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D2 Tool Steel Heat Treatment Guide

Preheating, austenitizing, quenching, optional cryogenic treatment and tempering for D2, 1.2379 and SKD11, with the hardness each tempering temperature produces. Reference summary of published D2 practice, not a heat treatment specification and not an Aobo Steel standard.

Reference only. Aobo Steel supplies D2 tool steel in the annealed condition and does not provide heat treatment services. Verify the values below against the applicable standard, the mill data sheet and the heat treater's own procedure.

D2 Heat Treatment Quick Parameter Table

Step	Recommended Range	Purpose	Shop note
Preheating	1200–1250°F / 649–677°C	Reduce thermal shock and cracking risk	The part should be held until the cross-section is uniformly heated. D2 should be heated in a vacuum furnace, a controlled-atmosphere furnace, a neutral salt bath, or under stainless steel foil.
Austenitizing	1795–1875°F / 980–1025°C	Form austenite and dissolve alloy carbides	Soaking time should begin only after the entire section reaches the target temperature. A common reference is 45–60 minutes per inch of thickness, adjusted by furnace loading, cross-section, and tool geometry.
Quenching	Air, gas, oil, or salt bath depending on section size	Harden the steel with controlled distortion	After quenching, the tool should normally cool to about 120–150°F (50–66°C) before tempering. Tempering should begin immediately.
Optional Cryogenic Treatment	Down to -196°C	Reduce retained austenite and improve dimensional stability	Cryogenic treatment may be performed after quenching and before tempering, or between tempering cycles, depending on the heat-treatment practice.
Tempering	900–960°F / 480–515°C, double tempering	Improve stability and reach about 58–60 HRC	Tempering time also depends on section size. A common reference is at least 2 hours per inch (25 mm) of thickness, with cooling to room temperature between tempering cycles. Double tempering is normally recommended for D2.

Process data source, the Aobo Steel D2 Tool Steel Heat Treatment Guide.

D2 Tempering Temperature and Hardness Chart

Tempering Temperature	Typical Condition	Expected Hardness
As quenched	Standard hardening	About 64 HRC
300°F / 150°C	Low-temperature temper	About 62 HRC
400°F / 205°C	Low-temperature temper	About 61 HRC
500°F / 260°C	Tempered	About 60 HRC
600°F / 315°C	Tempered	About 59 HRC
700°F / 370°C	Tempered	About 58 HRC
800°F / 425°C	Tempered	About 58 HRC
900°F / 480°C	High-temperature temper	About 58 HRC
960°F / 515°C	High-temperature temper	About 58–60 HRC depending on practice
1000°F / 540°C	High-temperature temper	About 55 HRC

Final hardness depends on austenitizing temperature, quenching method, tempering temperature, number of tempering cycles, section size, and whether cryogenic treatment is used.

Key Tempering Strategies for D2 Tool Steel

Tempering Strategy	Typical Temperature	Expected Result	Best Used When
Low-temperature tempering	Around 400°F / 205°C	About 60–62 HRC	Maximum hardness is more important than dimensional stability
High-temperature double tempering	900–960°F / 480–515°C	About 58–60 HRC	Dimensional stability, stress relief, and retained austenite control are important

For most industrial D2 tools, high-temperature double tempering at 900–960°F / 480–515°C gives a safer balance between hardness, wear resistance, stability, and cracking resistance.

Target Hardness for Different D2 Tooling Applications

Application	Typical Target Hardness	Selection Logic
Long-run blanking dies	58–62 HRC	Balance edge wear and cracking risk
Blanking punches	58–62 HRC	Maintain wear resistance while reducing breakage risk
Forming and bending dies	58–60 HRC	Improve toughness and reduce chipping
Slitting cutters and shear blades	58–61 HRC	Maintain edge retention under abrasive cutting
Cold extrusion tooling	58–62 HRC	Balance compressive strength, toughness, and wear
Gauges and measuring tools	58–60 HRC	Prioritize dimensional stability and wear resistance
Thread rolling dies	58–60 HRC	Maintain surface wear resistance and compressive strength
Small abrasive plastic mold inserts	58–60 HRC	Use when abrasion resistance is required

The practical working hardness of D2 tool steel is commonly selected between 56 HRC and 62 HRC. Higher hardness can improve wear resistance but also increase the risk of chipping and cracking.

Common D2 Heat Treatment Problems

Problem	Cause and control
Overheating	Overheating happens when D2 is austenitized above the recommended range or soaked too long. The solution is to control the austenitizing temperature and soaking time based on section size.
Underheating	Underheating happens when the austenitizing temperature is too low or the soaking time is too short. This usually appears as low hardness, weak wear resistance, and poor service performance.
Surface decarburization	If D2 is heated without protection, the surface can lose carbon during austenitizing. Vacuum heat treatment, controlled-atmosphere heat treatment, neutral salt bath, or stainless-foil wrapping can reduce this problem.
Delayed tempering	D2 should be tempered immediately after quenching, when it has cooled to approximately 120–150°F (50–66°C). Leaving hardened D2 untempered overnight is risky, especially for complex tools and heavy sections.
Improper tempering temperature	The tempering temperature should match the application. For many industrial tools, double tempering at 900–960°F (480–515°C) is more reliable than a single low-temperature temper.
Design-induced quench cracking	Some D2 tools crack because of geometry rather than steel quality. Sharp internal corners, deep marks, blind holes, thin walls adjacent to heavy sections, and sudden cross-sectional changes all increase the risk of cracking. Where possible, sharp corners should be radiused, section changes should be reduced, and complex tools should be designed with heat treatment in mind.
Grinding damage after heat treatment	D2 has high wear resistance, so aggressive grinding can generate localized heat. This may soften the surface, cause grinding burns, or create shallow surface cracks. After hardening, D2 should be ground with light passes, proper coolant, and controlled stock removal.

Problem data source, the Aobo Steel D2 Tool Steel Heat Treatment Guide.

Table notes

- The parameters below are practical reference ranges. Final heat-treatment settings should be adjusted according to furnace capability, section thickness, part geometry, and the required working hardness.
- For very large sections, air cooling may not cool the core fast enough to reach the required hardness. More aggressive cooling may be needed, but stronger quenching also increases the risk of cracking.
- If the D2 tool will later receive nitriding, PVD coating, or another high-temperature surface treatment, the tempering temperature should be selected with the coating temperature in mind.
- Final heat-treatment procedures and validation should be performed by the customer's heat-treatment facility in accordance with the specific tooling application and production requirements.

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 and O1, hot work grades such as H10 and H13, and stainless grades 420, 440C and 4Cr13. D2, 1.2379 and SKD11 are supplied in the annealed condition with mill test certificates to EN 10204 3.1.
Reference data compiled from published D2 heat treatment sources and the Aobo Steel D2 Tool Steel Heat Treatment Guide.

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