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Data Sheet

1.4435/316L-SEMI F20-UHP

Quick Facts

This Alloy is a modified 316L version an austenitic stainless steel, a low carbon version of 316 and is melted as AOD + VAR, or VIM + VAR or ESR + VAR or EAF (+ VOD) + ESR + VAR. The low carbon helps to improve weldability as compared to the standard 316 as well as improved corrosion resistance! This version is called UHP (ultra-high purity). It can be used for manufacturing of components for general purpose and high purity chemical (gas or liquid) distribution systems in semiconductor manufacturing facilities.

Typical Applications

- General Clean Room Fittings
- Valves
- UHP pressure Sensors
- Metal UHP sealings
- Welding fittings

Stock Range

We stock a comprehensive range of Flat Bars and Round Bars.

Flat Bars with a thickness between 19mm – 45mm and various width, we are cutting to size.
Round Bars from OD 5mm up to 40mm.

We are offering as well:

General forgings
Blocks
Primarily manufactured in Europe,

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1.4435/316L-SEMI F20-UHP

relevant Specifications

- SEMI F20-706E-UHP-
- German Material no.: 1.4435
- EN 10277 class 3, surface
- EN 10308,
- ASTM A 276-Rev.2016, ASTM A 479/A, 479M Rev. 2016
- ASTM E112 Rev. 2013, ASTM E45 Rev. 2013, ASTM A262 practice E Rev. 2015

Material may also be supplied against Customer specifications, subject to enquiry!

Melting Practices

The VIM/VAR route as performed by other companies, is the most common melting process.

- The VIM technique stands for “Vacuum Induction Melting”
- With this method all alloying elements are put inside a sealed (vacuum) vessel and then being melted through energy in form of magnetic fields (eddy-current).
- So, the steel inside does not get into contact with air (oxygen) leading to a very good/high steel-cleanliness already.
- The VAR technique stands for: “Vacuum Arc Re-melting”
- After the initial melting and alloying of the steel, it is being re-melted inside another sealed (vacuum) vessel.
- The energy in this case comes from an electric arc.
- This additional refinement is applied to the steel in order to receive an Ultra High (Purity) level of the steel-cleanliness.

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Melting route, we are using is <u>EAF (+ VOD) + ESR + VAR</u>

- EAF + VOD stands for “Electric Arc Furnace” and Vacuum Oxygen Decarburization.
- In our manufacturers steel plant, the steel is initially being melted with an electric arc furnace under an open atmosphere.
- During this process the steel collecting a lot of carbon and the cleanliness is not good at all.
- In order to reduce the carbon content and to improve steel-cleanliness and also achieving the final chemical analysis, the steel is refined under vacuum in the VOD vessel.
- As a result, the steel-cleanliness is good for standard applications, but often not quite as good as the cleanliness of steel coming from the VIM-process
- ESR stands for “Electro Slag re-melting”
- To improve the steel cleanliness, it is being re-melted inside a vessel (open air or under protective gas).
- The energy comes from a melted slag. This slag slowly melts the steel again and the drops off liquid steel which travels through the slag while being refined.
- After that process the steel cleanliness is raised to a very high level.
- VAR (as above)
- To further improve the steel-cleanliness to the Ultra High (Purity) Level, the steel is refined further via the Vacuum Arc re-melting process.

As a result, our manufacturer has established a production route, that is capable of reaching UHP as required under SEMI F20-706E with the above described melting process.

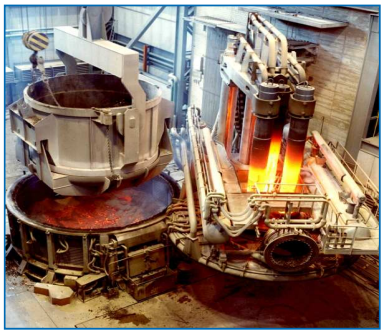
The pictures next page, showing the melting and re-melting process very clearly.

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Steelmelting: Electric arc furnace

purpose: melting down scrap, coarse adjustment of the analysis



top of furnace opened ; with scrap basket



furnace in operation

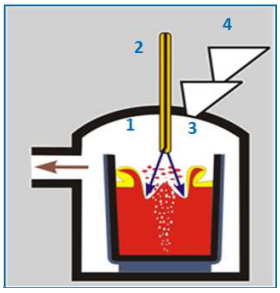
Steelmelting: VOD-Process (Vacuum Oxygen Decarburization)

purpose: decarburization, degassing, adding of alloy elements, refining

working principle:
- ladle is placed into the vessel and gasses are pumped off (vacuum)
- oxigen is blown on top of steel through a lance (tube): C + O2 -> CO2



