

Cryogenic Treatment of Tool Steel

Cold treatment temperatures, hold times and the temper that follows, for tool steel that is cryogenically treated after quenching. Printed from the reference page on aobosteel.com. This is a reference summary of published practice and not an Aobo Steel specification.

Reference only. This card is a reference summary of published practice, not an Aobo Steel specification. It gives the temperatures and hold times printed in the source. The result on your part also depends on the heat treatment that came before the cold soak, on the load and on the processor, so confirm the cycle with your heat treater and with the mill data sheet for the grade before running production.

Cryogenic treatment routes and their temperatures and hold times

Source, printed pages 108 to 113.

Route	Temperature reached	Cool down	Hold at temperature	Warm up
Liquid nitrogen, dry gas first and then liquid	-320°F (-196°C)	4 to 8 hours	20 hours minimum	20 to 30 hours, with no added heat
Liquid nitrogen, liquid let in at the end	-250°F (-157°C) on gas, then liquid	a few hours on gas alone	18 to 20 hours covered	on its own, lid closed
Dry ice in a Styrofoam chest	-109°F (-79°C)	not stated	8 to 10 hours minimum, longer is better	6 to 7 hours to 2 days

A processor limited to dry gas reaches only -260 to -300°F (-162 to -184°C), which the source calls the minimum needed to produce the required change. The 97% and the 99.8% to 100% figures both assume a sound heat treatment that itself yielded 75% to 80% martensite.

Austenite to martensite transformation by condition

Source, printed pages 107 and 113.

Condition	Martensite after treatment	What the source says
Good practice, recipe followed, equipment calibrated	95% to 96%	the most a straight heat treatment normally delivers
Mass heat treated items, drill bits and saw blades as the example	50% to 60%	what the source found on commercially treated parts
Dry ice, soaked long enough	up to 97%	set by how much retained austenite is left after tempering
Liquid nitrogen, dry or wet, load packed correctly	99.8% to 100%	the only route that comes close to full transformation

Post cryogenic tempering requirements

Source, printed pages 109, 111 and 112.

Step	Requirement	Why it matters
Tempering temperature	300°F (150°C), or 25°F (14°C) below the tempering temperature originally used	300°F sits below any prescribed tempering temperature, so it cannot change the temper hardness
Tempering time	2 hours per inch of thickness	the source repeats the 2 hour per inch rate at every stage of the process
When it starts	after the parts are back at room temperature	it stabilises the martensite formed during the cold soak
What to confirm with the processor	that the temper is actually carried out	the source reports that some commercial processors skip it

Tempering after the cold treatment is not optional. The parts must be back at room temperature first, and the source reports that not every commercial processor carries this temper out, so confirm it with the processor or repeat it in a workshop oven at 300°F (150°C).

Aobo Steel, tool steel supplier

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Reference data compiled from the Cryogenics chapter of Heat Treatment, Selection, and Application of Tool Steels (William E. Bryson, 2nd edition, Hanser), printed pages 107 to 113, with the retained austenite figures also used in the CPM 10V chapter, printed page 105.

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