / 360.021	360.062 / 360.119	↓	360.000 / 360.057	↓	359.797 / 359.886	↓
370	370.057 / 370.021	370.062 / 370.119		370.000 / 370.057		369.797 / 369.886	
380	380.057 / 380.021	380.062 / 380.119	↓	380.000 / 380.057	↓	379.797 / 379.886	↓
390	390.057 / 390.021	390.062 / 390.119		390.000 / 390.057		389.797 / 389.886	
400	400.057 / 400.021	400.062 / 400.119	↓	400.000 / 400.057	↓	399.797 / 399.886	↓
>400	m6	F7		H7		R8	-0.286
	0.063 / 0.023	0.068 / 0.131		0.000 / 0.063		-0.223 / -0.126	-0.149
410	410.063 / 410.023	410.068 / 410.131	↓	410.000 / 410.063	↓	409.777 / 409.874	↓
420	420.063 / 420.023	420.068 / 420.131		420.000 / 420.063		419.777 / 419.874	
430	430.063 / 430.023	430.068 / 430.131	↓	430.000 / 430.063	↓	429.777 / 429.874	↓
440	440.063 / 440.023	440.068 / 440.131		440.000 / 440.063		439.777 / 439.874	
450	450.063 / 450.023	450.068 / 450.131	↓	450.000 / 450.063	↓	449.777 / 449.874	↓
>450	m6	F7		H7		R8	-0.292
	0.063 / 0.023	0.068 / 0.131		0.000 / 0.063		-0.229 / -0.132	-0.155
460	460.063 / 460.023	460.068 / 460.131	↓	460.000 / 460.063	↓	459.771 / 459.868	↓
470	470.063 / 470.023	470.068 / 470.131		470.000 / 470.063		469.771 / 469.868	
480	480.063 / 480.023	480.068 / 480.131	↓	480.000 / 480.063	↓	479.771 / 479.868	↓
490	490.063 / 490.023	490.068 / 490.131		490.000 / 490.063		489.771 / 489.868	
500	500.063 / 500.023	500.068 / 500.131	↓	500.000 / 500.063	↓	499.771 / 499.868	↓

NOTE:

1) Positive values are clearance, negative values are interference.

5 Tapered bore hubs

5.1 Typical tapered bores

The standard taper as defined in ISO R775:1969, *Cylindrical and 1/10 Conical Shaft Ends*, is 1/10 (1 to 10 rate of taper, 5.7248 degrees included angle).

Other tapers, such 1/8, 1/15 and 1/20, are also used.

5.2 Keyways

Keyways for tapered bore hubs may be parallel to the taper or parallel to the bore centerline.

5.3 Tapered bore dimensional control requirements

Three dimensions are required to control the form and size of a conical surface.

- the axial length of the tapered feature, l ;
- the diameter at one end of the taper (preferably the large end, D_b , or the small end, D_{se}), or at a cross-sectional plane which may be within or outside the tapered feature;
- the angle of taper, given as a rate of taper or as an included angle, α .

Typical requirements are shown in figure 1.

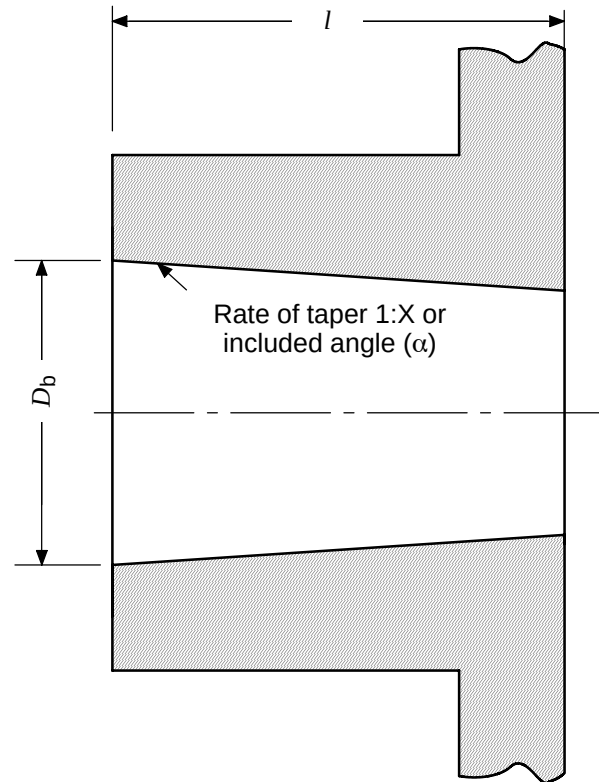


Figure 1 - Tapered bore requirements

5.4 Dimensioning of tapered bores

Preferred method of dimensioning requires the large end of the taper bore with tolerance, hub length, and taper. See figure 2 for preferred dimensioning. Stand-off to a gauge line should also be provided for large end diameter inspection purposes (see annex B). The gauge line is a reference plane which could be beyond, flush, or within the hub.

