

Tool Steel Composition Chart

Chemical composition limits for the principal AISI tool steel types, the M, T, H, A, D, O, S, L, P and W groups. Values are cast or heat analysis ranges in weight percent. A single value is a maximum unless followed by the word min.

Reference only. These are published composition limits, not an Aobo Steel specification. Product analysis tolerances, and any purchase requirement, are set by the governing standard (ASTM A681, A600 or A686, or the national equivalent) and by the mill certificate.

Molybdenum high-speed steels (M series)

Molybdenum based high-speed steels, with tungsten partly replaced by molybdenum.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
M1	T11301	0.78-0.88	0.15-0.40	0.20-0.50	3.50-4.00	0.30 max	8.20-9.20	1.40-2.10	1.00-1.25	—
M2	T11302	0.78-0.88; 0.95-1.05	0.15-0.40	0.20-0.45	3.75-4.50	0.30 max	4.50-5.50	5.50-6.75	1.75-2.20	—
M3, class 1	T11313	1.00-1.10	0.15-0.40	0.20-0.45	3.75-4.50	0.30 max	4.75-6.50	5.00-6.75	2.25-2.75	—
M3, class 2	T11323	1.15-1.25	0.15-0.40	0.20-0.45	3.75-4.50	0.30 max	4.75-6.50	5.00-6.75	2.75-3.75	—
M4	T11304	1.25-1.40	0.15-0.40	0.20-0.45	3.75-4.75	0.30 max	4.25-5.50	5.25-6.50	3.75-4.50	—
M7	T11307	0.97-1.05	0.15-0.40	0.20-0.55	3.50-4.00	0.30 max	8.20-9.20	1.40-2.10	1.75-2.25	—
M10	T11310	0.84-0.94; 0.95-1.05	0.10-0.40	0.20-0.45	3.75-4.50	0.30 max	7.75-8.50	—	1.80-2.20	—
M30	T11330	0.75-0.85	0.15-0.40	0.20-0.45	3.50-4.25	0.30 max	7.75-9.00	1.30-2.30	1.00-1.40	4.50-5.50
M33	T11333	0.85-0.92	0.15-0.40	0.15-0.50	3.50-4.00	0.30 max	9.00-10.00	1.30-2.10	1.00-1.35	7.75-8.75
M34	T11334	0.85-0.92	0.15-0.40	0.20-0.45	3.50-4.00	0.30 max	7.75-9.20	1.40-2.10	1.90-2.30	7.75-8.75
M35	T11335	0.82-0.88	0.15-0.40	0.20-0.45	3.75-4.50	0.30 max	4.50-5.50	5.50-6.75	1.75-2.20	4.50-5.50
M36	T11336	0.80-0.90	0.15-0.40	0.20-0.45	3.75-4.50	0.30 max	4.50-5.50	5.50-6.50	1.75-2.25	7.75-8.75
M41	T11341	1.05-1.15	0.20-0.60	0.15-0.50	3.75-4.50	0.30 max	3.25-4.25	6.25-7.00	1.75-2.25	4.75-5.75
M42	T11342	1.05-1.15	0.15-0.40	0.15-0.65	3.50-4.25	0.30 max	9.00-10.00	1.15-1.85	0.95-1.35	7.75-8.75
M43	T11343	1.15-1.25	0.20-0.40	0.15-0.65	3.50-4.25	0.30 max	7.50-8.50	2.25-3.00	1.50-1.75	7.75-8.75
M44	T11344	1.10-1.20	0.20-0.40	0.30-0.55	4.00-4.75	0.30 max	6.00-7.00	5.00-5.75	1.85-2.20	11.00-12.25
M46	T11346	1.22-1.30	0.20-0.40	0.40-0.65	3.70-4.20	0.30 max	8.00-8.50	1.90-2.20	3.00-3.30	7.80-8.80
M47	T11347	1.05-1.15	0.15-0.40	0.20-0.45	3.50-4.00	0.30 max	9.25-10.00	1.30-1.80	1.15-1.35	4.75-5.25
M48	T11348	1.42-1.52	0.15-0.40	0.15-0.40	3.50-4.00	0.30 max	4.75-5.50	9.50-10.50	2.75-3.25	8.00-10.00
M62	T11362	1.25-1.35	0.15-0.40	0.15-0.40	3.50-4.00	0.30 max	10.00-11.00	5.75-6.50	1.80-2.10	—

