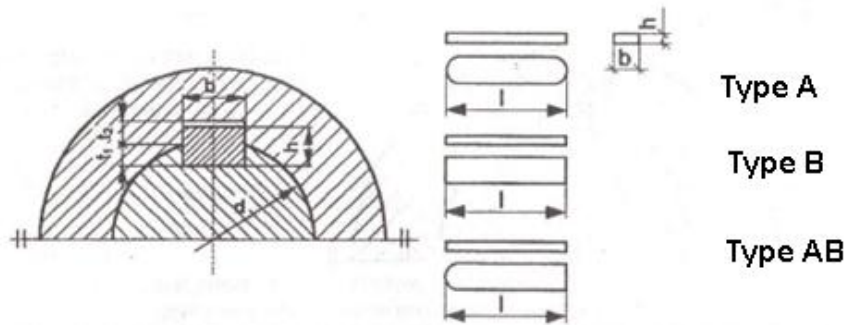


Problem:1 Name: Badiane Lamine

Design a key joint for a shaft with a diameter 30 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 190 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

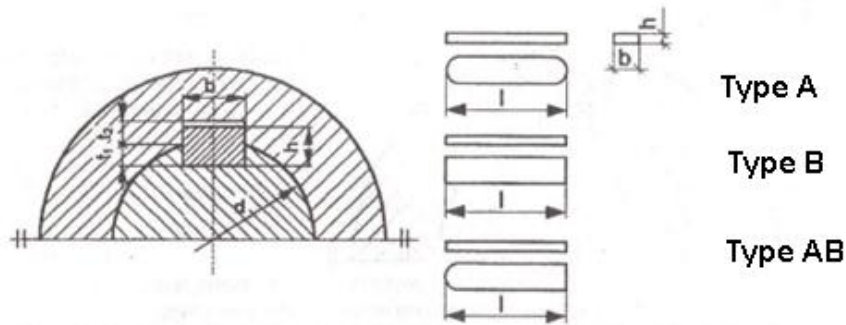
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6} & \boxed{8} & \boxed{10} & 12 & \boxed{14} & 16 & \boxed{18} & 20 & \boxed{22} & 25 & \boxed{28} & 32 \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36} & \boxed{40} & \boxed{45} & \boxed{50} & \boxed{56} & \boxed{63} & \boxed{70} & \boxed{80} & \boxed{90} & \boxed{100} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110} & \boxed{125} & \boxed{140} & \boxed{160} & \boxed{180} & \boxed{200} & \boxed{220} & \boxed{250} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 & & & \end{matrix}$

Problem:2 Name: Kamiloğlu Eylül Bahar

Design a key joint for a shaft with a diameter 34 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 280 Nm.



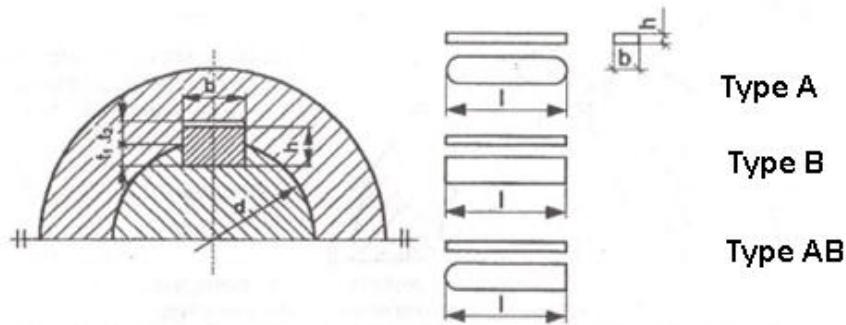
shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & 20, & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{matrix}$

Design a key joint for a shaft with a diameter 38 mm if the key is made of S275 steel ($k_o=110[\text{MPa}]$, $k_t=65[\text{MPa}]$), and the torque is 450 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

