



Tool Steel Density and Thermal Expansion Chart

Density and mean thermal expansion for 57 tool steels — water-, shock-, oil-, air-hardening, cold-work (D), hot-work (H), high-speed (T, M), special-purpose (L) and mold (P) types. Both metric (g/cm³, μm/m·K) and imperial (lb/in.³, μin./in.·°F) values are listed, for die and tooling design that involves thermal growth or weight.

This sheet is a reference summary of published tool steel data. It is not an Aobo Steel standard.

Reference only. Values are reproduced from the published source for comparison. Verify them against the applicable grade specification and the mill certificate for the heat before design use.

Type	Density g/cm ³	Density lb/in. ³	μm/m·K 20→100 °C	μm/m·K →200 °C	μm/m·K →425 °C	μm/m·K →540 °C	μm/m·K →650 °C	μin./in.·°F 70→200 °F	μin./in.·°F →400 °F	μin./in.·°F →800 °F	μin./in.·°F →1000 °F	μin./in.·°F →1200 °F
W1	7.84	0.282	10.4	11.0	13.1	13.8(a)	14.2(b)	5.76	6.13	7.28	7.64(a)	7.90(b)
W2	7.85	0.283	—	—	14.4	14.8	14.9	—	—	8.0	8.2	8.3
S1	7.88	0.285•	12.4	12.6	13.5	13.9	14.2	6.9	7.0	7.5	7.7	7.9
S2	7.79	0.281	10.9	11.9	13.5	14.0	14.2	6.0	6.6	7.5	7.8	7.9
S5	7.76	0.280	—	—	12.6	13.3	13.7	—	—	7.0	7.4	7.6
S6	7.75	0.279	—	—	12.6	13.3	—	—	—	7.0	7.4	—
S7	7.76	0.280	—	12.6	13.3	13.7(a)	13.3	—	7.0	7.4	7.6(a)	7.4
O1	7.85	0.283	—	10.6(c)	12.8	14.0(d)	14.4(d)	—	5.9(c)	7.1	7.8(d)	8.0(d)
O2	7.66	0.277	11.2	12.6	13.9	14.6	15.1	6.2	7.0	7.7	8.1	8.4
O6	7.70	0.277	—	11.2	12.6	12.9	13.7	—	6.2	7.0	7.2	7.6
O7	7.8	0.282	—	—	—	—	—	—	—	—	—	—
A2	7.86	0.284	10.7	10.6(c)	12.9	14.0	14.2	5.96	5.9(c)	7.2	7.8	7.9
A6	7.84	0.283	11.5	12.4	13.5	13.9	14.2	6.4	6.9	7.5	7.7	7.9
A7	7.66	0.277	—	—	12.4	12.9	13.5	—	—	6.9	7.2	7.5
A8	7.87	0.284	—	—	12.0	12.4	12.6	—	—	6.7	6.9	7.0
A9	7.78	0.281	—	—	12.0	12.4	12.6	—	—	6.7	6.9	7.0
A10	7.68	0.278	12.8	13.3	—	—	—	7.1	7.4	—	—	—
D2	7.70	0.278	10.4	10.3	11.9	12.2	12.2	5.8	5.7	6.6	6.8	6.8
D3	7.70	0.278	12.0	11.7	12.9	13.1	13.5	6.7	6.5	7.2	7.3	7.5
D4	7.70	0.278	—	—	12.4	—	—	—	—	6.9	—	—
D5	—	—	—	—	—	12.0	—	—	—	—	—	6.7