Tungsten high-speed steels (T series)

Tungsten based high-speed steels, 12 to 20 percent tungsten.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
T1	T12001	0.65-0.80	0.10-0.40	0.20-0.40	3.75-4.50	0.30 max	—	17.25-18.75	0.90-1.30	—
T2	T12002	0.80-0.90	0.20-0.40	0.20-0.40	3.75-4.50	0.30 max	1.00 max	17.50-19.00	1.80-2.40	—
T4	T12004	0.70-0.80	0.10-0.40	0.20-0.40	3.75-4.50	0.30 max	0.40-1.00	17.50-19.00	0.80-1.20	4.25-5.75
T5	T12005	0.75-0.85	0.20-0.40	0.20-0.40	3.75-5.00	0.30 max	0.50-1.25	17.50-19.00	1.80-2.40	7.00-9.50
T6	T12006	0.75-0.85	0.20-0.40	0.20-0.40	4.00-4.75	0.30 max	0.40-1.00	18.50-21.00	1.50-2.10	11.00-13.00
T8	T12008	0.75-0.85	0.20-0.40	0.20-0.40	3.75-4.50	0.30 max	0.40-1.00	13.25-14.75	1.80-2.40	4.25-5.75
T15	T12015	1.50-1.60	0.15-0.40	0.15-0.40	3.75-5.00	0.30 max	1.00 max	11.75-13.00	4.50-5.25	4.75-5.25

Intermediate high-speed steels

M50 and M52, intermediate between the molybdenum and tungsten groups.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
M50	T11350	0.78-0.88	0.15-0.45	0.20-0.60	3.75-4.50	0.30 max	3.90-4.75	—	0.80-1.25	—
M52	T11352	0.85-0.95	0.15-0.45	0.20-0.60	3.50-4.30	0.30 max	4.00-4.90	0.75-1.50	1.65-2.25	—

Chromium hot-work steels (H10-H19)

Chromium hot-work steels for die casting, extrusion and forging dies.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
H10	T20810	0.35-0.45	0.25-0.70	0.80-1.20	3.00-3.75	0.30 max	2.00-3.00	—	0.25-0.75	—
H11	T20811	0.33-0.43	0.20-0.50	0.80-1.20	4.75-5.50	0.30 max	1.10-1.60	—	0.30-0.60	—
H12	T20812	0.30-0.40	0.20-0.50	0.80-1.20	4.75-5.50	0.30 max	1.25-1.75	1.00-1.70	0.50 max	—
H13	T20813	0.32-0.45	0.20-0.50	0.80-1.20	4.75-5.50	0.30 max	1.10-1.75	—	0.80-1.20	—
H14	T20814	0.35-0.45	0.20-0.50	0.80-1.20	4.75-5.50	0.30 max	—	4.00-5.25	—	—
H19	T20819	0.32-0.45	0.20-0.50	0.20-0.50	4.00-4.75	0.30 max	0.30-0.55	3.75-4.50	1.75-2.20	4.00-4.50

Tungsten hot-work steels (H21-H26)

Tungsten hot-work steels, higher hot hardness with lower toughness.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
H21	T20821	0.26-0.36	0.15-0.40	0.15-0.50	3.00-3.75	0.30 max	—	8.50-10.00	0.30-0.60	—
H22	T20822	0.30-0.40	0.15-0.40	0.15-0.40	1.75-3.75	0.30 max	—	10.00-11.75	0.25-0.50	—
H23	T20823	0.25-0.35	0.15-0.40	0.15-0.60	11.00-12.75	0.30 max	—	11.00-12.75	0.75-1.25	—
H24	T20824	0.42-0.53	0.15-0.40	0.15-0.40	2.50-3.50	0.30 max	—	14.00-16.00	0.40-0.60	—
H25	T20825	0.22-0.32	0.15-0.40	0.15-0.40	3.75-4.50	0.30 max	—	14.00-16.00	0.40-0.60	—
H26	T20826	0.45-0.55 (b)	0.15-0.40	0.15-0.40	3.75-4.50	0.30 max	—	17.25-19.00	0.75-1.25	—

