ASTM SAE AISI D2 Tool Steel Heat Treatment, Chemical Composition, Properties

SAE AISI D2 Steel

D2 steel is a high carbon-high chromium air hardening tool steel that can be heat treated to a hardness of 60-62 HRC. Due to the presence of a large volume of carbides in its micro-structure, D2 steel offers excellent wear and abrasion resistance. It is widely used in long production cold work applications that require extremely high wear resistance and compression strength. D2 steel is machinable in the annealed condition and, like other air hardening tool steels, exhibits minimal distortion during heat treatment. It is available in decarb-free rounds, flats, squares, as well as ground flat stock and drill rod.

Applications

Typical applications of D2 include blanking, forming, and trimming dies, measuring instruments, cutting tools, wear-resistant parts, lamination dies, thread rolling dies, drawing dies, rotary cutting dies, knurls, bending dies, gauges, shear blades, polishing tools, rolls, machine parts, master parts, injection screws and nozzle components, seaming rolls, extrusion dies, scrap choppers, stamping dies, forming dies, punches, forming rolls, knives, slitters, shear blades, tools, scrap choppers, tire shredders, etc.

Data sheet & Specification

The following table provides the AISI SAE ASTM D2 steel data sheet, including chemical composition, physical properties, mechanical properties, etc.

Chemical Composition

C	Si	Mn	P	S	Cr	Mo	V
1.40-1.60	0.10-0.60	0.10-0.60	0.030 max	0.030 max	11.0-13.0	0.70-1.20	0.50-1.10

D2 Steel Heat Treatment

Forging

Heating for forging of D2 steel must be done slowly and uniformly. Soak the steel at a temperature range of 1850°-1950°F and reheat as necessary, stopping the forging process when the temperature drops below 1700°F. After forging, cool the steel

slowly using lime, mica, dry ashes, or a furnace. Annealing is always recommended for D2 steel after forging.

Annealing

For D2 steel, heat it slowly to a temperature range of 1550°-1600°F, hold it at this temperature until the entire mass is heated through, and then cool it slowly in the furnace (at a rate of 40°F per hour) to around 1000°F. After reaching 1000°F, the cooling rate can be increased. Care should be taken to prevent excessive carburization or decarburization during the annealing process.

Stress relieving

When it is desired to relieve the stresses from machining, heat the steel slowly to a temperature range of 1050°-1250°F, allow it to equalize at that temperature, and then cool it in still air (stress relieving).

Preheat prior to hardening

Preheat slowly to 1350°-1450°F and hold at this temperature until material is uniformly heated.

Hardening

After thorough preheating, heat the workpiece to a temperature range of 1800°-1850°F. Hold the workpiece at this hardening temperature until it is completely and uniformly heated.

Quenching

D2 steel is an air-hardening steel and will achieve hardness when cooled in still air. To prevent scaling and decarburization of the workpiece surface, it is recommended to use controlled atmosphere or vacuum furnaces. If these furnaces are not available, pack hardening, salt baths, or wrapping the piece in stainless steel foil can provide some level of surface protection during the hardening process. Parts should be allowed to cool to 150°F, or until they can be held in the bare hand, and then tempered immediately.

Tempering

The tempering temperature can be adjusted according to the desired hardness. If maximum hardness is desired, tempering should be done in the range of 300°-400°F. However, if a lower hardness is acceptable, tempering at 950°F will provide the best combination of hardness and toughness.

D2 steel grade comparison

The equivalent comparisons of ASTM AISI SAE D2 tool steel to European standards Germany DIN EN, and Japanese JIS standards are as follows:

ASTM	Material No.	DIN	EN	GB
D2	1.2379	X155CrVMo12-1	X160CrMoV121	Cr12Mo1V1