6 Keys

6.1 Key sizes

Key sizes for cylindrical shafts are shown in table 3 and key dimensions in table 4. Key types are shown in figure 3. The key type selected is determined by the shaft manufacturer.

Key sizes for conical shaft ends can be found in annex C.

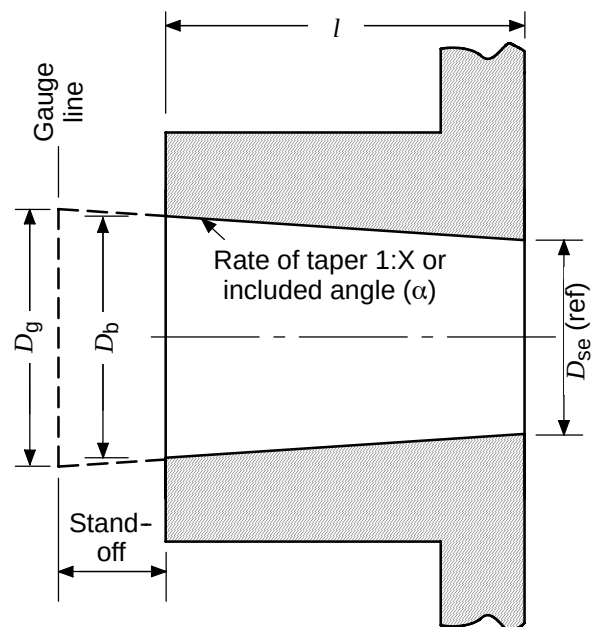


Figure 2 - Tapered bore drawing dimensions

Table 3 - Key sizes for cylindrical shafts from ISO R773:1969, mm

Cylindrical shaft diameter, d		Nominal key size, $b \times h$	Cylindrical shaft diameter, d		Nominal key size, $b \times h$
over	To (incl.)		over	To (incl.)	
10	12	4x4	95	110	28x16
12	17	5x5	110	130	32x18
17	22	6x6	130	150	36x20
22	30	8x7	150	170	40x22
30	38	10x8	170	200	45x25
38	44	12x8	200	230	50x28
44	50	14x9	230	260	56x32
50	58	16x10	260	290	63x32
58	65	18x11	290	330	70x36
65	75	20x12	330	380	80x40
75	85	22x14	380	440	90x45
85	95	25x14	440	500	100x50

Table 4 - Key dimensions from ISO R773:1969, mm

Nominal size $b \times h$	Width, b		Height, h		Chamfer, s	
	Nominal	Tolerance ($h9$)	Nominal	Tolerance ¹⁾	Minimum	Maximum
4x4	4		4		0.16	0.25
5x5	5	0 / -0.030	5	0 / -0.030		
6x6	6		6		0.25	0.40
8x7	8	0 / -0.036	7			
10x8	10		8	0 / -0.090	0.40	0.60
12x8	12		8			
14x9	14	0 / -0.043	9			
16x10	16		10			
18x11	18		11			
20x12	20		12	0 / -0.110	0.60	0.80
22x14	22	0 / -0.052	14			
25x14	25		14			
28x16	28		16			
32x18	32		18			
36x20	36	0 / -0.062	20	0 / -0.130	1.00	1.20
40x22	40		22			
45x25	45		25			
50x28	50		28			
56x32	56		32	0 / -0.160	1.60	2.00
63x32	63	0 / -0.074	32			
70x36	70		36			
80x40	80		40			
90x45	90	0 / -0.087	45		2.50	3.00
100x50	100		50			

¹⁾ Square section ($h9$), rectangular section ($h11$), ISO 286-2:1988.

