

ATI Allcorr® Alloy

GENERAL

ATI Allcorr® alloy (UNS N06110) is produced by ATI Allvac in “long” product forms (billet, bar, rod, and wire) and by ATI Allegheny Ludlum in “flat” product forms (sheet, plate, and strip). It is a single phase, non-age hardenable, corrosion-resistant alloy for service in highly corrosive environments. This nickel-base alloy contains nominally 31 percent chromium, 10 percent molybdenum, and 2 percent tungsten. It is characterized by the following properties: high resistance to general corrosion, pitting and crevice corrosion, inter-granular corrosion, and stress corrosion cracking. The alloy has high strength and ductility, good weldability, good hot and cold workability, and good machinability.

Applications for Allcorr alloy include the following process environments: deep sour gas wells, chemical processing, flue gas desulfurization, pulp and paper, marine hardware, desalinization, petroleum refining, food processing, agri-chemical, sludge processing, and energy conversion.

PHYSICAL PROPERTIES

	Temp, °F	British Units	Temp, °C	Metric Units
Density	68	0.302 lb/in ³	20	8.327 g/cc
Electrical Resistivity	68	48.1 microhm-in	20	1.22 microhm-m
Mean Coefficient of Thermal Expansion	68-212	6.7x10 ⁻⁶ in/°F	20-100	12.0x10 ⁻⁶ m/°C
Thermal Conductivity	68	5.2 Btu/ft-hr-°F	20	9.0 W/m-°C
Specific Heat	68	0.101 Btu/lb-°F	20	421 J/Kg-°C

MECHANICAL PROPERTIES

Allcorr alloy is solid solution hardened with good strength and excellent ductility. Strength values can be raised to very high levels by cold working, as shown in the figure “Effects of Cold Work on Mechanical Properties (see p. 2). Good ductility and excellent corrosion resistant properties are retained in the cold worked condition.

WELDABILITY

WELDING CHARACTERISTICS: Gas Tungsten Arc Welding (GTAW) and Gas Metal Arc Welding (GMAW) techniques, used for other commercial nickel base alloys, results in sound welds with good bead appearance, 100% joint efficiency, and excellent ductility. Fusion in both the interpass and base metal/filler material should take place with no tendency towards crater cracking or hot cracking. No deleterious second phase precipitation occurs in the heat-affected zone.

MICROSTRUCTURE: The microstructure of both the GTAW and GMAW welds, when performed at optimum parameters, will be similar to other nickel base alloys, consisting of a fine columnar structure growing from the equiaxed base metal. There should be no discernible grain growth in the heat affected zone, no deleterious second phase precipitation and no microfissuring. Base metal/filler material fusion should be complete in all areas.

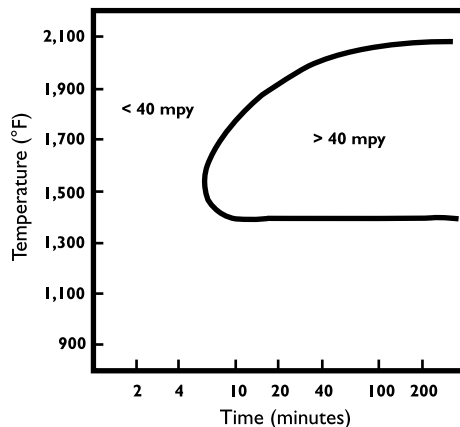
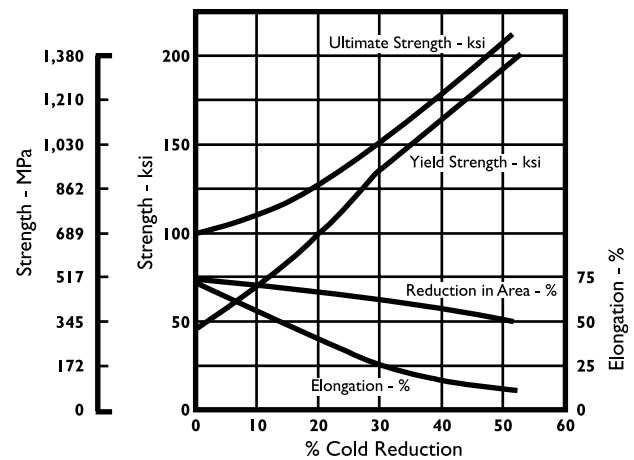
CORROSION TESTING: Results of tests in accordance with the specification, “G28-97 Standard Test Methods of Detecting Susceptibility to Intergranular Corrosion in Wrought, Nickel-Rich, Chromium-Bearing Alloys”, show no evidence of sensitization.

50% H ₂ SO ₄ + 2.2% Fe ₂ (SO ₄) ₃ 24 Hour Boiling	Corrosion Rate in mpy (µmy)				
	Base Metal	GTAW		GMAW	
		Optimum	High Heat	Optimum	High Heat
7-8 (180-200)	6-7 (150-180)	4-6 (100-150)	5-6 (130-150)	6-7 (150-180)	

A more quantitative measurement of Allcorr alloy’s susceptibility to sensitization is shown by the graph, “Susceptibility to Sensitization During Welding”, (see p. 2). The nose of the curve is shifted far to the right, showing a high tolerance for welding process conditions.

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Chemistry	C	Cr	Mo	W	Cb	Ti	Al	Ni
wt %, nominal	0.02	31.0	10.0	2.0	0.10	0.25	0.25	Bal.

Susceptibility to Sensitization During Welding

Effect of Cold Work on Mechanical Properties

CORROSION RESISTANCE

Allcorr alloy has outstanding corrosion resistance to a wide range of corrosive environments including pure and mixed acids, oxidizing solutions, sulfates, organics, and salts. The alloy also shows good resistance to sulfide stress corrosion and hydrogen embrittlement cracking. The following is a comparison of corrosion rates for Allcorr alloy and ATI 276 alloy in selected corrosive environments.

Test Solution	Corrosion Rate in mpy ($\mu\text{m/y}$)	
	Allcorr® Alloy	Allvac 276 Alloy
Aqua Regia - Ambient	0 (0)	147 (3680)
Hydrochloric Acid (10%) - Boiling	>200 (>5000)	>200 (>5000)
Formaldehyde (20%) - Boiling	0 (0)	10-20 (250-500)
Cupric Chloride (20%) - Ambient	0 (0)	10-20 (250-500)
Ferric Chloride (45%) - Ambient	0 (0)	10-20 (250-500)
"Green Death Solution" - Boiling (H_2SO_4 (7%) + HCl (3%) + FeCl_3 (1%) + CuCl_2 (1%))	1.8 (45)	24-40 (600-1,000)
Ammonium Sulfate (10%) - Boiling	0 (0)	10-20 (250-500)
Nitric Acid (40%) - Boiling	1 (25)	50-200 (1,250-5,000)
Sulfuric Acid (10%) - Boiling	2 (50)	20-30 (500-750)