Foreword

The development of this National Standard was initiated by the Agricultural Machinery Testing and Evaluation Center (AMTEC) under the project entitled "Enhancing the Implementation of the AFMA Through Improved Agricultural Engineering Standards" which was funded by the Bureau of Agricultural Research (BAR) of the Department of Agriculture (DA).

This Standard was reviewed by the Technical Committee for Study 2 – Development of Standards for Engineering Materials and was circulated to various private and government agencies/organizations concerned for their comments and reactions. These standards were presented to the Philippine Society of Agricultural Engineers (PSAE) and subjected to a public hearing organized by the National Agriculture and Fisheries Council (NAFC). The comments and reactions received during the presentation and public hearing were taken into consideration in the finalization of the standards.

This Standard has been technically formulated in accordance with PNS 01:Part 4:1998 – Rules for the Structure and Drafting of Philippine National Standard. It provides specifications of keys and its corresponding keyways and does not cover manufacturing specifications.

This standard was based from JIS B 1301:1996, Keys and their corresponding keyways. In the preparation of this standard, the following references were considered.

Faires, V. M. 1969. Design of Machine Elements. Macmillan Company, New York USA.

Dodge design manual

Engineering Materials – Keys and Keyways for Agricultural Machines – Specifications and Applications

1 Scope

This Standard specifies the parallel keys, taper keys and Woodruff keys made of steel used for agricultural machines (hereafter referred to as "keys" in generic term) and their corresponding keyways.

2 Reference

The following normative references contains provisions which, through reference in this text, constitute provisions of this Standard:

PAES 305:2000, Engineering Materials – Shafts for Agricultural Machines – Specifications and Applications

3 Application

Keys are used to prevent relative movement of rotating members and the shafts or spindles to which they are mounted.

4 Classification

Keys are classified into the following classes:

1) Parallel keys – keys whose longitudinal sides are parallel with each other.
2) Taper keys – keys with a tapered longitudinal section.
3) Woodruff keys – keys with a semi-circular cross-section.

5 Parallel keys

5.1 Nomenclature of parallel keys and keyways

Parallel keys can also be either square or rectangular with respect to its cross section. The designation of dimensions of parallel keys and parallel keyways are shown in Figure 1 and 2 respectively and are defined as follows:

b – the cross-sectional width of the key
h – the cross-sectional height of the key
l – length of the key
b_1 – width of keyway for the shaft
b_2 – width of keyway for the hub
t_1 – height of keyway for the shaft
t_2 – height of keyway for the hub
d – shaft diameter
r – radius of curvature

