

Retained Austenite in M2 Tool Steel and How to Reduce It

What M2 high speed steel keeps of its austenite after hardening, and what single, double, triple and quadruple 2-hour tempers at 965 °F (518 °C) each leave behind, from a tool and die shop handbook. A reference summary of published practice and not an Aobo Steel specification.

Reference only. The figures in this chart are reproduced from the source named at the foot of the sheet, one mill's test on M2, and are not a specification of ours. Retained austenite after hardening depends on the austenitising temperature, the soak, the quench rate and the section, so the numbers are an indication of what repeated tempering removes rather than a limit to work to. Verify the result on your own part with the hardness and dimensional checks your drawing calls for.

Retained austenite left after each tempering step

Source, Table 4-7, effect of tempering M2 high speed steel on austenite retention, printed page 64 of Tool and Die Making Troubleshooter (Richard M. Leed), PDF page 81 of the copy consulted. The book credits Teledyne Vasco, 1968.

Condition after hardening	Retained austenite, %
As quenched	24.0
Single 2-hour temper	16.1
Double temper, 2 + 2 hours	4.7
Triple temper, 2 + 2 + 2 hours	2.7
Quadruple temper, 2 + 2 + 2 + 2 hours	1.7

Every temper in the table was run at 965 °F (518 °C) for two hours, and the austenite was measured after each step. The figures come from one mill's test on M2, so they show what repeated tempering does rather than what a given heat will do; the starting figure after the quench depends on the austenitising temperature and the soak the shop used.

Hardening does not finish the job. The quench turns most of the austenite into martensite and the rest stays as austenite, because the cooling stopped the transformation before it was complete.

A second two-hour temper takes the figure below five percent, which is why double tempering is standard practice on air-hardening and high speed grades rather than a matter of preference.

Aobo Steel, tool steel supplier

Aobo Steel supplies tool steel to distributors and mold, tool and die shops, including D2, D3, O1, A2, S7, H13, H11, H10, H21, M2, M42, L6, P20 and 420 and 440C stainless. Forged or hot rolled, annealed or pre-hardened, cut to your sizes, with test certificates.

Compiled from Tool and Die Making Troubleshooter (Richard M. Leed), Table 4-7 on printed page 64 and the discussion of transformation, stress and retained austenite on printed pages 63 to 66. The measurements are reproduced from the published table and are a reference summary rather than an Aobo Steel specification, so treat them as an indication of what multiple tempers achieve on M2 rather than as a heat treatment instruction for a particular part.

CONTACT

EMAIL
sales@aobosteel.com

WHATSAPP
[+86 180 6294 5370](tel:+8618062945370)

WEB
aobosteel.com



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