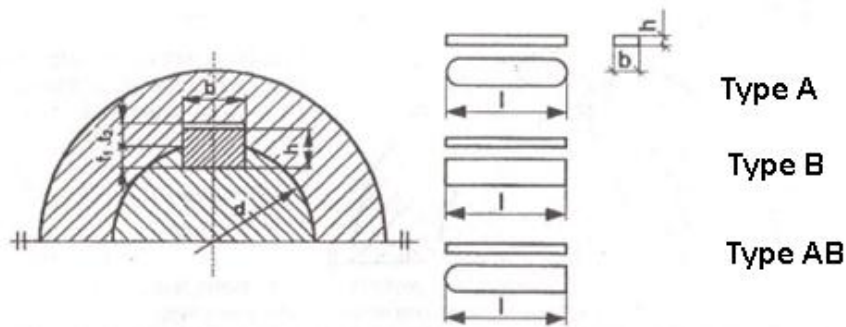
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$$L = \begin{array}{ccccccccc} & & & & & b=2 \rightarrow & & & \\ \boxed{6}, & \boxed{8}, & \boxed{10}, & 12, & \boxed{14}, & 16, & \boxed{18}, & \boxed{20}, & \boxed{22}, & 25, & \boxed{28}, & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \\ \\ b=3 & b=4 & b=5 & b=6 & b=8 \\ L = & \boxed{36}, & \boxed{40}, & \boxed{45}, & \boxed{50}, & \boxed{56}, & \boxed{63}, & \boxed{70}, & \boxed{80}, & \boxed{90}, & \boxed{100}, \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \\ \\ b=10 & b=12 & b=14 & b=16 & b=18 & b=20 & b=22 \\ L = & \boxed{110}, & \boxed{125}, & \boxed{140}, & \boxed{160}, & \boxed{180}, & \boxed{200}, & \boxed{220}, & \boxed{250}, & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{array}$$

Name: Muhala Norman Tawanda

Design a key joint for a shaft with a diameter 28 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 150 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$$L = \begin{array}{ccccccccc} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & \boxed{20,} & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 & \end{array}$$

$$b=3 \quad b=4 \quad b=5 \quad b=6 \quad b=8$$

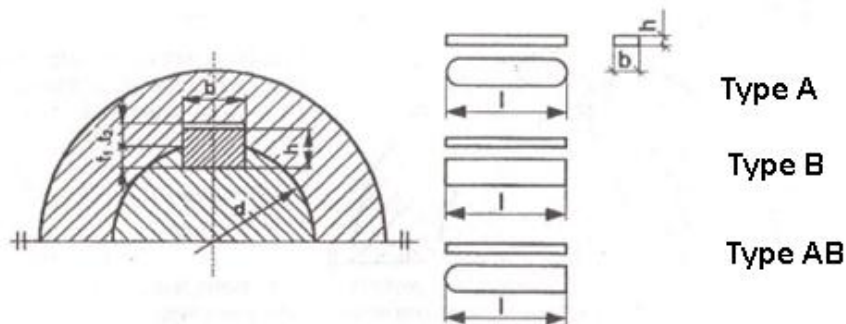
$$L = \begin{array}{ccccccccccccccc} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{array}$$

$$b=10 \quad b=12 \quad b=14 \quad b=16 \quad b=18 \quad b=20 \quad b=22$$

$$L = \begin{array}{ccccccccc} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & 220, & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 & & & \end{array}$$

Problem:5 Name: Naili Amin

Design a key joint for a shaft with a diameter 40 mm if the key is made of S275 steel ($k_o=110[\text{MPa}]$, $k_t=65[\text{MPa}]$), and the torque is 450 Nm.