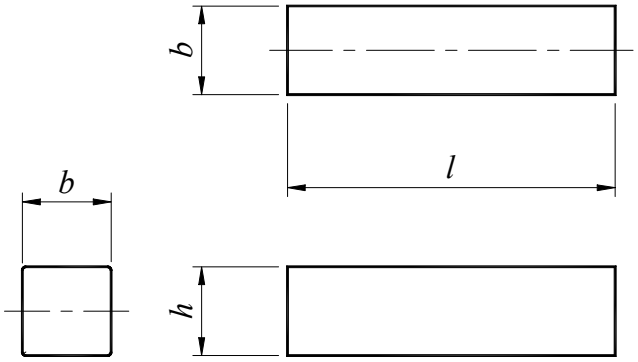

Figure 1 – Designation of dimension of parallel keys

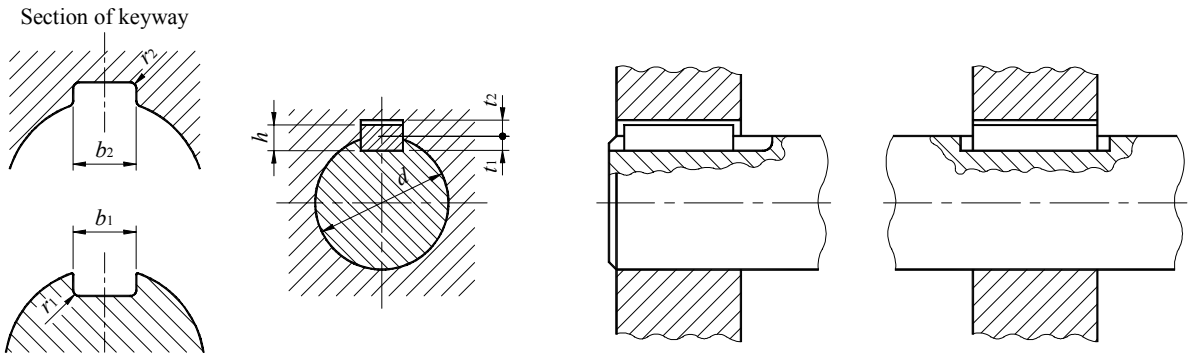

Figure 2 - Designation of dimension of keyway for parallel key

5.2 Classification of key ends

The end of the parallel key shall be classified into three classes as shown in Figure 3 according to its shape. If not specified, key ends shall be both ends rectangular or square.

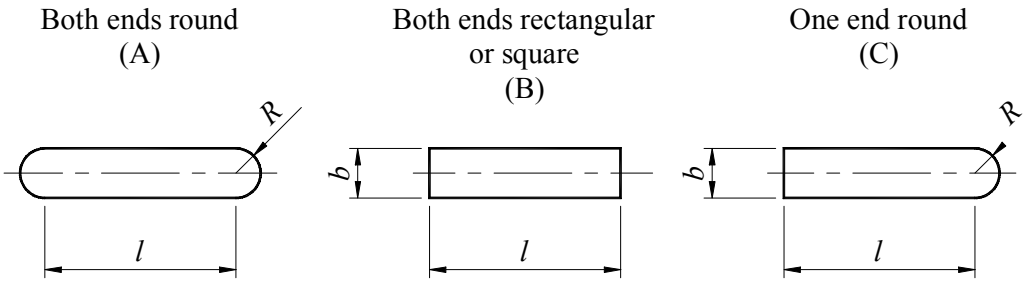

Figure 3 – End of key

5.3 Specifications of parallel keys and keyways

Dimensions of parallel keys and keyways are specified in Tables 1 and 2 respectively.

Table 1 – Dimensions of parallel keys, mm

Nominal dimension of key *b x h*	***l***	**Nominal dimension of key *b x h***	***l***
2x2	6 to 20	25x14	70 to 280
3x3	6 to 36	28x16	80 to 320
4x4	8 to 45	32x18	90 to 360
5x5	10 to 56	(35x22)	100 to 400
6x5	14 to 70	36x20	-
6x6	14 to 70	(38x24)	-
(7x7)	16 to 80	40x22	-
8x7	18 to 90	(42x26)	-
10x8	22 to 110	45x25	-
10x10	22 to 110	50x28	-
12x8	28 to 140	56x32	-
14x9	36 to 160	63x32	-
(15x10)	40 to 180	70x36	-
16x10	45 to 180	80x40	-
18x11	50 to 200	90x45	-
20x12	56 to 220	100x50	-
(24x16)	70 to 280		

Note: For other sizes of keys and keyways, refer to manufacturer's catalog. Those of parenthesized nominal dimensions which are not specified in the International Standards shall not be used in new design

Table 2 –Dimension of keyways for parallel keys, mm

Nominal dimension of key *b x h*	Basic dimension b_1 and b_2	Basic dimension of t_1	Basic dimension of t_2	Applicable shaft diameter, *d*
2x2	2	1.2	1.0	6 to 8
3x3	3	1.8	1.4	8 to 10
4x4	4	2.5	1.8	10 to 12
5x5	5	3.0	2.3	12 to 17
6x6	6	3.5	2.8	17 to 22
(7x7)	7	4.0	3.3	20 to 25
8x7	8	4.0	3.3	22 to 30
10x8	10	5.0	3.3	30 to 38
12x8	12	5.0	3.3	38 to 44
14x9	14	5.5	3.8	44 to 50
(15x10)	15	5.0	5.3	50 to 55
16x10	16	6.0	4.3	50 to 58
18x11	18	7.0	4.4	58 to 65
20x12	20	7.5	4.9	65 to 75
22x14	22	9.0	5.4	75 to 85
(24x16)	24	8.0	8.4	80 to 90
25x14	25	9.0	5.4	85 to 95
28x16	28	10.0	6.4	95 to 110
32x18	32	11.0	7.4	110 to 130
(35x22)	35	11.0	11.4	125 to 140
36x20	36	12.0	8.4	130 to 150
(38x24)	38	12.0	12.4	140 to 160
40x22	40	13.0	9.4	150 to 170
(42x26)	42	13.0	13.4	160 to 180
45x25	45	15.0	10.4	170 to 200
50x28	50	17.0	11.4	200 to 230
56x32	56	20.0	12.4	230 to 260
63x32	63	20.0	12.4	260 to 290
70x36	70	22.0	14.4	290 to 330
80x40	80	25.0	15.4	330 to 380
90x45	90	28.0	17.4	380 to 440
100x50	100	31.0	19.5	440 to 500

