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S7 Tool Steel Heat Treatment

S7 is an air hardening, shock resisting tool steel. This card is a reference summary of published S7 practice. It is not a heat treatment specification and it is not an Aobo Steel standard. Final parameters are set by the heat treater.

> Reference only. Aobo Steel supplies S7 tool steel in the annealed condition and does not provide heat treatment services. Verify the values below against the applicable standard and the heat treater's own procedure.

S7 Heat Treatment Quick Guide

Process Phase	Temperature	Soak Time	Cooling Method
Preheating	1200–1300 °F 649–704 °C	Until uniform	—
Austenitizing	1725–1800 °F 940–982 °C	Controlled by section size	Air or oil depending on section size
Quenching	—	—	Air ≤63.5 mm; oil or flash oil >63.5 mm
Tempering	400–1000 °F 204–538 °C	2 hr/in, twice	Air cool between cycles
Annealing	1500–1600 °F 815–870 °C	1–1.5 hr/in	Furnace cool to 482 °C, then air cool
Stress Relieving	1200–1250 °F 649–677 °C	1–2 hr/in	Furnace cool preferred

For small sections, a 10–15 minute soak after temperature equalization is usually sufficient. Timing should begin only after the part has reached its full temperature. Cool the part to approximately 150 °F (65 °C) before tempering.

Austenitizing Soak Time by Section

Section Thickness	Metric	Recommended Soak Time
1/8 in.	3.2 mm	30 min
1/4 in.	6.4 mm	40 min
1/2 in.	12.7 mm	45–50 min
3/4 in.	19 mm	50–55 min
≥1 in.	25 mm	About 1 hr/in

Tempering Temperature and Hardness

Tempering Temperature	Approximate Hardness	Practical Meaning
As-quenched, before tempering	58–64 HRC	Maximum hardness, but too brittle for service. Temper immediately after quenching.
400–500 °F / 204–260 °C	56–58 HRC	Common cold-work range for punches, dies, shear blades, and shock-loaded tools.
Around 450 °F / 230 °C	About 58 HRC	Practical general-purpose range when both wear resistance and impact toughness are required.
500–900 °F / 260–482 °C	About 54–56 HRC	Stable hardness range with better toughness than lower tempering temperatures.
900–1000 °F / 482–538 °C	About 48–52 HRC	Used for hot-work or elevated-temperature applications where thermal stability is more important than maximum hardness.

Typical working hardness for cold work tooling
56–58 HRC

Air quench for sections up to
2.5 in. (63.5 mm)

Double tempering, each cycle
2 hr/in

Quenching selection, annealing practice and troubleshooting are on the reverse

Quenching Method Selection

Condition	Method	Key Process	Critical Note
Sections ≤63.5 mm	Air quench	Cool in still air after austenitizing	Best dimensional stability
Sections >63.5 mm	Oil-based cooling	Use faster cooling to improve core hardness	Air cooling may be insufficient
Heavy sections requiring stress control	Flash oil quench	Oil quench until red heat disappears, then air cool	Do not use stainless steel foil
Complex or distortion-sensitive parts	Martempering	Salt bath at 595–650 °C, equalize, then air cool	Reduces thermal gradients

Annealing and Stress Relieving

Practice	Temperature	Soak Time	Cooling	Final Hardness
Annealing	1500–1600 °F 815–870 °C	About 1.5 hr/in	Furnace cool at ≤14 °C/hr to 482 °C, then air cool	Normally not above about 230 HB
Stress relieving	1200–1250 °F 649–677 °C	1–2 hr/in	Furnace cooling preferred	—

Tempering Range by Application

Application	Tempering Range	Typical Hardness	Main Priority
Cold-work tooling, dies, punches, shear blades	400–500 °F / 204–260 °C	56–58 HRC	Wear and toughness balance
Cold-work tooling with maximum hardness focus	345–400 °F / 175–204 °C	Higher hardness	Maximum wear resistance, lower toughness
Hot-work or plastic molding tools	900–1000 °F / 482–538 °C	48–52 HRC	Thermal stability
Shock-dominant tools	700–750 °F / 370–400 °C	Moderate hardness	Fracture resistance
Strength and toughness balance	Around 575 °F / 300 °C	Controlled hardness	Yield strength and impact balance

Common S7 Heat Treatment Problems

Problem	Root Cause	Corrective Action
Decarburization	Surface carbon loss in an oxidizing atmosphere	Use vacuum, controlled atmosphere, neutral salt, or sealed foil
Distortion or thermal cracking	Thermal gradients, sharp geometry, or machining stress	Preheat properly, stress relieve before hardening, avoid sharp corners
Low hardness in large sections	Cooling rate too slow through the section	Use oil-based cooling or flash oil quenching for heavier sections
Overheating or retained austenite	Excessive austenitizing temperature or soak time	Control temperature and soaking time strictly
Cracking after quenching	Delayed tempering or excessive internal stress	Temper immediately and apply double tempering

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. Mill test certificates to EN 10204 3.1 travel with every shipment and every order is checked against its working hardness range before it leaves the works.

Reference data compiled from published S7 heat treatment sources and the Aobo Steel S7 heat treatment guide

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