Grade Data Sheet

420

Grade 420 stainless steel is a higher carbon version of 410; like most carbon and low alloy steels it can be hardened by heat treatment. It contains a minimum of 12 per cent chromium, just sufficient to give corrosion resistant properties. 420 has good ductility in the annealed condition but is capable of being hardened up to Rockwell Hardness 50HRC, the highest hardness of the 12 per cent chromium grades. Its best corrosion resistance is achieved when hardened and surface ground or polished.

Related grades to 420 are high carbon high hardness martensitic stainless steels such as the 440 series (see the Atlas Datasheet on this series of grades) and also variations to 420 containing molybdenum (for increased corrosion resistance and mechanical properties), sulphur (for increased machinability) or vanadium (for higher hardness). A slightly higher carbon version of 420 is the non-standard grade 420C.

Martensitic stainless steels are optimised for high hardness, and other properties are to some degree compromised. Fabrication must allow for poor weldability and usually also include a final harden and temper heat treatment. Corrosion resistance is lower than the common austenitic grades, and their useful operating temperature range is limited by their loss of ductility at sub-zero temperatures and loss of strength by over-tempering at elevated temperatures.

Corrosion Resistance

Grade 420 in the hardened condition has good resistance to the atmosphere, foods, fresh water and mild alkalies or acids. Corrosion resistance is lower in the annealed condition. Less corrosion resistant than the austenitic grades and also less than 17% chromium ferritic alloys such as Grade 430; 420 also has slightly lower resistance than grade 410. Performance is best with a smooth surface finish.

This grade is commonly used for cutlery - particularly blades of table knives and for some carving knives and similar. The corrosion resistance is sufficient to resist food and normal washing methods, but prolonged contact with unwashed food residues can result in pitting. Consult Atlas Technical Assistance for specific environmental recommendations.

Heat Resistance

Not recommended for use in temperatures above the relevant tempering temperature, because of reduction in mechanical properties. The scaling temperature is approximately 650°C.

Heat Treatment

Annealing

Full anneal - 840-900°C, slow furnace cool to 600°C and then air cool.
Process Anneal - 735-785°C and air cool.

Hardening

Heat to 980-1035°C, followed by quenching in oil or air. Oil quenching is necessary for heavy sections. Temper at 150-370°C to obtain a wide variety of hardness values and mechanical properties as indicated in the accompanying table.

The tempering range 425-600°C should be avoided.

Welding

Pre-heat to 150-320°C and post-heat at 610-760°C. Grade 420 coated welding rods are recommended for high strength joints, where a post-weld hardening and tempering heat treatment is to be carried out.

If parts are to be used in the "as welded" condition, a ductile joint can be achieved by using Grade 309 filler rod. AS 1554.6 pre-qualifies welding of 420 with Grade 309 rods or electrodes.

Machining

In the annealed condition this grade is relatively easily machined, but if hardened to above 30HRC machining becomes more difficult. Free machining grade 416 (refer Atlas Datasheet) is a very readily machined alternative.

Typical Applications

Cutlery, knife blades, surgical instruments. Needle valves. Shear blades.

Grade Data Sheet

420

Specified Properties

These properties are specified for bar product in ASTM A276. Bar is the most commonly available form of grade 420. Similar but not necessarily identical properties are specified for other products such as plate and forgings in their respective specifications.

Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Mo	Ni	N
420	min.	0.15	-	-	-	-	12.00	-	-	-
	max.	-	1.00	1.00	0.040	0.030	14.00			

Mechanical Properties - typical values

Tempering Temperature (°C)	Tensile Strength (MPa)	Yield Strength 0.2% Proof (MPa)	Elongation (% in 50mm)	Hardness Brinell (HB)	Impact Charpy V (J)
Annealed *	655	345	25	255 max *	-
204	1600	1360	12	444	20
316	1580	1365	14	444	19
427	1620	1420	10	461	#
538	1305	1095	15	375	#
593	1035	810	18	302	22
650	895	680	20	262	42

* Annealed tensile properties are typical for Condition A; annealed hardness is the specified maximum for cold finished Condition A bar, given in ASTM A276-06.

Due to associated low impact resistance this steel should not be tempered in the range 425-600°C

Physical Properties

(typical values in the annealed condition)

Grade	Density (kg/m^3)	Elastic Modulus (GPa)	Mean Coefficient of Thermal Expansion		Thermal Conductivity		Specific Heat	Electrical Resistivity
			0-100°C (µm/m/°C)	0-315°C (µm/m/°C)	at 100°C (W/m.K)	at 500°C (W/m.K)	0-100˚C (J/kg.K)	(nΩ.m)
420	7700	200	10.3	10.8	24.9	-	460	550

Grade Specification Comparison

Grade	UNS No	Euronorm		Swedish SS	Japanese JIS
		No	Name		
420	S42000	1.4021	X20Cr13	2303	SUS 420J1

These comparisons are approximate only. The list is intended as a comparison of functionally similar materials **not** as a schedule of contractual equivalents. If exact equivalents are needed original specifications must be consulted.

Possible Alternative Grades

Grade	Why it might be chosen instead of 420
410	Only a lower hardened strength is needed.
416	High machinability is required, and the lower hardened strength and lower corrosion resistance of 416 is acceptable.
440C	A higher hardened strength or hardness than can be obtained from 420 is needed.
"specials"	Variations of 420 are available to special order. These offer higher hardness, corrosion resistance and machinability for particular applications.