Note: Those of parenthesized nominal dimensions which are not specified in the International Standards shall not be used in new design

6 Taper keys

6.1 Nomenclature of taper keys and keyways

The designation of dimensions of taper keys and keyways are shown in Figure 4 and 5 respectively and are defined as follows:

b – the cross-sectional width of the key

h – the cross-sectional height of the key

h_1 – height of the gib head

l – length of the key

b_1 – width of keyway for the shaft

b_2 – width of keyway for the hub

t_1 – height of keyway for the shaft

t_2 – height of keyway for the hub

d – shaft diameter

r – radius of curvature

6.2 Classification

The classifications of tapered keys are as follows:

Without gib head	-	T
With gig head	-	TG

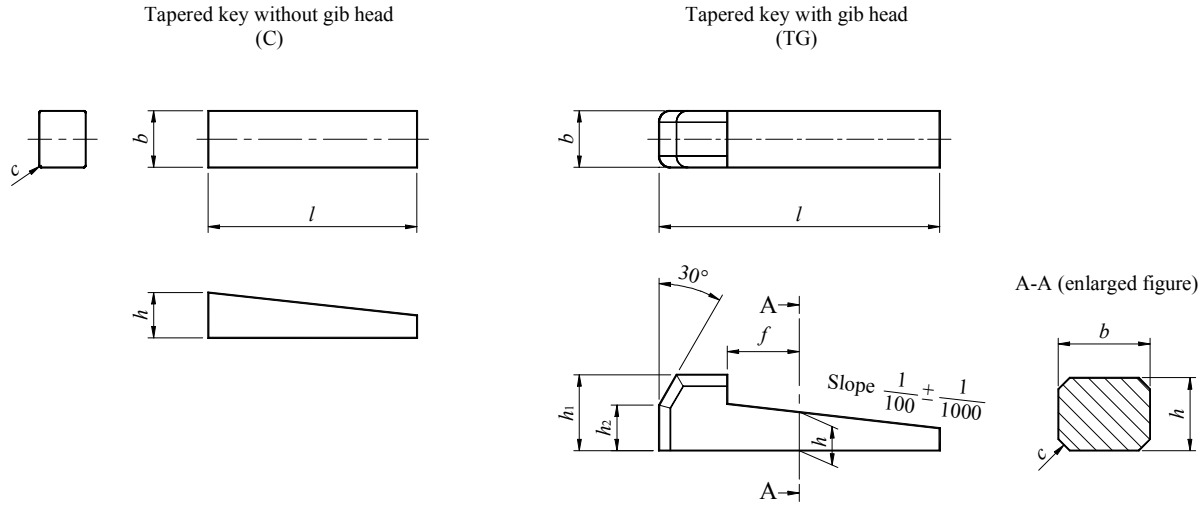

Figure 4 – Designation of dimension of tapered key

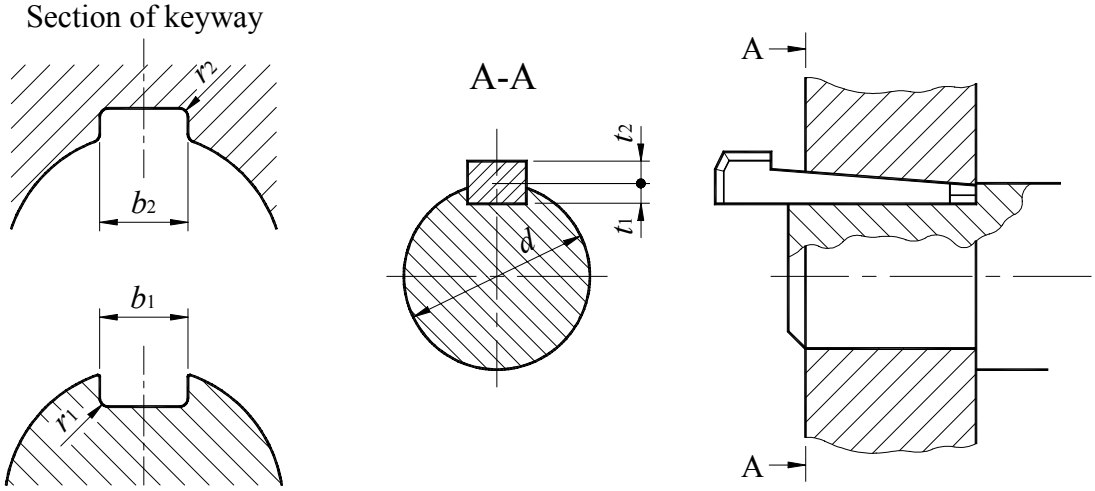

Figure 5 - Designation of dimension of keyway for tapered key

6.3 Dimensions of tapered keys and keyways

Dimensions of tapered keys and keyways are specified in Tables 3 and 4 respectively.

Table 3 – Dimension of tapered keys, mm

Nominal dimension of key *b x h*	Key body			
	l	***b***	***h***	h_1
2x2	6 to 30	2	2	-
3x3	6 to 36	3	3	-
4x4	8 to 45	4	4	7
5x5	10 to 56	5	5	8
6x6	14 to 70	6	6	10
(7x7)	16 to 80	7	7.2	10
8x7	18 to 90	8	7	11
10x8	22 to 110	10	8	12
12x8	28 to 140	12	8	12
14x9	36 to 160	14	9	14
(15x10)	40 to 180	15	10.2	15
16x10	45 to 180	16	10	16
18x11	50 to 200	18	11	18
20x12	56 to 220	20	12	20
22x14	63 to 250	22	14	22
(24x16)	70 to 280	24	16.2	24
25x14	70 to 280	25	14	22
