

How to Treat Stainless Steels

Comparison of Thermal and Surface Hardening Techniques

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TREATMENT
TYPE

TYPE	APPLICATION GUIDELINES	OBJECTIVE	ADVANTAGES	DISADVANTAGES
QUENCHING & TEMPERING	Suitable only for martensitic or transformation-hardening stainless steels. Requires sufficient carbon content.	Increase hardness and strength, fine-tune toughness through a two-step heat cycle.	High hardness, precise toughness control, suitable for structural components.	Not suitable for austenitics. Risk of distortion and carbide formation if improperly controlled.
ANNEALING	Used on all stainless steel grades to stabilize the structure and relieve internal stresses.	Soften, remove residual stresses, restore ductility.	Restores original properties, stabilizes microstructure.	Reduces hardness; may cause grain growth if not properly controlled.
AGING	For precipitation-hardening (PH) stainless steels such as 17-4PH.	Increase hardness by forming fine intermetallic precipitates.	Improves hardness without distortion; ideal for high-precision components.	Improves hardness without distortion; ideal for high-precision components.
COLD WORKING	Austenitic and, to a lesser extent, ferritic grades can be strengthened through cold deformation.	Increase hardness and mechanical strength without heat treatment.	Improves properties without heat; good for thin or delicate geometries.	Shallow depth of effect; may cause residual stresses and reduced ductility.
GAS NITRIDING	Suitable for martensitic and ferritic stainless steels. For austenitics,	Create a nitride layer to enhance wear resistance.	Well-established, cost-effective method to improve wear resistance.	May reduce corrosion resistance and damage the passive layer;

PLASMA NITRIDING

Suitable for all stainless steel grades; ideal for austenitics where other treatments fall short.

low-temperature processes are used.

Harden the surface without harming the passive layer; boost wear resistance while preserving the core.

High surface hardness, no distortion, preserves passive layer, no coating required.

Higher initial equipment cost; sensitive to geometry for uniform results.

requires controlled atmospheres.