Molybdenum hot-work steels

H42, the molybdenum member of the hot-work group.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
H42	T20842	0.55-0.70 (b)	0.15-0.40	—	3.75-4.50	0.30 max	4.50-5.50	5.50-6.75	1.75-2.20	—

Air-hardening cold-work steels (A series)

Air-hardening cold-work steels for blanking, forming and long-run dies.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
A2	T30102	0.95-1.05	1.00 max	0.50 max	4.75-5.50	0.30 max	0.90-1.40	—	0.15-0.50	—
A3	T30103	1.20-1.30	0.40-0.60	0.50 max	4.75-5.50	0.30 max	0.90-1.40	—	0.80-1.40	—
A4	T30104	0.95-1.05	1.80-2.20	0.50 max	0.90-2.20	0.30 max	0.90-1.40	—	—	—
A6	T30106	0.65-0.75	1.80-2.50	0.50 max	0.90-1.20	0.30 max	0.90-1.40	—	—	—
A7	T30107	2.00-2.85	0.80 max	0.50 max	5.00-5.75	0.30 max	0.90-1.40	0.50-1.50	3.90-5.15	—
A8	T30108	0.50-0.60	0.50 max	0.75-1.10	4.75-5.50	0.30 max	1.15-1.65	1.00-1.50	—	—
A9	T30109	0.45-0.55	0.50 max	0.95-1.15	4.75-5.50	1.25-1.75	1.30-1.80	—	0.80-1.40	—
A10	T30110	1.25-1.50 (c)	1.60-2.10	1.00-1.50	—	1.55-2.05	1.25-1.75	—	—	—

High-carbon, high-chromium cold-work steels (D series)

High-carbon, high-chromium cold-work steels at about 12 percent chromium.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
D2	T30402	1.40-1.60	0.60 max	0.60 max	11.00-13.00	0.30 max	0.70-1.20	—	1.10 max	—
D3	T30403	2.00-2.35	0.60 max	0.60 max	11.00-13.50	0.30 max	—	1.00 max	1.00 max	—
D4	T30404	2.05-2.40	0.60 max	0.60 max	11.00-13.00	0.30 max	0.70-1.20	—	1.00 max	—
D5	T30405	1.40-1.60	0.60 max	0.60 max	11.00-13.00	0.30 max	0.70-1.20	—	1.00 max	2.50-3.50
D7	T30407	2.15-2.50	0.60 max	0.60 max	11.50-13.50	0.30 max	0.70-1.20	—	3.80-4.40	—

Oil-hardening cold-work steels (O series)

Oil-hardening cold-work steels for short and medium production runs.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
O1	T31501	0.85-1.00	1.00-1.40	0.50 max	0.40-0.60	0.30 max	—	0.40-0.60	0.30 max	—
O2	T31502	0.85-0.95	1.40-1.80	0.50 max	0.50 max	0.30 max	0.30 max	—	0.30 max	—
O6	T31506	1.25-1.55 (c)	0.30-1.10	0.55-1.50	0.30 max	0.30 max	0.20-0.30	—	—	—
O7	T31507	1.10-1.30	1.00 max	0.60 max	0.35-0.85	0.30 max	0.30 max	1.00-2.00	0.40 max	—

Shock-resisting steels (S series)