28x16	80 to 320	28	16	25
32x18	90 to 360	32	18	28
(35x22)	100 to 400	35	22.3	32
36x20	-	36	20	32
(38x24)	-	38	24.3	36
40x22	-	40	22	36
(42x26)	-	42	26.3	40
45x25	-	45	25	40
50x28	-	50	28	45
56x32	-	56	32	50
63x32	-	63	32	50
70x36	-	70	36	56
80x40	-	80	40	63
90x45	-	90	45	70
100x50	-	100	50	80

Note: For other sizes of keys and keyways, refer to manufacturer's catalog. Those of parenthesized nominal dimensions which are not specified in the International Standards shall not be used in new design

Table 4 –Dimension of keyways for tapered keys, mm

Nominal dimension of key *b x h*	Basic dimension of b_1 and b_2	Basic dimension of t_1	Basic dimension of t_2	Applicable shaft diameter *d*
2x2	2	1.2	0.5	6 to 8
3x3	3	1.8	0.9	8 to 10
4x4	4	2.5	1.2	10 to 12
5x5	5	3.0	1.7	12 to 17
6x6	6	3.5	2.2	17 to 22
(7x7)	7	4.0	3.0	20 to 25
8x7	8	4.0	2.4	22 to 30
10x8	10	5.0	2.4	30 to 38
12x8	12	5.0	2.4	38 to 44
14x9	14	5.5	2.9	44 to 50
(15x10)	15	5.0	5.0	50 to 55
16x10	16	6.0	3.4	50 to 58
18x11	18	7.0	3.4	58 to 65
20x12	20	7.5	3.9	65 to 75
22x14	22	9.0	4.4	75 to 85
(24x16)	24	8.0	8.0	80 to 90
25x14	25	9.0	4.4	85 to 95
28x16	28	10.0	5.4	95 to 110
32x18	32	11.0	6.4	110 to 130
(35x22)	35	11.0	11.0	125 to 140
36x20	36	12.0	7.1	130 to 150
(38x24)	38	12.0	12.0	140 to 160
40x22	40	13.0	8.1	150 to 170
(42x26)	42	13.0	13.0	160 to 180
45x25	45	15.0	9.1	170 to 200
50x28	50	17.0	10.0	200 to 230
56x32	56	20.0	11.1	230 to 260
63x32	63	20.0	11.1	260 to 290
70x36	70	22.0	13.1	290 to 330
80x40	80	25.0	14.1	330 to 380
90x45	90	28.0	16.1	380 to 440
100x50	100	31.0	18.1	440 to 500

