

Tool Steel Impact Toughness Chart

V notch Charpy impact energy for the principal tool steels, read at the optimum tempering temperature for each grade, with the hardness the grade carries at that temper. Printed from the reference page on aobosteel.com. This is a reference summary of published test data and not an Aobo Steel specification.

Reference only. The impact energies are the source's own V notch Charpy test series, read at the optimum tempering temperature it marks for each grade. Notch geometry, specimen size, the direction of the specimen relative to the bar and the test temperature all move a Charpy result, so the figures compare grades under those conditions rather than predicting a service life. Agree the test conditions before writing an impact requirement into a purchase specification.

Cold work and general purpose tool steels

Source, tool steel selection chapter, printed pages 142 to 149. W1 and W2 share one chart in the source, as do 4140 and 4150, which are shown there as a reference point against the case hardened water hardening grades.

Grade	Type	Optimum temper, °F	°C	Hardness at that temper, HRC	Charpy impact, ft lb	J
W1	Water hardening	300	150	64	80	108
W2	Water hardening	300	150	64	77	104
O1	Oil hardening	300	150	63	33	45
O6	Oil hardening, graphitic	300	150	63	33	45
L6	Oil hardening, nickel	300	150	60/61	72	98
A2	Air hardening, 5% chromium	400	205	60	17	23
A6	Air hardening, 1% chromium	400	205	59	28	38
D2	Air hardening, 12% chromium	960	515	58/60	8	11
D3	High carbon, high chromium	400	205	62	6	8
D7	High carbon, 4% vanadium	400	205	62	6	8
4140 / 4150	Medium alloy, reference grades	300	150	53/54	65	88

4140 and 4150 are not tool steels. The source prints them in the same chart to place the case hardened water hardening tool steels against a medium alloy steel.

Shock resisting tool steels

Source, tool steel selection chapter, printed pages 150 to 153.

Grade	Type	Optimum temper, °F	°C	Hardness at that temper, HRC	Charpy impact, ft lb	J
S7	Shock resisting, air hardening	450	230	58	240	325
S1	Shock resisting, oil hardening	400	205	56	185	250
S5	Shock resisting, oil hardening	400	205	60	170	230

The 240 ft lb (325 J) figure for S7 is the maximum level the test equipment could record. The source states that calculations put the value nearer 280 ft lb (380 J).

Tool steel impact toughness chart, continued

Hot work tool steels

Source, tool steel selection chapter, printed pages 154 to 157. The source lists A8 with the hot work group, and it is also supplied as a mold steel.

Grade	Type	Optimum temper, °F	°C	Hardness at that temper, HRC	Charpy impact, ft lb	J
H13	Chromium hot work	1000	540	54	68	92
H11	Chromium hot work	1000	540	57	85	115
H12	Chromium tungsten hot work	1000	540	54	96	130
A8	Air hardening, tungsten	1000	540	57	42	57
H19	Chromium tungsten cobalt hot work	1100	595	52	43	58
H21	Tungsten hot work	1000	540	53	34	46

High speed steels

Source, tool steel selection chapter, printed pages 158 to 162.

Grade	Type	Optimum temper, °F	°C	Hardness at that temper, HRC	Charpy impact, ft lb	J
M1	Molybdenum high speed	1000	540	65	12	16
M2	Molybdenum high speed	1000	540	66	10	13.5
M3, class 1	Molybdenum high speed	1000	540	67	7	9
M4	Molybdenum high speed, vanadium	1000	540	66	7	9
M7	Molybdenum high speed	1000	540	67	11	15
M42	Cobalt high speed	950	510	68	10	13.5
T1	Tungsten high speed	1000	540	64	9	12
T5	Tungsten high speed	1000	540	64	5	7
T15	Tungsten high speed, high vanadium	1000	540	67	3-4	4-5

Where two hardness values appear, in D2, L6 and the 4140 and 4150 row, the source prints a span rather than a single figure.

Aobo Steel, tool steel supplier

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

Reference data compiled from the tool steel selection chapter of Heat Treatment, Selection, and Application of Tool Steels (William E. Bryson, 2nd edition, Hanser), printed pages 139 to 163. The impact energies are the source's own V notch Charpy test series, read at the optimum tempering temperature it marks for each grade.

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