PRINTABLE REFERENCE CHART

Shaft key calculation: formulas, example and table by key size

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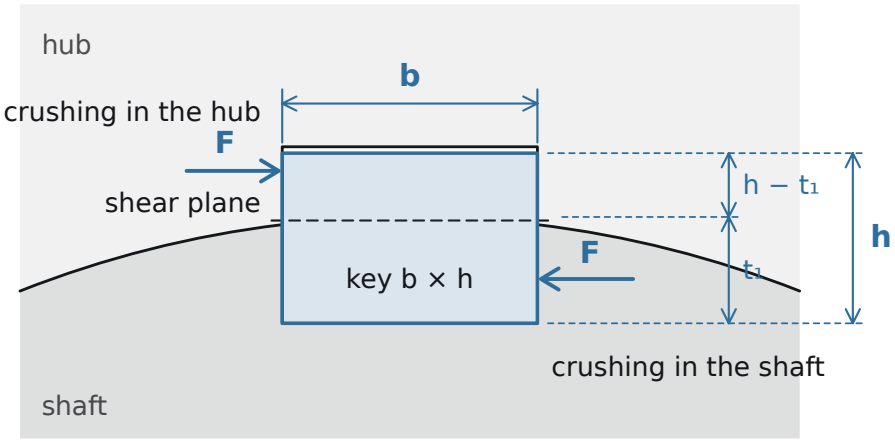
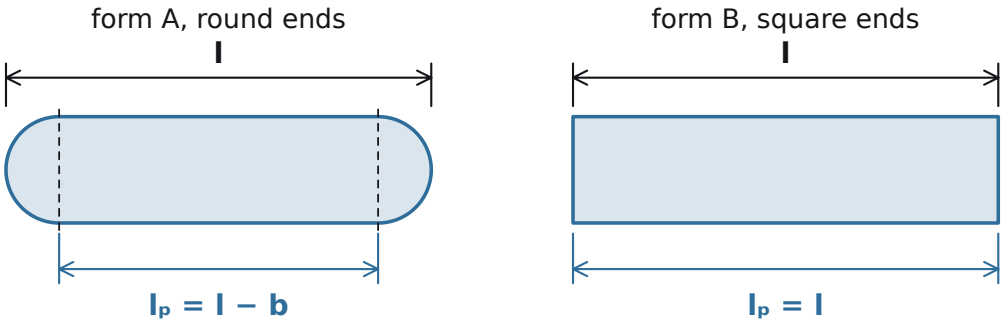
1. Shaft key calculation formulas



Quantity	Formula	Allowable (classical method)
Force on the key	$F = 2 \cdot T / d$	—
Effective length	$l_p = l - b$ (form A); $l - b/2$ (form C); l (form B)	—
Key shear stress	$\tau = F / (b \cdot l_p)$	$\tau \leq 0.577 \cdot R_{e\ clavette} / S$
Crushing stress in the hub	$p_m = F / ((h - t_1) \cdot l_p)$	$p_m \leq R_e / S$
Crushing stress in the shaft	$p_a = F / (t_1 \cdot l_p)$	$p_a \leq R_e / S$
Minimum effective length	$l_p \geq F \cdot S / \min(0.577 \cdot R_{e\ key} \cdot b;\ R_{e\ hub} \cdot (h - t_1);\ R_{e\ shaft} \cdot t_1)$	—

For crushing, R_e is that of the weaker of the two parts in contact: the key and the hub at the top, the key and the shaft at the bottom. The factor $0.577 = 1/\sqrt{3}$ relates shear yield strength to tensile yield strength (von Mises criterion): it is the method of machine design textbooks such as Shigley. Many textbooks simplify the bearing height to h/2 on each side; using $h - t_1$ for the hub is more conservative, because the key protrudes from the shaft by less than half its height (3 mm out of 8 for a 12 × 8 key).



3. Worked example: Ø 40 shaft, 200 N·m

Ø 40 mm shaft in S355, S235 hub, 200 N·m torque, 40 mm form A key, required safety factor: 2. For 38 < d ≤ 44 mm, the DIN 6885 key is a 12 × 8, with $t_1 = 5.0$ mm, so $h - t_1 = 3.0$ mm.