7 Woodruff keys

7.1 Nomenclature of Woodruff keys and keyways

The designation of dimensions of Woodruff keys and keyways are shown in Figure 6 and 7 respectively and are defined as follows:

d_O – the diameter of the key
b – the cross-sectional width of the key
h – the cross-sectional height of the key
h_1 – height of Whitney form key
l – length of the key
b_1 and b_2 – width of keyway for the shaft and hub respectively
d_1 – diameter of the cross-section of the keyway
t_1 – height of keyway for the shaft
t_2 – height of keyway for the hub
d – shaft diameter

7.2 Classification

The symbols for Woodruff keys are as follows:

Normal form - WA
Whitney form - WB

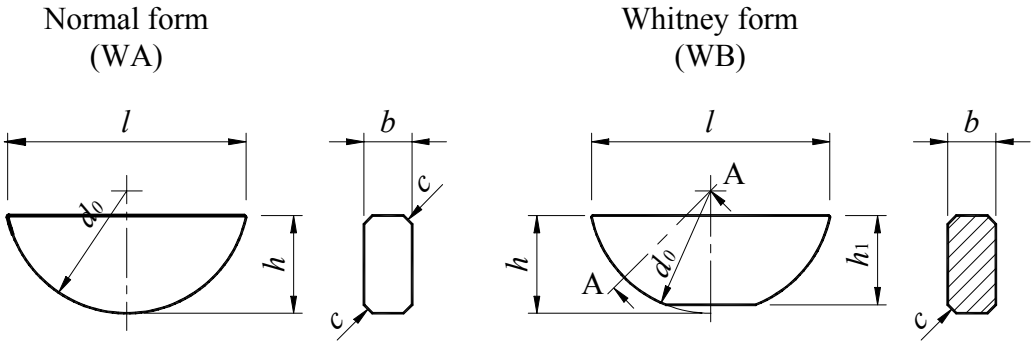

Figure 6 – Designation of dimensions of Woodruff key

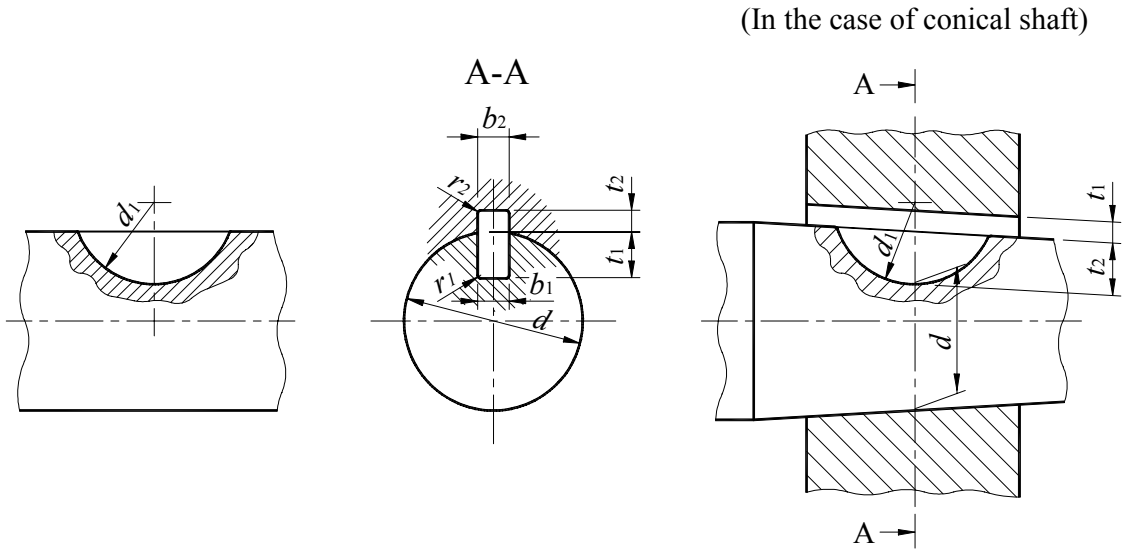

Figure 7 - Designation of dimension of keyways for Woodruff keys

7.3 Dimensions of Woodruff keys and keyways

Dimensions of Woodruff keys and keyways are specified in Tables 5 and 6 respectively. Table 7 specifies the applicable shaft diameter applicable to Woodruff keys.

Table 5 –Dimension of Woodruff keys, mm

Nominal dimension of key $b \times d_O$	Dimension of key				Informative reference
	b	d_O	h	h_1	l (Calculated value)
1x4	1	4	1.4	1.1	-
1.5x7	1.5	7	2.6	2.1	-
2x7	2	7	2.6	2.1	-
2x10	2	10	3.7	3.0	-
2.5x10	2.5	10	3.7	3.0	9.6
(3x10)	3	10	3.7	3.55	9.6
3x13	3	13	5.0	4.0	12.6
3x16	3	16	6.5	5.2	15.7
(4x13)	4	13	5.0	4.75	12.6
4x16	4	16	6.5	5.2	15.7
4x19	4	19	7.5	6.0	18.5
5x16	5	16	6.5	5.2	15.7
5.19	5	19	7.5	6.0	18.5
5x22	5	22	9.0	7.2	21.6
6x22	6	22	9.0	7.2	21.6