Shock-resisting steels for chisels, punches and pneumatic tooling.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
S1	T41901	0.40-0.55	0.10-0.40	0.15-1.20	1.00-1.80	0.30 max	0.50 max	1.50-3.00	0.15-0.30	—
S2	T41902	0.40-0.55	0.30-0.50	0.90-1.20	—	0.30 max	0.30-0.60	—	0.50 max	—
S5	T41905	0.50-0.65	0.60-1.00	1.75-2.25	0.50 max	—	0.20-1.35	—	0.35 max	—
S6	T41906	0.40-0.50	1.20-1.50	2.00-2.50	1.20-1.50	—	0.30-0.50	—	0.20-0.40	—
S7	T41907	0.45-0.55	0.20-0.90	0.20-1.00	3.00-3.50	—	1.30-1.80	—	0.20-0.30 (d)	—

Low-alloy special-purpose steels (L series)

Low-alloy special-purpose steels, including bearing and shock applications.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
L2	T61202	0.45-1.00 (b)	0.10-0.90	0.50 max	0.70-1.20	—	0.25 max	—	0.10-0.30	—
L6	T61206	0.65-0.75	0.25-0.80	0.50 max	0.60-1.20	1.25-2.00	0.50 max	—	0.20-0.30 (d)	—

Low-carbon mold steels (P series)

Low-carbon mold steels for plastic molds and die casting inserts.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
P2	T51602	0.10 max	0.10-0.40	0.10-0.40	0.75-1.25	0.10-0.50	0.15-0.40	—	—	—
P3	T51603	0.10 max	0.20-0.60	0.40 max	0.40-0.75	1.00-1.50	—	—	—	—
P4	T51604	0.12 max	0.20-0.60	0.10-0.40	4.00-5.25	—	0.40-1.00	—	—	—
P5	T51605	0.10 max	0.20-0.60	0.40 max	2.00-2.50	0.35 max	—	—	—	—
P6	T51606	0.05-0.15	0.35-0.70	0.10-0.40	1.25-1.75	3.25-3.75	—	—	—	—
P20	T51620	0.28-0.40	0.60-1.00	0.20-0.80	1.40-2.00	—	0.30-0.55	—	—	—
P21	T51621	0.18-0.22	0.20-0.40	0.20-0.40	0.50 max	3.90-4.25	—	—	0.15-0.25	—

Water-hardening tool steels (W series)

Water-hardening carbon tool steels for low-cost, short-run tooling.

AISI	UNS	C	Mn	Si	Cr	Ni	Mo	W	V	Co
W1	T72301	0.70-1.50 (e)	0.10-0.40	0.10-0.40	0.15 max	0.20 max	0.10 max	0.15 max	0.10 max	—
W2	T72302	0.85-1.50 (e)	0.10-0.40	0.10-0.40	0.15 max	0.20 max	0.10 max	0.15 max	0.15-0.35	—
W5	T72305	1.05-1.15	0.10-0.40	0.10-0.40	0.40-0.60	0.20 max	0.10 max	0.15 max	0.10 max	—

Table notes

- (a)** All steels except group W contain 0.25% max Cu, 0.03% max P and 0.03% max S. Group W steels contain 0.20% max Cu, 0.025% max P and 0.025% max S. Where specified, sulfur may be increased to 0.06 to 0.15% to improve the machinability of group A, D, H, M and T steels.
- (b)** Available in several carbon ranges.
- (c)** Contains free graphite in the microstructure.
- (d)** Optional.
- (e)** Specified carbon ranges are designated by suffix numbers.

P21 additionally contains 1.05 to 1.25% Al, specified for resistance to heat checking. Aluminium is not shown as a separate column in the table.

Two values in the source table were printed with a missing decimal point. M10 chromium reads 3.75-450 in the source and is given here as 3.75-4.50; A9 molybdenum reads 1.30-180 and is given as 1.30-1.80.

Composition limits are heat analysis values. Product analysis tolerances apply to the delivered bar or plate, and the governing standard sets them. Confirm both against the mill certificate before ordering.

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, O1 and DC53, hot work grades such as H10 and H13, and stainless grades 420, 440C and 4Cr13.

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Scan to open the tool steel composition chart

Source, ASM Handbook, Volume 1, Properties and Selection: Irons, Steels, and High Performance Alloys, 10th edition, Table 1, Composition limits of principal types of tool steels. Aobo Steel reference chart, verify the applicable standard before ordering.