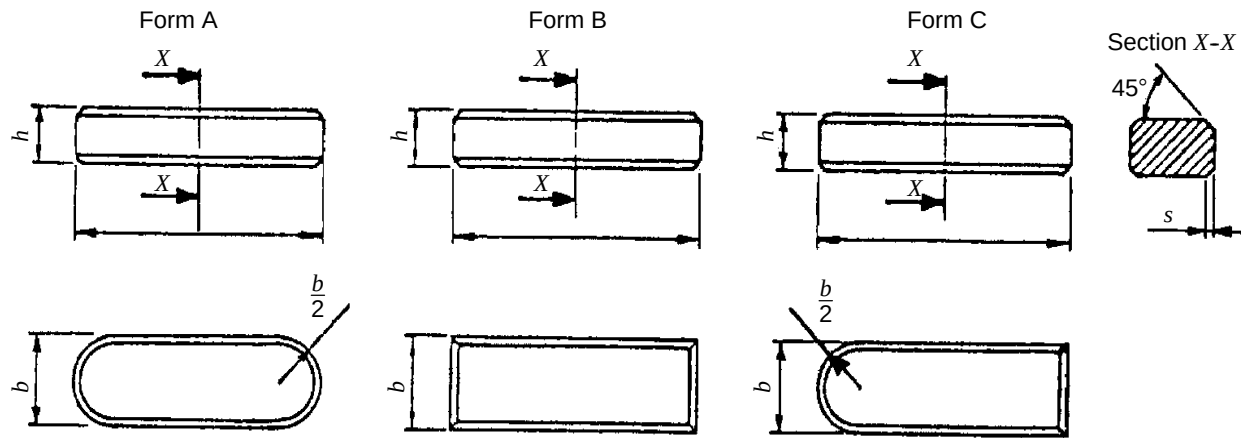


Figure 3 - Types of keys

7 Hub keyways

7.1 Classes of key-to-hub keyway fit

This standard covers two classes of key-to-hub keyway fit: normal Js9 (preferred) and close P9 (hand fitted).

7.1.1 Normal Js9 (preferred)

Normal Js9 (preferred) key-to-hub keyway fits, which are used for most applications, have a transitional fit between the sides of the keyway and key. Keyway width and depth tolerances are per table 5. Key tolerances are given in table 4. The resulting fit dimensions are shown in table 6.

7.1.2 Close P9 (hand fitted)

Close P9 (hand fitted) key-to-hub keyway fits require use of an undersize keyway and a key whose width must be hand fitted at assembly to suit the

keyway. Keyway width and depth tolerances are given in table 5. Key tolerances are given in table 4. The resulting fit dimensions are shown in table 6 for unmodified keys.

7.2 Hub keyway sizes

Keyway sizes for cylindrical shafts are listed in table 5. Keyway data for conical shafts can be obtained from the data listed in table C.1. Clearance is required above the key in the hub.

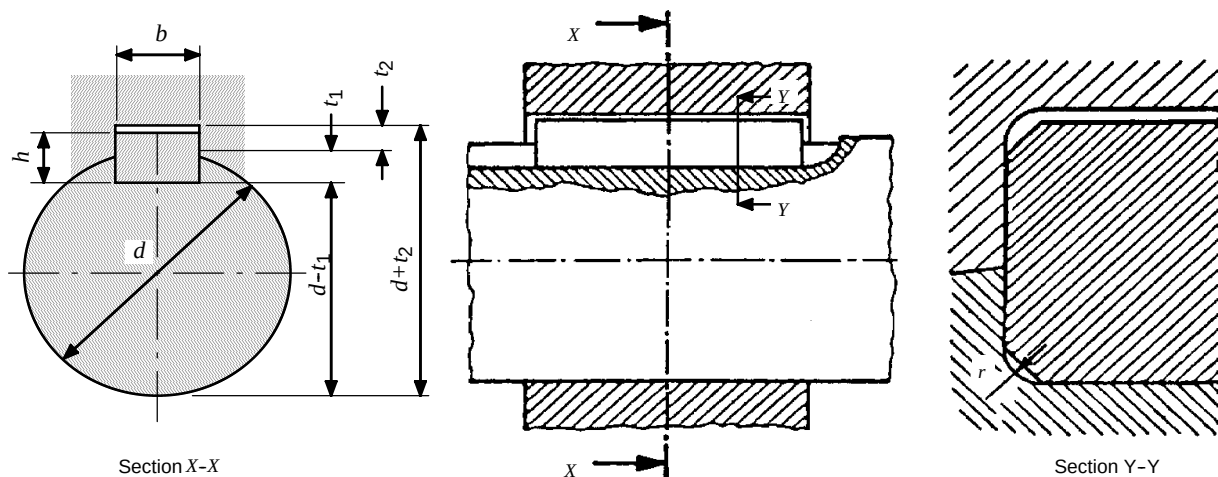
7.3 Hub keyway dimensions and tolerances

Keyway dimensions for square and rectangular keys are shown in figure 4 and their use is illustrated in the following paragraphs.

7.3.1 Keyway width

Nominal keyway width for both classes of fits is equal to nominal key width.

Keyway width tolerances are shown in table 5.



Detail of keyway and key
Figure 4 - Keyway dimensions