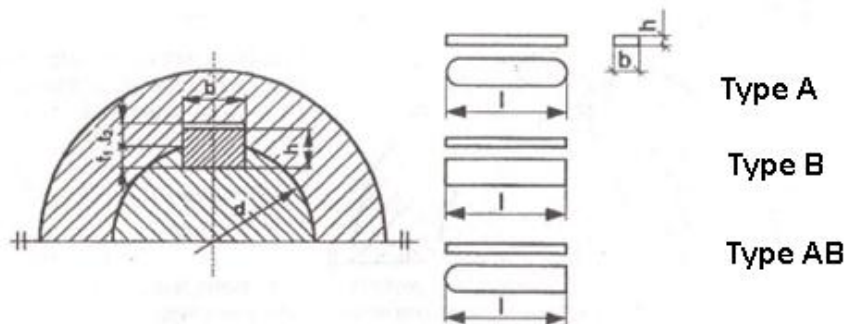
shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \left[\begin{array}{c} 6, \\ b=2,3 \end{array} \right] \left[\begin{array}{c} 8, \\ b=4 \end{array} \right] \left[\begin{array}{c} 10, 12, \\ b=5 \end{array} \right] \left[\begin{array}{c} 14, 16, \\ b=6 \end{array} \right] \left[\begin{array}{c} 18, 20, \\ b=8 \end{array} \right] \left[\begin{array}{c} 22, 25, \\ b=10 \end{array} \right] \left[\begin{array}{c} 28, 32, \\ b=12 \end{array} \right]$
$l = \left[\begin{array}{c} 36, \\ b=14 \end{array} \right] \left[\begin{array}{c} 40, \\ b=16 \end{array} \right] \left[\begin{array}{c} 45, \\ b=18 \end{array} \right] \left[\begin{array}{c} 50, \\ b=20 \end{array} \right] \left[\begin{array}{c} 56, \\ b=22 \end{array} \right] \left[\begin{array}{c} 63, \\ b=25 \end{array} \right] \left[\begin{array}{c} 70, \\ b=28 \end{array} \right] \left[\begin{array}{c} 80, \\ b=32 \end{array} \right] \left[\begin{array}{c} 90, \\ b=36 \end{array} \right] \left[\begin{array}{c} 100, \\ b=40 \end{array} \right]$
$l = \left[\begin{array}{c} 110, \\ b=45 \end{array} \right] \left[\begin{array}{c} 125, \\ b=50 \end{array} \right] \left[\begin{array}{c} 140, \\ b=56 \end{array} \right] \left[\begin{array}{c} 160, \\ b=63 \end{array} \right] \left[\begin{array}{c} 180, \\ b=70 \end{array} \right] \left[\begin{array}{c} 200, \\ b=80 \end{array} \right] \left[\begin{array}{c} 220, \\ b=90 \end{array} \right] \left[\begin{array}{c} 250, \\ b=100 \end{array} \right] \dots$

Design a key joint for a shaft with a diameter 44 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 470 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

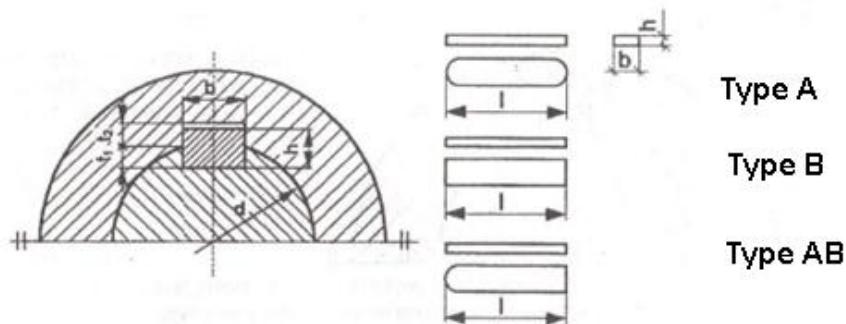
$$l = \begin{array}{|c|c|c|c|c|c|c|c|} \hline 6, & 8, & 10, & 12, & 14, & 16, & 18, & 20, \\ \hline b=2,3 & b=4 & b=5 & & b=6 & & b=8 & b=10 \\ \hline \end{array} \begin{array}{|c|c|c|} \hline 22, & 25, & 28, \\ \hline b=10 & b=12 & \end{array} 32,$$

$$l = \begin{array}{|c|c|c|c|c|c|c|c|} \hline 36, & 40, & 45, & 50, & 56, & 63, & 70, & 80, \\ \hline b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 \\ \hline \end{array} \begin{array}{|c|c|c|} \hline 90, & 100, & \\ \hline b=36 & b=40 & \end{array}$$

$$l = \begin{array}{|c|c|c|c|c|c|c|c|} \hline 110, & 125, & 140, & 160, & 180, & 200, & 220, & 250, \\ \hline b=45 & b=50 & b=56 & b=63 & b=70 & b=80 & & \end{array} \dots$$

Problem:7 Name: Hachem Boushaba

Design a key joint for a shaft with a diameter 60 mm if the key is made of S275 steel ($k_o=110[\text{MPa}]$, $k_t=65[\text{MPa}]$), and the torque is 1120 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