6x25	6	25	10.0	8.0	24.4
(6x28)	6	28	11.0	10.6	27.3
(6x32)	6	32	13.0	12.5	31.4
(7x22)	7	22	9.0	8.5	21.6
(7x25)	7	25	10.0	9.5	24.4
(7x28)	7	28	11.0	10.6	27.3
(7x32)	7	32	13.0	12.5	31.4
(7x38)	7	38	15.0	14.0	37.1
(7x45)	7	45	16.0	15.0	43.0
(8x25)	8	25	10.0	9.5	24.4
8x28	8	28	11.0	8.8	27.3
(8x32)	8	32	13.0	12.5	31.4
(8x38)	8	38	15.0	14.0	37.1
10x32	10	32	13.0	10.4	31.4
(10x45)	10	45	16.0	15.0	43.0
(10x55)	10	55	17.0	16.0	50.8
(10x65)	10	65	19.0	18.0	59.0
(12x65)	12	65	19.0	18.0	59.0
(12x80)	12	80	24.0	22.4	73.3

Note: For other sizes of keys and keyways, refer to manufacturer's catalog. Those of parenthesized nominal dimensions which are not specified in the International Standards shall not be used in new design

Table 6 –Dimension of keyways for Woodruff keys, mm

Nominal dimension of key $b \times d_O$	Basic dimension of b_1 and b_2	Basic dimension of t_1	Basic dimension of t_2	d_1
1x4	1	1.0	0.6	4
1.5x7	1.5	2.0	0.8	7
2x7	2	1.8	1.0	7
2x10	2	2.9	1.0	10
2.5x10	2.5	2.7	1.2	10
(3x10)	3	2.5	1.4	10
3x13	3	3.8	1.4	13
3x16	3	5.3	1.4	16
(4x13)	4	3.5	1.7	13
4x16	4	5.0	1.8	16
4x19	4	6.0	1.8	19
5x16	5	4.5	2.3	16
5.19	5	5.5	2.3	19
5x22	5	7.0	2.3	22
6x22	6	6.5	2.8	22
6x25	6	7.5	2.8	25
(6x28)	6	8.6	2.6	28
(6x32)	6	10.6	2.6	32
(7x22)	7	6.4	2.8	22
(7x25)	7	7.4	2.8	25
(7x28)	7	8.4	2.8	28
(7x32)	7	10.4	2.8	32
(7x38)	7	12.4	2.8	38
(7x45)	7	13.4	2.8	45
(8x25)	8	7.2	3.0	25
8x28	8	8.0	3.3	28
(8x32)	8	10.2	3.0	32
(8x38)	8	12.2	3.0	38
10x32	10	10.0	3.3	32
(10x45)	10	12.8	3.4	45
(10x55)	10	13.8	3.4	55
(10x65)	10	15.8	3.4	65
(12x65)	12	15.2	4.0	65
(12x80)	12	20.2	4.0	80

