HASTELLOY® G-35® alloy

Welding and Fabrication

HASTELLOY® G-35® alloy is very amenable to the Gas Metal Arc (GMA/MIG), Gas Tungsten Arc (GTA/TIG), and Shielded Metal Arc (SMA/Stick) welding processes. For matching filler metals (i.e. solid wires and coated electrodes) that are available for these processes, and welding guidelines, please click here.

Wrought products of HASTELLOY® G-35® alloy are supplied in the Mill Annealed (MA) condition, unless otherwise specified. This solution annealing procedure has been designed to optimize the alloy's corrosion resistance and ductility. Following all hot forming operations, the material should be re-annealed, to restore optimum properties. The alloy should also be re-annealed after any cold forming operations that result in an outer fiber elongation of 7% or more. The annealing temperature for HASTELLOY® G-35® alloy is 1121°C (2050°F), and water quenching is advised (rapid air cooling is feasible with structures thinner than 10 mm (0.375 in). A hold time at the annealing temperature of 10 to 30 minutes is recommended, depending on the thickness of the structure (thicker structures need the full 30 minutes). More details concerning the heat treatment of HASTELLOY® G-35® alloy, click here.

HASTELLOY® G-35® alloy can be hot forged, hot rolled, hot upset, hot extruded, and hot formed. However, it is more sensitive to strain and strain rates than the austenitic stainless steels, and the hot working temperature range is quite narrow. For example, the recommended start temperature for hot forging is 1204°C (2200°F) and the recommended finish temperature is 954°C (1750°F). Moderate reductions and frequent re-heating provide the best results, as described here. This reference also provides guidelines for cold forming, spinning, drop hammering, punching, and shearing of the HASTELLOY® alloys. G-35® alloy is stiffer than most austenitic stainless steels, and more energy is required during cold forming. Also, G-35® alloy work hardens more readily than most austenitic stainless steels, and may require several stages of cold work, with intermediate anneals.

While cold work does not usually affect the resistance of HASTELLOY® G-35® alloy to general corrosion, and to chloride-induced pitting and crevice attack, it can affect resistance to stress corrosion cracking. For optimum corrosion performance, therefore, the re-annealing of cold worked parts (following an outer fiber elongation of 7% or more) is important.

Tensile Data for Weldments

Welding Process	Form	Test Temperature		0.2% Offset Yield Strength		Ultimate Tensile Strength		Elongation
		°F	°C	ksi	MPa	ksi	MPa	%
Gas Tungsten Arc Welding (GTAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	RT	RT	63.5	438	101.0	696	44.0
		500	260	44.9	310	79.0	545	40.0
		1000	538	36.1	249	65.0	448	37.0
Synergic Gas Metal Arc Welding (GMAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	RT	RT	66.5	459	105.0	724	31.5
		500	260	48.6	335	80.5	555	43.0
		1000	538	35.7	246	72.7	501	51.0
	All Weld Metal Sample of Diameter 12.7 mm/0.5 in from Cruciform	RT	RT	70.5	486	101.0	696	43.0
		500	560	48.8	336	78.0	538	46.0
		1000	238	43.8	302	64.0	441	42.0

Charpy V-Notch Impact Data for Weldments

Welding Process	Form	Notch Position	Test Temperature		Impact Strength	
			°F	°C	ft.lbf	J
Synergic Gas Metal Arc Welding (GMAW)	Transverse Sample from Welded Plate of Thickness 12.7 mm/0.5 in	Mid-Weld	RT	RT	201	273
			-320	-196	153	207
		Heat Affected Zone	RT	RT	>264	>358
			-320	-196	>264	>358

Room Temperature Charpy V-Notch Data for Aged Weldments
(Synergic Gas Metal Arc Welding, Transverse Samples from Welded 12.7 mm Plate)

Notch Position	Aging Time	Aging Temperature		Impact Strength	
	h	ºF	ºC	ft.lbf	J
Mid-Weld	2000	800	427	223	302
Mid-Weld	2000	900	482	219	297
Mid-Weld	2000	1000	538	224	304
Mid-Weld	2000	1100	593	125	169
Mid-Weld	2000	1200	649	79	107