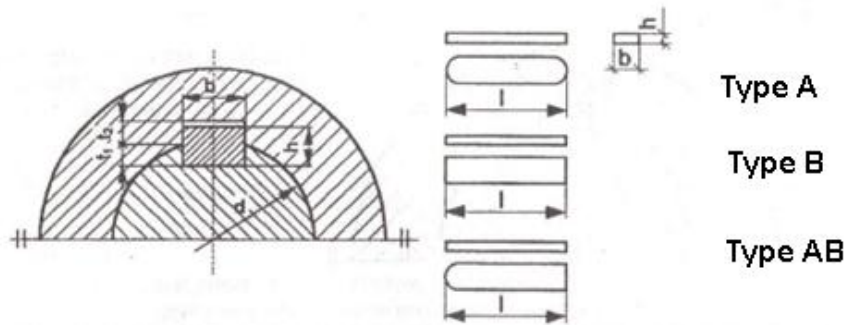
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & 20, & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{matrix}$

Problem:8 Name: Khiter Abdenmour

Design a key joint for a shaft with a diameter 50 mm if the key is made of E335 steel ($k_o=130[\text{MPa}]$, $k_t=90[\text{MPa}]$), and the torque is 990 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

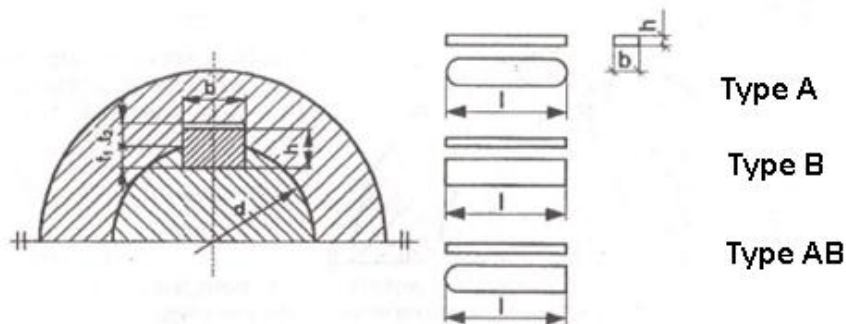
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & 20, & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{matrix}$

Problem:9 Name: Bachir Salah Eddine

Design a key joint for a shaft with a diameter 58 mm if the key is made of E295 steel ($k_o=120[\text{MPa}]$, $k_t=80[\text{MPa}]$), and the torque is 1350 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

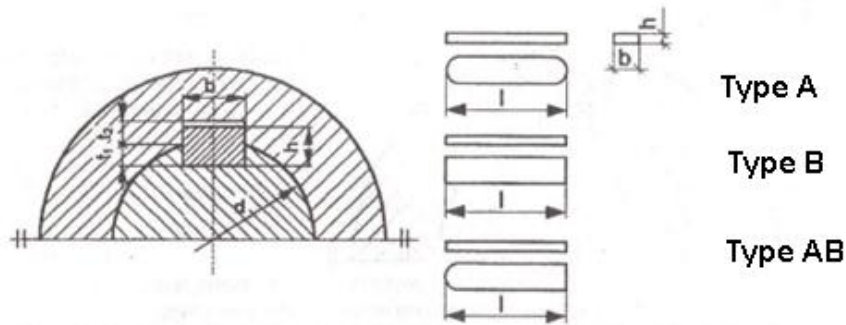
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \left[\begin{array}{c} 6, \\ b=2,3 \end{array} \right] \left[\begin{array}{c} 8, \\ b=4 \end{array} \right] \left[\begin{array}{c} 10, 12, \\ b=5 \end{array} \right] \left[\begin{array}{c} 14, 16, \\ b=6 \end{array} \right] \left[\begin{array}{c} 18, 20, \\ b=8 \end{array} \right] \left[\begin{array}{c} 22, 25, \\ b=10 \end{array} \right] \left[\begin{array}{c} 28, 32, \\ b=12 \end{array} \right]$
$l = \left[\begin{array}{c} 36, \\ b=14 \end{array} \right] \left[\begin{array}{c} 40, \\ b=16 \end{array} \right] \left[\begin{array}{c} 45, \\ b=18 \end{array} \right] \left[\begin{array}{c} 50, \\ b=20 \end{array} \right] \left[\begin{array}{c} 56, \\ b=22 \end{array} \right] \left[\begin{array}{c} 63, \\ b=25 \end{array} \right] \left[\begin{array}{c} 70, \\ b=28 \end{array} \right] \left[\begin{array}{c} 80, \\ b=32 \end{array} \right] \left[\begin{array}{c} 90, \\ b=36 \end{array} \right] \left[\begin{array}{c} 100, \\ b=40 \end{array} \right]$
$l = \left[\begin{array}{c} 110, \\ b=45 \end{array} \right] \left[\begin{array}{c} 125, \\ b=50 \end{array} \right] \left[\begin{array}{c} 140, \\ b=56 \end{array} \right] \left[\begin{array}{c} 160, \\ b=63 \end{array} \right] \left[\begin{array}{c} 180, \\ b=70 \end{array} \right] \left[\begin{array}{c} 200, \\ b=80 \end{array} \right] \left[\begin{array}{c} 220, \\ b=90 \end{array} \right] \left[\begin{array}{c} 250, \\ b=100 \end{array} \right] \dots$

