Stainless Steel 410 Grade Data Sheet

Grade 410

Grade 410 is the basic martensitic stainless steel; like most non-stainless steels it can be hardened by a "quench-and-temper" heat treatment. It contains a minimum of 11.5 per cent chromium, just sufficient to give corrosion resistance properties. It achieves maximum corrosion resistance when it has been hardened and tempered and then polished. Grade 410 is a general-purpose grade often supplied in the hardened, but still machinable condition, for applications where high strength and moderate heat and corrosion resistance are required.

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

Grade 410 is usually a bar steel, most commonly only available in Australia when imported for a particular application.

Corrosion Resistance

410 resists dry atmosphere, fresh water, mild alkalies and acids, food, steam and hot gases. It must be hardened for maximum heat and corrosion resistance. Performance is best with a smooth surface finish. This grade has less corrosion resistance than the austenitic grades and also, less than 17% chromium ferritic alloys such as Grade 430.

Heat Resistance

Good resistance to scaling up to approximately 650°C, but generally not recommended for use in temperatures between 400 and 580°C, because of the reduction in mechanical properties.

Heat Treatment

Full Annealing

815-900°C, slow furnace cool to 600°C and then air cool.

Process Annealing

650-760°C and air cool.

Hardening

Heat to 925-1010°C, followed by quenching in oil or air. Oil quenching is necessary for heavy sections. Temper, generally within the range 200-400°C, to obtain a variety of hardness values and mechanical properties as indicated in the accompanying table.

The tempering range 400-580°C should generally be avoided.

Welding

Readily welded by all standard methods, but a pre-heat of 150-260°C and post-weld annealing treatment is required to reduce the possibility of cracking. Use Grade 410 welding rod if post hardening and tempering is involved. If parts are to be used in the "as welded" condition, a ductile joint can be achieved by using Grade 309 filler rods.
AS 1554.6 pre-qualifies welding of 410 with Grade 309 rods or electrodes.

Stainless Steel 410 Grade Data Sheet

Machining

In the annealed or highly tempered conditions Grade 410 is relatively easily machined, but if hardened to above 30HRC machining becomes more difficult. Free machining Grade 416 (refer to the Atlas Steels Datasheet) is a very readily machined alternative, but with lower corrosion resistance and mechanical properties.

Typical Applications

Bolts, nuts, screws, bushings. Pump and valve parts and shafts. Steam and gas turbine parts. Petroleum fractionating towers. Mine ladder rungs.

Specified Properties

These properties are specified for bar product in ASTM A276. Similar but not necessarily identical properties are specified for other products such as plate, wire and forgings in their respective specifications.

Composition Specification (%)

Grade		C	Mn	Si	P	S	Cr	Mo	Ni	N
410	min.	0.08	-	-	-	-	11.5	-	-	-
	max.	0.15	1.00	1.00	0.040	0.030	13.5			

Mechanical Property Specification (Typical and specified values)

Tempering Temperature (°C)	Tensile Strength (MPa)	Yield Strength 0.2% Proof (MPa)	Elongation (% in 50mm)	Hardness Brinell (HB)	Impact Charpy V (J)
Annealed *	480 min.	275 min.	16 min.	-	-
204	1310	1000	16	388	30
316	1240	960	14	325	36
427	1405	950	16	401	#
538	985	730	16	321	#
593	870	675	20	255	39
650	755	575	23	225	80

* Annealed properties are specified for Condition A of ASTM A276, for cold finished bar.

\# 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/m³)	Elastic Modules (GPa)	Mean Coefficient of Thermal Expansion			Thermal Conductivity		Specific Heat	Electrical Resistivity at 20°C
			0-100°C (µm/m/°C)	0-315°C (µm/m/°C)	0-538°C (µm/m/°C)	at 100°C (W/m.K)	at 500°C (W/m.K)	0-100°C (J/kg.K)	(nΩ.m)
410	7700	200	9.9	11.4	11.6	24.9	28.7	460	570

Stainless Steel 410 Grade Data Sheet

Grade Specification Comparison

Grade	UNS No	Euronorm		Swedish SS	Japanese JIS
		No	Name		
410	S41000	1.4006	X12Cr13	2302	SUS 410

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 410
416	High machinability is required, and the lower corrosion resistance of 416 is acceptable.
3Cr12	A non-hardenable alternative with much better availability in flat products. Similar corrosion resistance to 410.
420	A higher hardened strength or hardness than can be obtained from 410 is needed.
440C	A higher hardened strength or hardness than can be obtained even from 420 is needed.