



Typical Treatments for Carbon, Alloy and Stainless Steels

Carbon

1000, 1100, 1200, 1500 series, Main alloying additions: manganese [Mn], sulfur [S] (1100), phosphorus [P] (1100, 1200), boron [B], Good machining, forming, welding properties, High carbon grades show poor welding characteristics

Type	Typical Heat Treatments	Machinability (11L41 is 100%) ³	Material Cost (1020 is 100%) ³
Low Carbon 0.10-0.30%	Carburizing, Carbonitriding, Nitriding, Nitrocarburizing (FNC)	50-200%	100-160%
Med. Carbon 0.30-0.60%	Quench & Temper, Austempering, Nitriding, Nitrocarburizing	65-100%	80-220%
High Carbon 0.60-1.00%	Quench & Temper, Austempering, Nitriding	30-40%	150-200%

Alloy

1300 – 9700 series, common alloying additions (0.15-1.5 wt %): chromium [Cr], molybdenum [Mo], nickel [Ni], silicon [Si], vanadium [V]. High hardenability and excellent response to most heat treatments. Generally stronger than equivalent plain carbon steels

Type	Typical Heat Treatments	Machinability (11L41 is 100%) ³	Material Cost (1020 is 100%) ³
Low Carbon 0.10-0.30%	Carburizing, Nitriding, Carbonitriding, Nitrocarburizing (FNC)	50-90%	145-500%
Med. Carbon 0.30-0.60%	Quench & Temper, Austempering, Nitriding, Nitrocarburizing (FNC)	65-100%	80-220%
High Carbon 0.60-1.00%	Quench & Temper, Austempering, Nitriding	30-40%	150-200%

Stainless

Please see below regarding specifics on Austenitic, Ferritic, Martensitic and Precipitation Hardening

Type	Typical Heat Treatments	Machinability (11L41 is 100%) ³	Material Cost (1020 is 100%) ³
Austenitic ~ 200/300 series; non-magnetic; oxidation resistant; highest corrosion resistance	Solution Treating, Nitriding, Ion Carburizing, "S"Phase Nitriding	20-70%	100-300%
Ferritic ~ 400 series; magnetic	Solution Treating, Nitriding	---	---
Martensitic ~ 400 series; magnetic; hardenable; less corrosion resistant than other types	Quench & Temper, Induction, Nitriding	40-80% (416 is "free machining")	90-200%
Precipitation Hardening ~ Standard to weak magnetic properties; hardenable through age hardening; corrosion resistance slightly lower than Austenitic types; 13-8, 15-5, 17-4 (e.g.)	Solution treating and age hardening; Nitriding	45-50%	120-200%