MATERIAL DATASHEET

D2 Tool Steel

Other Designations: DIN 12379, ASTM A681, UNS T30402, BD 2

D2 tool steel is a high carbon, high chromium air-hardening tool steel that can be heat treated to high hardness and compressive strength. D2 offers excellent wear resistance and is widely used in cold work applications that require sharp edges, abrasion resistance, and compressive strength. Markforged D2 meets chemical requirements of ASTM A681.

Composition	Amount
Chromium	11-13%
Carbon	1.4-1.6%
Molybdenum	0.7-1.2%
Vanadium	0.5-1.1%
Nickel + Copper	0.75% max
Manganese	0.1-0.6%
Silicon	0.1-0.6%
Phosphorus	0.03% max
Sulfur	0.03% max
Iron	bal

Typical Mechanical Properties	Standard	Markforged As-Sintered	Markforged Heat-Treated[1]	Wrought Heat Treated[2]
0.2% Compressive Yield Strength	ASTM E9	830 MPa	1690 MPa	2200 MPa
Elastic Modulus	ASTM E9	170 GPa	187 GPa	210 GPa
Hardness[3]	ASTM E18	54 HRC	60 HRC	62 HRC
Relative Density[4]	ASTM B923	97%	97%	100%

Heat Treatment

D2 tool steel can be heat-treated to increase hardness and durability after an optional annealing step and machining work. Markforged recommends heat-treating D2 tool steel to optimize material properties, though it can be used as-sintered.

1. Heat D2 Tool Steel part in a standard (non-vacuum) furnace to 1000°C (1830°F) . Hold part at temperature for 30-45 minutes.
2. Air quench part to below 65°C (150 °F).
3. Temper D2 Tool Steel part in a standard furnace. For each temper, heat part to 200°C[5] (392°F) and temper for 30 minutes. If double tempering, let part cool to room temperature between tempers.

1. Markforged heat-treated D2 tool steel was heated to 970°C (1780°F) and single tempered at 200°C (392°F) for 30 minutes.
2. Wrought heat treatment data from Bohler-Uddeholm: http://cdna.terasrenki.com/ds/1.2379_X153CrMoV12_AISI-D2_SS-2310_Datasheet_2.pdf
3. Markforged hardness was measured on a sample coupon that was printed at 100% infill and has a 25 mm diameter and 10 mm height.
4. Relative density for D2 assumes a density of 7.7 g/cm^2.
5. Tempering temperature has a significant effect on final material properties. For higher hardness, temper at low temperatures. For higher toughness, temper at higher temperatures.