Problem:10 Name: Salma Rhayate

Design a key joint for a shaft with a diameter 52 mm if the key is made of E295 steel ($k_o=120[\text{MPa}]$, $k_t=80[\text{MPa}]$), and the torque is 1020 Nm.



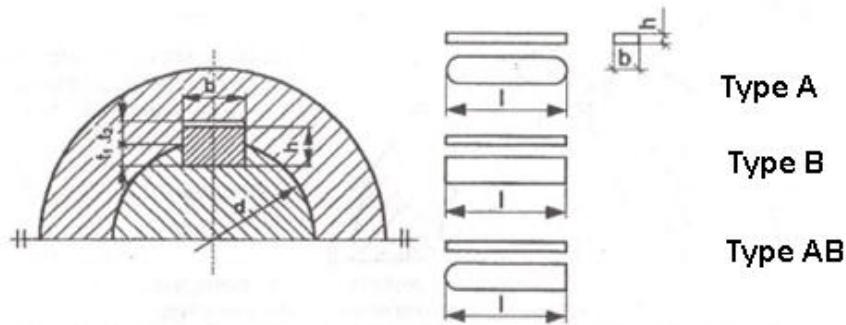
shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & 20, & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{matrix}$

Design a key joint for a shaft with a diameter 62 mm if the key is made of E295 steel ($k_o=120[\text{MPa}]$, $k_t=80[\text{MPa}]$), and the torque is 1700 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

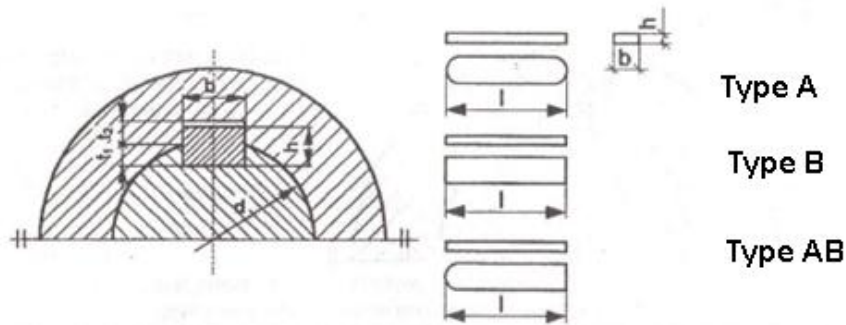
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$$L = \begin{array}{ccccccccc} \boxed{6,} & \boxed{8,} & \boxed{10, 12,} & \boxed{14, 16,} & \boxed{18, 20,} & \boxed{22, 25,} & \boxed{28, 32,} \\ b=2,3 & b=4 & b=5 & b=6 & b=8 & b=10 & b=12 \\ \hline & b=3 & b=4 & b=5 & b=6 & b=8 \\ L = & \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ & b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \\ \hline & b=10 & b=12 & b=14 & b=16 & b=18 & b=20 & b=22 \\ L = & \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} \dots \\ & b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{array}$$

Problem:12 Name: Belaid Yanis

Design a key joint for a shaft with a diameter 85 mm if the key is made of S275 steel ($k_o=110[\text{MPa}]$, $k_t=65[\text{MPa}]$), and the torque is 3800 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

