ATI Ultra-High Purity 316L Stainless Steel *Alloy*

Technical Data Sheet

GENERAL

ATI Ultra-High Purity 316L stainless steel alloy was developed to provide the semiconductor industry with a material to help reduce micro-contamination of semiconductor chips. Semiconductor manufacturing facilities require 316L tubes, fittings, and valves made from high purity metals, and the exposed surfaces must have minimal surface defects after electropolishing. Purity, as used here, describes a condition wherein the metal is free from non-metallic inclusions. The production of high purity 316L alloy requires superior process and chemistry controls, which include tight control over melting procedures and raw materials.

To achieve this goal, a Vacuum Induction Melting (VIM) melt practice provides a clean electrode with tight compositional limits and low gas contents for subsequent remelting. Usually, a Vacuum Arc Remelting (VAR) step is employed to produce a high quality ingot with low levels of volatile tramp elements and reduced gas levels. A less common method for remelting is Electro-Slag Remelting (ESR), a process especially effective for removing large oxide clusters and sulfides. However, the ESR melting process is not as effective at reducing dissolved gases.

SPECIFICATIONS - AMS

- ASTM A 182/A 182M
- ASTM A-276
- SEMI F20

PHYSICAL PROPERTIES

Melting Range: 2,500° to 2,550° F (1,370° to 1,400° C)
Density: 0.29 lbs/in^3 (8.03 gms/cc)

HEAT TREATMENT

The recommended annealing temperature range for 316L alloy is 1,850-2,050° F (1,010 - 1,121° C). Important reasons for annealing are to dissolve secondary carbides and to eliminate sensitization. Higher annealing temperatures result in a coarser grained material.

HARDNESS

The hardness of annealed 316L alloy is approximately 140 BHN. Cold working increases hardness due to strain hardening. Hardnesses on the order of HR_C 36 can be achieved with significant cold work.

CORROSION AND OXIDATION

ATI Ultra-High Purity 316L alloy has good general corrosion resistance. However, heating in the in the 1,000 to 1,500 °F range (538 - 816 °C) can sensitize the alloy to intergranular corrosion. The alloy is subject to stress-corrosion cracking, and increasing cold work and increasing temperature exposure both accelerate the crack growth rate.

The alloy has good oxidation resistance to 1,500°F (816 °C).

FORGEABILITY AND FORMABILITY

ATI Ultra-High Purity 316L alloy is easily hot worked. Material should be preheated to 2,100° to 2,300° F (1,149 to 1,260° C) and should be finish forged above 1,700° F (927° C). Annealing is recommended after hot working. Annealed 316L alloy is readily cold worked using conventional forming techniques.

MACHINABILITY

Allvac Ultra-High Purity 316L alloy is machined using rigid machines and sharp tooling. Heavy feed rates and adequate coolant are recommended.

WELDABILITY

The alloy can be welded using most conventional electric arc welding techniques. It is recommended that the filler metal be of the same composition as the parent material.

SPECIAL PRECAUTIONS

All lubricants and coolants, particularly sulfur-bearing, should be removed prior to heat treating and welding.

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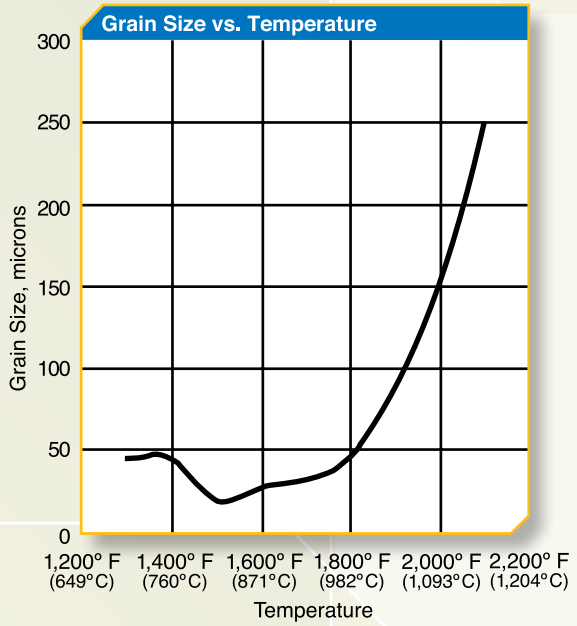
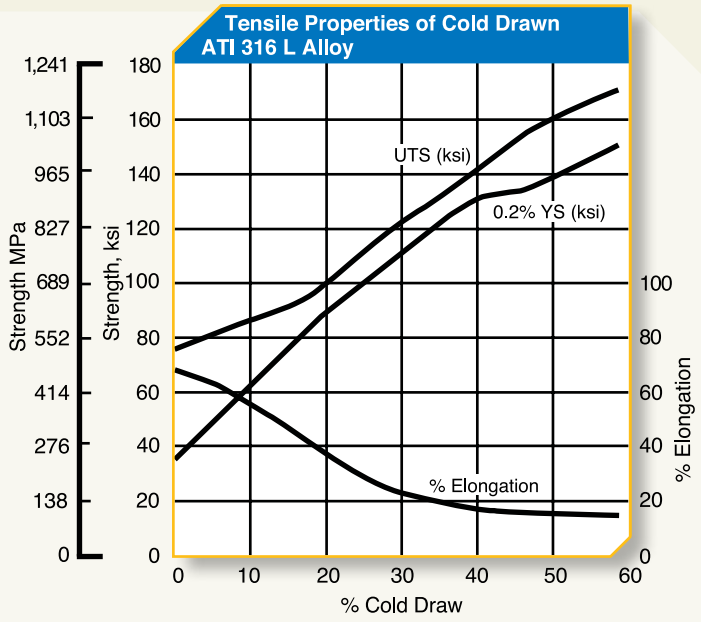
Chemical Composition

	C	N	S	P	SI	Mn	Ni	Cr	Mo	Fe
wt %, min.	-	-	0.00*	-	-	-	10.00	16.00	2.00	Bal.
wt %, max.	0.03	0.10	0.010	0.05	1.00	2.00	14.00	18.00	3.00	Bal.

* The S minimum value is generally controlled by the customer's specification.





Cleanliness per ASTM E-45, Method A for ATI VIM-VAR 316L Heats

	Type A* (Sulfide)		Type B (Alumina)		Type C (Silicate)		Type D (Oxide)	
Heat No.	**Thin**	**Heavy**	**Thin**	**Heavy**	**Thin**	**Heavy**	**Thin**	**Heavy**
AA69	0	0	0	0	0	0	0.87	0.25
AA70	0	0	0	0	0	0	0.5	0
PD96	0	0	0	0	0	0	0.5	0
AB46	0	0	0	0	0	0	0.5	0.05

* Type A inclusion levels are based on customer's required S levels.

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