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Cutting Speeds for Tool Steels

High speed steel cutting speeds for the tool steel grades, by hardness, for turning, milling, drilling and reaming, with the factors that trade speed against tool life. Reference summary of published speeds and feeds practice, not a machining specification and not an Aobo Steel standard.

Reference only. Aobo Steel supplies tool steel in the annealed condition and does not provide machining services. Verify the values below against the applicable standard and the machine shop's own procedure.

High speed steel cutting speeds by grade

The carbide speeds for the same grades run several times higher in the source tables.

Grade	Condition	Turning, fpm	Milling, fpm	Drilling, fpm	Reaming, fpm
Water hardening					
W1, W2, W5	150–200 Bhn	100	85	85	55
Shock resisting					
S1, S2, S5, S6, S7	175–225 Bhn	70	55	50	35
Cold work, oil hardening					
O1, O2, O6, O7	175–225 Bhn	70	50	45	30
Cold work, high carbon high chromium					
D2, D3, D4, D5, D7	200–250 Bhn	45	40	30	20
Cold work, air hardening					
A2, A3, A8, A9, A10	200–250 Bhn	70	50	50	35
A4, A6	200–250 Bhn	55	45	45	30
A7	225–275 Bhn	45	40	30	20
Hot work, chromium type					
H10, H11, H12, H13, H14, H19	150–200 Bhn	80	60	60	40
	200–250 Bhn	65	50	50	30
	325–375 Bhn	50	30	30	20
	48–50 HRC	20	n/a	n/a	n/a
	50–52 HRC	10	n/a	n/a	n/a
	52–56 HRC	n/a	n/a	n/a	n/a
Hot work, tungsten type					
H21, H22, H23, H24, H25, H26	150–200 Bhn	60	55	55	35
	200–250 Bhn	50	45	40	25
Hot work, molybdenum type					
H41, H42, H43	150–200 Bhn	55	55	45	30
	200–250 Bhn	45	45	35	20
Low alloy, special purpose					
L2, L3, L6	150–200 Bhn	75	65	60	40
Mold steels					
P2, P3, P4, P5, P6, P21, P26	100–150 Bhn	90	75	75	50
	150–200 Bhn	80	60	60	40
High speed steels					
M1, M2, M6, M10, T1, T2, T6	200–250 Bhn	65	50	45	30
M3-1, M4, M7, M30, M33, M34, M36, M41, M42, M43, M44, M46, M47, T5, T8	225–275 Bhn	55	40	35	20
T15, M3-2	225–275 Bhn	45	30	25	15

Speeds in feet per minute (fpm). n/a means the source gives no speed for that condition, because those hardnesses are worked by grinding or EDM instead.

Adjusting the speed for a longer tool life

To trade speed for a longer life, multiply the tabulated speed by the factor for the life you want. At 45 minutes the turning speed falls to about four fifths, and at 180 minutes to about two thirds.

Tool life, min	up to 300 Bhn			over 300 Bhn			mixed ceramics		
	small	medium	large	small	medium	large	small	medium	large
15	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
45	0.86	0.81	0.76	0.80	0.75	0.70	0.89	0.87	0.84
90	0.78	0.71	0.64	0.70	0.63	0.56	0.82	0.79	0.75
180	0.71	0.63	0.54	0.61	0.53	0.45	0.76	0.72	0.67

Tool life factors for turning, Table 5b.

Tool life, min	face milling			end milling			drilling		
	small	medium	large	small	medium	large	small	medium	large
15	1.69	1.78	1.87	1.10	1.23	1.35	1.11	1.21	1.30
45	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
90	0.72	0.70	0.67	0.94	0.89	0.83	0.93	0.89	0.85
180	0.51	0.48	0.45	0.69	0.69	0.69	0.87	0.80	0.72

Tool life factors for milling and drilling, Table 15e.

Notes on the speeds

- A speed from a table is a starting value. Run it, watch the chip and the finish, and move from there.
- A heavier, more rigid machine carries a higher speed, and worn holders, thin sections and long overhangs are the usual reasons a speed from the table has to come down.
- The turning speeds for high speed steel tools assume a feed of 0.012 in./rev and a depth of cut of 0.125 inch. For other feeds and depths the source carries a further factor table, Table 5c.
- Milling speeds are based on a tool life of about 45 minutes for all tabulated values; the end milling data assume a 3-tooth cutter of 1 inch diameter, and the face milling data a 10-tooth, 8 inch face mill.
- Drilling and reaming speeds also carry a tool life of about 45 minutes. For other drill diameters and feeds the source adjusts the drilling speed with the diameter factors of Table 22.
- Tapping runs at the lowest speed of any of these operations because the tap is fully engaged in the cut.
- The speeds change with the condition of the material. The machinability ratings compare the grades against a 100 per cent baseline, and the machining allowance chart covers the stock left on for the finishing cuts.

Aobo Steel, tool steel supplier

Aobo Steel supplies forged tool steel from Huangshi, Hubei, China, where the local supply chain covers ESR melting, vacuum degassing and LF refining, forging, hot rolling, turned and peeled bar, heat treatment and third party inspection. We have worked in tool steel since 2003 and supply to order in cold work grades such as D2, D3 and O1, hot work grades such as H10 and H13, and stainless grades 420, 440C and 4Cr13. Mill test certificates to EN 10204 3.1 travel with every shipment.

Reference data compiled from Machinery's Handbook 28th Edition (Industrial Press), Speeds and Feeds section, and from the Aobo Steel cutting speeds page.

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