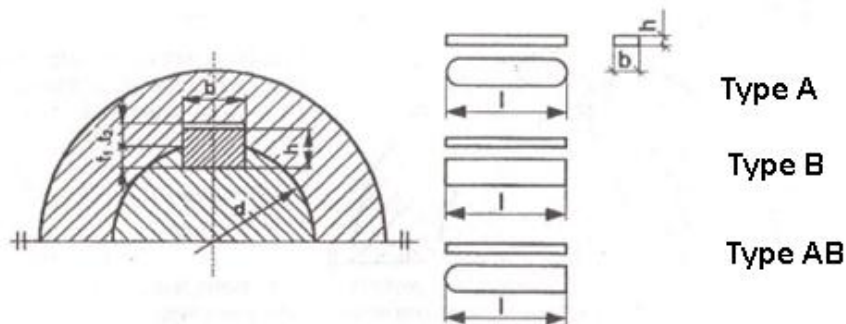
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \left[\begin{array}{c} 6, \\ b=2,3 \end{array} \right] \left[\begin{array}{c} 8, \\ b=4 \end{array} \right] \left[\begin{array}{c} 10, 12, \\ b=5 \end{array} \right] \left[\begin{array}{c} 14, 16, \\ b=6 \end{array} \right] \left[\begin{array}{c} 18, 20, \\ b=8 \end{array} \right] \left[\begin{array}{c} 22, 25, \\ b=10 \end{array} \right] \left[\begin{array}{c} 28, 32, \\ b=12 \end{array} \right]$
$l = \left[\begin{array}{c} 36, \\ b=14 \end{array} \right] \left[\begin{array}{c} 40, \\ b=16 \end{array} \right] \left[\begin{array}{c} 45, \\ b=18 \end{array} \right] \left[\begin{array}{c} 50, \\ b=20 \end{array} \right] \left[\begin{array}{c} 56, \\ b=22 \end{array} \right] \left[\begin{array}{c} 63, \\ b=25 \end{array} \right] \left[\begin{array}{c} 70, \\ b=28 \end{array} \right] \left[\begin{array}{c} 80, \\ b=32 \end{array} \right] \left[\begin{array}{c} 90, \\ b=36 \end{array} \right] \left[\begin{array}{c} 100, \\ b=40 \end{array} \right]$
$l = \left[\begin{array}{c} 110, \\ b=45 \end{array} \right] \left[\begin{array}{c} 125, \\ b=50 \end{array} \right] \left[\begin{array}{c} 140, \\ b=56 \end{array} \right] \left[\begin{array}{c} 160, \\ b=63 \end{array} \right] \left[\begin{array}{c} 180, \\ b=70 \end{array} \right] \left[\begin{array}{c} 200, \\ b=80 \end{array} \right] \left[\begin{array}{c} 220, \\ b=90 \end{array} \right] \left[\begin{array}{c} 250, \\ b=100 \end{array} \right] \dots$

Problem:13 Name: Labrach Alaa Lamisse M H

Design a key joint for a shaft with a diameter 20 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 60 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

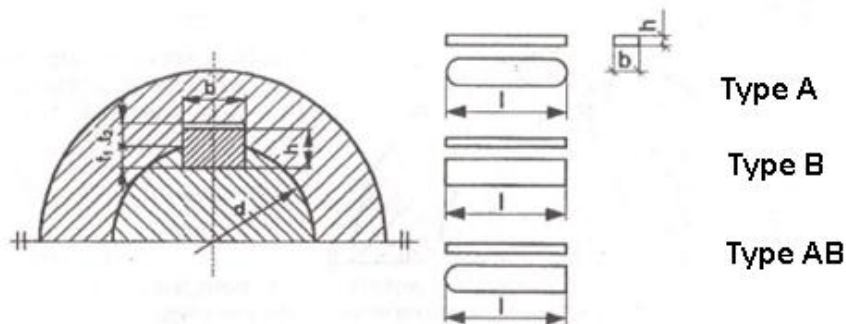
standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \begin{matrix} \boxed{6,} & \boxed{8,} & \boxed{10,} & 12, & \boxed{14,} & 16, & \boxed{18,} & 20, & \boxed{22,} & 25, & \boxed{28,} & 32, \\ b=2,3 & b=4 & b=5 & & b=6 & & b=8 & & b=10 & & b=12 \end{matrix}$
$l = \begin{matrix} \boxed{36,} & \boxed{40,} & \boxed{45,} & \boxed{50,} & \boxed{56,} & \boxed{63,} & \boxed{70,} & \boxed{80,} & \boxed{90,} & \boxed{100,} \\ b=14 & b=16 & b=18 & b=20 & b=22 & b=25 & b=28 & b=32 & b=36 & b=40 \end{matrix}$
$l = \begin{matrix} \boxed{110,} & \boxed{125,} & \boxed{140,} & \boxed{160,} & \boxed{180,} & \boxed{200,} & \boxed{220,} & \boxed{250,} & \dots \\ b=45 & b=50 & b=56 & b=63 & b=70 & b=80 \end{matrix}$

