

Tool Steel Heat Treatment Temperature Ranges and Reference Points

The temperature ranges tool steel is hardened, annealed, carburized, nitrided and stress relieved at, with the heat sources above them and the subzero range below, from a tool and die shop handbook. A reference summary of published practice and not an Aobo Steel specification.

Reference only. The figures in this chart are reproduced from the source named at the foot of the sheet, which credits Bethlehem Steel Corp., and are not a specification of ours. They are ranges for a group of grades rather than settings for one heat, and where a given grade sits inside a range depends on its alloy content and on the section being treated. Work to the cycle your grade supplier publishes for the material in hand.

Temperatures for various operations and conditions

Source, Table 8-1, temperatures for various operations and conditions, printed page 153 of Tool and Die Making Troubleshooter (Richard M. Leed), PDF page 170 of the copy consulted. The book credits Bethlehem Steel Corp., 1936.

Operation or condition	°F	°C
Tungsten arc	11,600	(6,427)
Iron welding arc	10,800	(5,982)
Oxyacetylene flame	6,300	(3,482)
MAPP gas	5,301	(2,927)
Propane flame	5,300	(2,927)
Oxyhydrogen	5,072	(2,800)
Laboratory burner	3,360	(1,849)
Iron melts (liquid)	2,800	(1,538)
Welding and steel melting	2,400	(1,316)
High speed hardening	2,100–2,400	(1,149–1,316)
Alloy tool steel hardening	1,500–1,900	(816–1,038)
Carburizing range	1,700–1,800	(927–982)
Flame hardening range (4140 / 4150)	1,550–1,600	(843–871)
Annealing range	1,400–1,700	(760–927)
Carbon steel hardening	1,350–1,550	(732–843)
Stress relieving	400–1,200	(204–649)
Nitriding range	900–1,000	(482–538)
Blue brittle range	600–800	(316–427)
Water boils	212	(100)
Ice melts	32	(0)
Zero Fahrenheit	0	(-18)
Dry ice	-120	(-84)
Subzero treatment	-320 to 0	(-196 to -18)
Absolute zero	-460	(-273)

MAPP gas in the table is the liquefied petroleum and methylacetylene-propadiene mixture the book names, and the flame hardening range is quoted there for 4140 and 4150, which are printed as a reference point rather than as tool steels. Degrees Celsius are the book's own conversions, shown in brackets exactly as the source prints them.

The ranges a tool steel buyer is usually quoted for are the ones in the middle of the table.

The blue brittle range at 600 to 800 °F (316 to 427 °C) is the band where a tempered part gives up impact toughness, which is why a temper is often run below it or well above it.

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, O1, A2, S7, H13, H11, H10, H21, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.

Compiled from Tool and Die Making Troubleshooter (Richard M. Leed), Table 8-1 on printed page 153, with the surrounding discussion of hardening, soaking and heat colours on printed pages 152 to 155. The figures are reproduced from the published table and are a reference summary rather than an Aobo Steel specification, so treat them as the ranges the trade works inside rather than as a heat treatment instruction for a particular part.

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