Quantity	Calculation	Result
Force F	2 × 200,000 N·mm / 40 mm	**10,000 N**
Effective length l_p	40 − 12	**28 mm**
Shear stress τ	10,000 / (12 × 28)	**29.8 MPa (S = 6.9)**
Crushing in the hub	10,000 / (3 × 28)	**119.0 MPa (S = 1.97)**
Crushing in the shaft	10,000 / (5 × 28)	**71.4 MPa (S = 4.97)**
Minimum length	12 + 10,000 × 2 / (235 × 3)	**40.4 mm → 45 mm**
With l = 45 mm (l_p = 33)	10,000 / (3 × 33)	**101.0 MPa (S = 2.33)**

The 40 mm key passes easily in shear and in shaft crushing, but not quite in hub crushing (S = 1.97 for 2 required): the S235 hub and the small height h − t_1 are the limit. The next standard length, 45 mm, gives S = 2.33, provided the hub is at least 45 mm long. With the textbook simplification h/2, the result would have been 89.3 MPa instead of 119 MPa, wrongly concluding that 40 mm was enough.

4. Table: transmissible force by key size

As hub crushing usually governs, this table gives, for each DIN 6885 key size, the force carried per millimetre of effective length when the hub pressure is 100 MPa, and the matching torque for 10 mm of effective length at the largest diameter of the range. Everything is proportional: for 150 MPa allowable, multiply by 1.5; for 30 mm of effective length, by 3.

Shaft Ø (mm)	b × h	t_1	h − t_1	Force per mm at 100 MPa (N/mm)	Torque for 10 mm, max Ø (N·m)	Shear / crushing ratio
6 to 8	2 × 2	1.2	0.8	80	3.2	1.44
8 to 10	3 × 3	1.8	1.2	120	6.0	1.44
10 to 12	4 × 4	2.5	1.5	150	9.0	1.54
12 to 17	5 × 5	3.0	2.0	200	17	1.44
17 to 22	6 × 6	3.5	2.5	250	27.5	1.38
22 to 30	8 × 7	4.0	3.0	300	45	1.54
30 to 38	10 × 8	5.0	3.0	300	57	1.92
38 to 44	12 × 8	5.0	3.0	300	66	2.31
44 to 50	14 × 9	5.5	3.5	350	87.5	2.31
50 to 58	16 × 10	6.0	4.0	400	116	2.31
58 to 65	18 × 11	7.0	4.0	400	130	2.60
65 to 75	20 × 12	7.5	4.5	450	168.8	2.56
75 to 85	22 × 14	9.0	5.0	500	212.5	2.54
85 to 95	25 × 14	9.0	5.0	500	237.5	2.89
95 to 110	28 × 16	10.0	6.0	600	330	2.69

Dimensions b, h and t_1 in mm, from the DIN 6885 chart. The last column compares the key's shear capacity (0.577·b) with the hub crushing capacity (h − t_1), for the same R_e: it is above 1 over the whole range. With

equal materials, the key crushes the hub before it shears, so a shear-only check is never enough.

6. Shaft key calculation in Excel

With, in row 2: d in A (mm), T in B (N·m), l in C (mm), b, h and t_1 in D, E and F (mm), key, shaft and hub R_e in G, H and I (MPa), S in J. Example values: 40, 200, 40, 12, 8, 5, 355, 355, 235, 2.

Result	Excel or LibreOffice	Value
K2: force F (N)	`=2000*B2/A2`	10,000
L2: effective length, form A	`=C2-D2`	28
M2: shear stress τ (MPa)	`=K2/(D2*L2)`	29.76
N2: hub crushing stress (MPa)	`=K2/((E2-F2)*L2)`	119.05
O2: shaft crushing stress (MPa)	`=K2/(F2*L2)`	71.43
P2: minimum safety factor	`=MIN(0.577*G2/M2,I2/N2,H2/O2)`	1.97
Q2: minimum length, form A (mm)	`=D2+K2*J2/MIN(0.577*G2*D2,I2*(E2-F2),H2*F2)`	40.37

For a form B key, replace L2 with `=C2` and remove "D2+" from Q2; for form C, use `=C2-D2/2` and "D2/2+". In French-language Excel, MIN keeps its name, but argument separators are semicolons and the decimal mark is a comma: `=MIN(0,577*G2/M2;I2/N2;H2/O2)`. These formulas were checked in LibreOffice Calc on the example: the values are those in the table.

Reference values taken from the article https://www.baouch.fr/en/blog/calcul-clavette-cisaillement-matage/, which explains the assumptions, formulas and edge cases. For critical use, check the current standard or the manufacturer's documentation. Free to print and share with credit to the source.