VOD vessel with top opened
ladle is allready placed inside



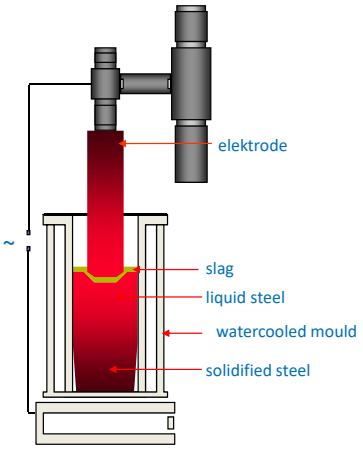
1: evacuated vessel
2:Oxigen lance
3: bubbles=protective gas Ar or N2
4: adding of alloy elements

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Steelmelting: remelting ESR (Electro Slag Remelting)

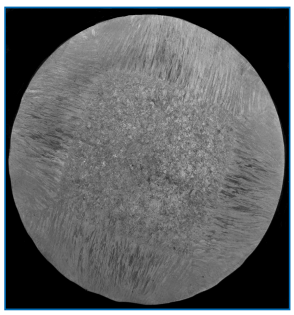
a liquid slag melts the steel electrode and the drops travel throught it downwards
impurities remain in the slag, the steel solidifies cleaned and with less segregation



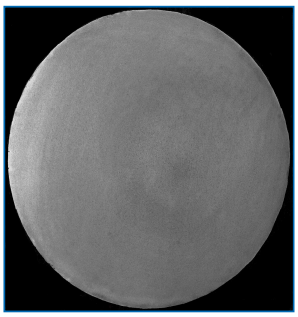


Steelmelting: remelting ESR (Electro Slag Remelting)

advantage of remelting:
not only improvement of steel cleanliness,
but also improvement of internal structure (finer, less segregation)



open melted, hot rolled (with low deformation ratio for clarification)



ESR remelted, hot rolled

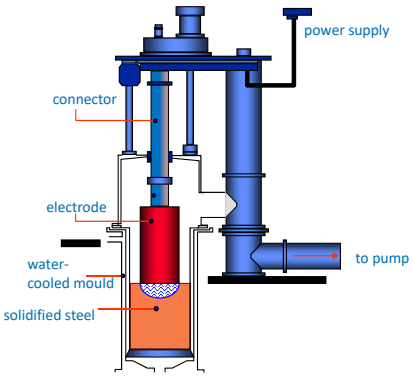
macro etching of slice: 1.4307, Ø 250 mm

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Steelmelting: remelting VAR (Vacuum Arc Remelting)

an electric arc melts the steel, by electromagnetic stiring the impurities travel towards the wall of the mould
they accumulate at the outside of the ingot and later can be removed by machining





ESR-re-melting – production facilities



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Chemical Analysis

This Alloy is a modified 316L version an austenitic stainless steel

	C	Si	Mn	P	S	Cr	Ni	Mo	Cb	Ti	Al	N	Cu	Nb	Se	Ca
Min	-	-	-	-	-	17.00	12.00	2.50	4.75	-	-	-	-	-	-	-
Max	0.03	1.00	2.00	0.03	0.01	18.00	-	3.00	5.5	0.02	0.01	0.10	0.30	0.05	0.02	0.02

Mechanical Properties

OD 5.00mm up to 12.70mm	h9 tolerance,
OD 12.70mm and above	k12 tolerance,
Straightness	2.00 mm/m
Surface depth	acc. to EN 10277, class 3
Grain Size	acc. to ASTM E112 ≤ 5
General standard	EN 10088-3, ASTM A 276

	Tensile Strength (MPA)	Yield Strength (0.2% offset), (MPA) min.	Elongation in 2" or 4D min%	Reduction of Area	Hardness, (mid radius)	Grain Size
Round Bars	675 - 875	> 260	>20	> 20	> 200 HB	≤ 5
Flat Bars	350 - 700	> 260	>20	> 20	> 200 HB	≤ 5

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Machinability

To be advised

Material Conditions, general

SEMI F20 defines the metallurgical cleanliness requirements and material composition of 316L stainless steel for use in manufacturing of components for general purpose, high purity, and ultra-high purity chemical (gas or liquid) distribution systems.
It defines the requirements for 316L stainless steel bar, forgings, and extruded shapes as specified in ASTM A 276, plate stock as specified in ASTM A 240, and tubing as specified in ASTM A 269 and ASTM A 632, for use in the manufacture of components used in general purpose and high purity chemical (gas or liquid) distribution systems in semiconductor manufacturing facilities.

Corrosion Resistance

1.4435/ 16L-SEMI F20-UHP has an excellent corrosion resistance. The low carbon content effectively reduces the susceptibility to intergranular corrosion. The presence of molybdenum enhances the resistance to oxidizing acids as well as to pitting corrosion.

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