Type	Density g/cm ³	Density lb/in. ³	μm/m·K 20→100 °C	μm/m·K →200 °C	μm/m·K →425 °C	μm/m·K →540 °C	μm/m·K →650 °C	μin./in.·°F 70→200 °F	μin./in.·°F →400 °F	μin./in.·°F →800 °F	μin./in.·°F →1000 °F	μin./in.·°F →1200 °F
H10	7.81	0.281	—	—	12.2	13.3	13.7	—	—	6.8	7.4	7.6
H11	7.75	0.280	11.9	12.4	12.8	12.9	13.3	6.6	6.9	7.1	7.2	7.4
H13	7.76	0.280	10.4	11.5	12.2	12.4	13.1	5.8	6.4	6.8	6.9	7.3
H14	7.89	0.285	11.0	—	—	—	—	6.1	—	—	—	—
H19	7.98	0.288	11.0	11.0	12.0	12.4	12.9	6.1	6.1	6.7	6.9	7.2
H21	8.28	0.299	12.4	12.6	12.9	13.5	13.9	6.9	7.0	7.2	7.5	7.7
H22	8.36	0.302	11.0	—	11.5	12.0	12.4	6.1	—	6.4	6.7	6.9
H26	8.67	0.313	—	—	—	12.4	—	—	—	—	6.9	—
H42	8.15	0.295	—	—	—	11.9	—	—	—	—	6.6	—
T1	8.67	0.313	—	9.7	11.2	11.7	11.9	—	5.4	6.2	6.5	6.6
T2	8.67	0.313	—	—	—	—	—	—	—	—	—	—
T4	8.68	0.313	—	—	—	11.9	—	—	—	—	6.6	—
T5	8.75	0.316	11.2	—	—	11.5	—	6.2	—	—	6.4	—
T6	8.89	0.321	—	—	—	—	—	—	—	—	—	—
T8	8.43	0.305	—	—	—	—	—	—	—	—	—	—
T15	8.19	0.296	—	9.9	11.0	11.5	—	—	5.5(c)	6.1	6.4	—
M1	7.89	0.285	—	10.6(c)	11.3	12.0	12.4	—	5.9(c)	6.3	6.7	6.9
M2	8.16	0.295	10.1	9.4(c)	11.2	11.9	12.2	5.6	5.2(c)	6.2	6.6	6.8
M3, class 1	8.15	0.295	—	—	11.5	12.0	12.2	—	—	6.4	6.7	6.8
M3, class 2	8.16	0.295	—	—	11.5	12.0	12.8	—	—	6.4	6.7	7.1
M4	7.97	0.288	—	9.5(c)	11.2	12.0	12.2	—	5.3(c)	6.2	6.7	6.8
M7	7.95	0.287	—	9.5(c)	11.5	12.2	12.4	—	5.3(c)	6.4	6.8	6.9
M10	7.88	0.285•	—	—	11.0	11.9	12.4	—	—	6.1	6.6	6.9
M30	8.01	0.289	—	—	11.2	11.7	12.2	—	—	6.2	6.5	6.8
M33	8.03	0.290	—	—	11.0	11.7	12.0	—	—	6.1	6.5	6.7
M36	8.18	0.296	—	—	—	—	—	—	—	—	—	—
M41	8.17	0.295	—	9.7	10.4	11.2	—	—	5.4	5.8	6.2	—
M42	7.98	0.288	—	—	—	—	—	—	—	—	—	—
M46	7.83	0.283	—	—	—	—	—	—	—	—	—	—
M47	7.96	0.288	10.6	11.0	11.9	—	12.6	5.9	6.1	6.6	—	7.0

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L2	7.86	0.284	—	—	14.4	14.6	14.8	—	—	8.0	8.1	8.2
L6	7.86	0.284	11.3	12.6	12.6	13.5	13.7	6.3	7.0	7.0	7.5	7.6
P2	7.86	0.284	—	—	13.7	—	—	—	—	7.6	—	—
P5	7.80	0.282	—	—	—	—	—	—	—	—	—	—
P6	7.85	0.284	—	—	—	—	—	—	—	—	—	—
P20	7.85	0.284	—	—	12.8	13.7	14.2	—	—	7.1	7.6	7.9

Footnotes

- (a) From 20 °C to 500 °C (70 °F to 930 °F).
- (b) From 20 °C to 600 °C (70 °F to 1110 °F).
- (c) From 20 °C to 260 °C (70 °F to 500 °F).
- (d) From 40 °C (100 °F).

Table notes

Density is given at room temperature. Thermal expansion is the mean coefficient between the base temperature (20 °C / 70 °F unless marked with a footnote) and the temperature shown in the column heading.

Dashes indicate values not given in the source table.

- Source correction: the source prints 0.255 lb/in.³ for S1 and M10, which is inconsistent with 7.88 g/cm³ (0.285 lb/in.³). The tabulated 0.285 value is shown here; the original figure is noted for traceability.

Note: footnote (d) is printed in the source as “From 40 ° (100 °F)” with the degree unit missing; it is shown here as 40 °C (100 °F).

The low-expansion cold-work grades (D2/D3, H13, M-series) sit near 10.4–12.4 μm/m·K, while the high-carbon water- and oil-hardening grades and L2 reach 13–15 μm/m·K — relevant when sizing dies, fixtures and tooling that see service heat. Verify against the applicable heat treatment before design use.

Reference data source: ASM Handbook, Volume 1, Properties and Selection: Irons, Steels, and High-Performance Alloys, Table 11.

Aobo Steel supplies tool steel to order from Huangshi, China: cold-work D2, D3 and O1, hot-work H10, H11 and H13, and stainless 420, 440C and 4Cr13, with EN 10204 3.1 mill certificates.

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