Problem:14 Name: Kadid Abdelrrahim

Design a key joint for a shaft with a diameter 24 mm if the key is made of S235 steel ($k_o=90[\text{MPa}]$, $k_t=50[\text{MPa}]$), and the torque is 100 Nm.



shaft - d [mm]		key	keyway [mm]		length range [mm]	
over	to	b x h [mm]	t ₁	t ₂	od	do
6	8	2 x 2	1,2	1,0	6	20
8	10	3 x 3	1,8	1,4	6	36
10	12	4 x 4	2,5	1,8	8	45
12	17	5 x 5	3,0	2,3	10	56
17	22	6 x 6	3,5	2,8	14	70
22	30	8 x 7	4,0	3,3	18	90
30	38	10 x 8	5,0	3,3	22	110
38	44	12 x 8	5,0	3,3	28	140
44	50	14 x 9	5,5	3,8	36	160
50	58	16 x 10	6,0	4,3	45	180
58	65	18 x 11	7,0	4,4	50	200
65	75	20 x 12	7,5	4,9	56	220
75	85	22 x 14	9,0	5,4	63	250
85	95	25 x 14	9,0	5,4	70	280
95	110	28 x 16	10	6,4	80	320
110	130	32 x 18	11	7,4	90	360
130	150	36 x 20	12	8,4	100	400
150	170	40 x 22	13	9,4	100	400
170	200	45 x 25	15	10,4	110	450

standardized lengths: 6 - 22 every 2mm, 25, 28, 32, 36, 40, 45, 50, 56, 63, 70, 80, 90, 100, 110, 125, 140, 160, 180, 200, 220, 250, 280, 320, 360, 400, 500mm

Allowable key lengths

$l = \left[\begin{array}{c} 6, \\ b=2,3 \end{array} \right] \left[\begin{array}{c} 8, \\ b=4 \end{array} \right] \left[\begin{array}{c} 10, 12, \\ b=5 \end{array} \right] \left[\begin{array}{c} 14, 16, \\ b=6 \end{array} \right] \left[\begin{array}{c} 18, 20, \\ b=8 \end{array} \right] \left[\begin{array}{c} 22, 25, \\ b=10 \end{array} \right] \left[\begin{array}{c} 28, 32, \\ b=12 \end{array} \right]$
$l = \left[\begin{array}{c} 36, \\ b=14 \end{array} \right] \left[\begin{array}{c} 40, \\ b=16 \end{array} \right] \left[\begin{array}{c} 45, \\ b=18 \end{array} \right] \left[\begin{array}{c} 50, \\ b=20 \end{array} \right] \left[\begin{array}{c} 56, \\ b=22 \end{array} \right] \left[\begin{array}{c} 63, \\ b=25 \end{array} \right] \left[\begin{array}{c} 70, \\ b=28 \end{array} \right] \left[\begin{array}{c} 80, \\ b=32 \end{array} \right] \left[\begin{array}{c} 90, \\ b=36 \end{array} \right] \left[\begin{array}{c} 100, \\ b=40 \end{array} \right]$
$l = \left[\begin{array}{c} 110, \\ b=45 \end{array} \right] \left[\begin{array}{c} 125, \\ b=50 \end{array} \right] \left[\begin{array}{c} 140, \\ b=56 \end{array} \right] \left[\begin{array}{c} 160, \\ b=63 \end{array} \right] \left[\begin{array}{c} 180, \\ b=70 \end{array} \right] \left[\begin{array}{c} 200, \\ b=80 \end{array} \right] \left[\begin{array}{c} 220, \\ b=90 \end{array} \right] \left[\begin{array}{c} 250, \\ b=100 \end{array} \right] \dots$