Note: For other sizes of keys and keyways, refer to manufacturer's catalog. Those of parenthesized nominal dimensions which are not specified in the International Standards shall not be used in new design

Table 7 – Shaft diameter applicable to Woodruff keys, mm

Nominal dimension of key $b \times d_O$	Series 1	Series 2	Series 3	Shearing cross sectional area
1x4	3 to 4	3 to 4	-	-
1.5x7	4 to 5	4 to 6	-	-
2x7	5 to 6	6 to 8	-	-
2x10	6 to 7	8 to 10	-	-
2.5x10	7 to 8	10 to 12	7 to 12	21
3x10	-	-	8 to 14	26
3x13	8 to 10	12 to 15	9 to 16	35
3x16	10 to 12	15 to 18	11 to 18	45
4x13	-	-	11 to 18	46
4x16	12 to 14	18 to 20	12 to 20	57
4x19	14 to 16	20 to 22	14 to 22	70
5x16	16 to 18	22 to 25	14 to 22	72
5.19	18 to 20	25 to 28	15 to 24	86
5x22	20 to 22	28 to 32	17 to 26	102
6x22	22 to 25	32 to 36	19 to 28	121
6x25	25 to 28	36 to 40	20 to 30	141
6x28	-	-	22 to 32	155
6x32	-	-	24 to 34	180
7x22	-	-	20 to 29	139
7x25	-	-	22 to 32	159
7x28	-	-	24 to 34	179
7x32	-	-	26 to 37	209
7x38	-	-	29 to 41	249
7x45	-	-	31 to 45	288
8x25	-	-	24 to 34	181
8x28	28 to 32	40 to -	26 to 37	203
8x32	-	-	28 to 40	239
8x38	-	-	30 to 44	283
10x32	32 to 38	-	31 to 46	295
10x45	-	-	38 to 54	406
10x55	-	-	42 to 60	477
10x65	-	-	46 to 65	558
12x65	-	-	50 to 73	660
12x80	-	-	58 to 82	834

Remarks

1. The series one and two are the shaft diameters given in the corresponding International Standards and are as follows:

   Series 1: Adequate for the assembly where the torque is transmitted by the key.
   Series 2: Adequate for the case where the positioning is made by key and the torque is not transmitted by it, e.g., where the shaft and the hub are in the fit of "interference fit".

2. Series 3 corresponds to the shearing strength at the shearing cross-section area shown in the Table. This shearing cross-section area is the calculated value of the part to be sheared at the time when the key is sinking completely in the keyway.

8 Materials

The key shall be free from cracks and harmful flaws, burrs and rust in appearance. Materials used for keys are of AISI designation 1020 as annealed. Its tensile strength shall be 393 MPa. The key shall have a lower shearing strength than the shaft and hub material.

9 Key, shaft and hub assembly

The three types of key, shaft, and hub assembly are shown in Table 8.

Table 8 – Assembly of shaft and hub by key

Type	Explanation	Applicable key
Sliding type	Assembly that shaft and hub can slide relatively in axial direction	Parallel key
Normal type	Assembly that hub is put into the key fixed on the shaft	Parallel key and Woodruff key
Fastening type	Assembly that hub is fastened on the key fixed on the shaft or assembly that the key is driven in between the combined shaft and hub.	Parallel key, Taper key, and Woodruff key

10 Shafts

Use of appropriate shafts with keys and keyways are discussed in PAES 205:2000.

11 Marking

The following information shall be marked on the package of the keys.

1) Classification
2) Nominal dimension x length (only nominal dimension in case of Woodruff key)
3) Shape of end (in case of parallel key)
4) Manufacturer’s name, its trademark, and address