

Ultra High Purity Process (FC-03)

- © This Specification is enacted for FITOK Ultra High Purity Products.
- © This Specification stipulates the requirements for raw material, machining, electropolishing, cleaning, welding, assembly, testing and packaging.

Process Requirements

- © Only high purity stainless steel materials could be utilized. The wetted internal surface contacted with media should be electro-polished.
- © Ultra High Purity cleaning in Federal Class 100 cleanroom, and welding, assembly, testing and packaging should be performed in Federal 10 cleanroom to prevent products from contamination.
- © Products are double packaged with polyethylene bags, with the outer packing bags labeled with process identification.

Raw Materials

- © AISI 316L (UNS S31603) SS is commonly used for High Purity (HP) and Ultra High Purity (UHP) Products, which has excellent corrosion resistance and oxidation resistance.
- © By Argon Oxygen Decarburization (AOD) or Vacuum Oxygen Decarburization (VOD), SS material could be refined. The detrimental chemicals including C, Mn, Si, P, S and etc. could be controlled at low level. Subsequently, Vacuum Arc Remelting (VAR) would be able to further purify the material and to give full play to its excellent characteristics.
- © Please refer to Table 1 below for the key compositions of the stainless steel material FITOK utilizes for our products for Ultra High Purity applications.

Table 1

Material	Composition, %		
	C	S	Mn
316L SS	≤0.03	≤0.012	≤2.0
316L SS VAR	≤0.03	≤0.010	≤1.5

- © Stainless Steel Material Standards:
 - © ASTM A479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
 - © SEMI F20, Specification for 316L SS Bar, Forgings, Extruded Shapes, Plate, and Tubing for Components Used in General Purpose, High Purity and Ultra-High Purity Semiconductor Manufacturing Applications
- © Material Inspection Standards:
 - © Intergranular Corrosion Test: ASTM A262, Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
 - © Chemical Composition Analysis: ASTM A751, Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
 - © Ultrasonic Test of Material Interior Defects: ASTM E214, Standard Practice for Immersed Ultrasonic Examination by the Reflection Method Using Pulsed Longitudinal Waves
 - © Materials Inclusion Content Analysis: ASTM E45, Standard Test Methods for Determining the Inclusion Content of Steel, with rating according to Plate III.

Machining

- © During the machining process, dimensions and surface finish of the products should be strictly controlled to ensure fine finish of each machined surface, smooth chamfer, flow pass and weld to eliminate any risk of defect and particles.
- © Surface Roughness:
 - © SEMI F19, Specification for the Surface Condition of the Wetted Surfaces of SS Components
 - © SEMI F37, Method for Determination of Surface Roughness Parameters for Gas Distribution System Components
- © Flow path surface roughness of FITOK Ultra High Purity Products could be controlled to less than Ra 5 μin. (0.13 μm).

Fittings

Valves

Regulators

Filters

Tubing

Integrated Systems

Other Products

Technical Information

Electropolishing

- ⊙ Internal surface of FITOK Ultra High Purity Products should be electropolished to improve the smoothness of flow path and corrosion resistance by forming chromium-rich layer on the metal surface. The electropolished products should be passivated to remove free iron ions.
- ⊙ Electropolishing and Passivation Standards:
 - ⊙ ASTM E1558, Standard Guide for Electrolytic Polishing of Metallographic Specimens
 - ⊙ ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
- ⊙ Please refer to Table 2 below for the specification of the electropolished FITOK products for Ultra High Purity applications.

Table 2

Parameter		Specification	Test Method
Oxide Thickness		$\geq 15\text{\AA}$	SEMI F72
Surface Defect Analysis	Over 5 Sample Areas, Maximum of Each Area	$\leq 40\text{pcs}$	SEMI F73
Chromium-to-Iron (Cr/Fe)		$\geq 1.5:1$	SEMI F60
Chromium Oxide-to-Iron Oxide (CrO/FeO)		$\geq 2:1$	
Surface Roughness (Ra)		$\leq \text{Ra } 0.13 \mu\text{m} (5 \mu\text{in.})$	SEMI F37

Cleaning and Inspection

- ⊙ Products should have fulfilled the requirements of FITOK Special Cleaning and Packaging Process (FC-02) before cleaning according to this Specification.
- ⊙ Carry out ultrasonic washing with DI water in the clean room.
- ⊙ After cleaning, dry the products by the closed oven in the clean room.
- ⊙ DI Water Standards:

Table 3 Parameters of DI Water

Characteristic	Capabilities
Resistivity	$\geq 18 \text{ M}\Omega \cdot \text{cm}$ @ 25 °C (77 °F)
TOC	$< 20 \text{ ppb}$
Silica	$< 5 \text{ ppb}$
Particles	$< 1 \text{ particle/milliliter}$ @ $\geq 0.1 \mu\text{m}$ size
Bacteria	$< 10 \text{ colonies/100 milliliter}$
Cl ⁻	$\leq 20 \text{ ppb}$
F ⁻	$\leq 20 \text{ ppb}$

Welding, Assembly and Testing

- ⊙ To prevent the cleaned products polluted by the particles and dusts in the air, the cleaned products shall be sent in the clean room directly to finish welding, assembly and testing.
- ⊙ The clean room is up to the requirement of ISO 14644-1 Class 4, which is equivalent to Federal Standard 209E Class 10.
- ⊙ High purity nitrogen or helium is used for the factory test of the products.

Packaging and Labeling

- ⊙ During storage and transportation, the products should be protected from damage and contamination as below:
 - ⊙ The functional ports of the product, such as: male threads, sealing surfaces, should be protected with clean protective films and proper caps.
 - ⊙ Finished products should be double packaged, the inner layer uses the plastic bag in polyethylene and free-dust for vacuum sealing, and the outer layer is sealed by polyethylene plastic bag.
 - ⊙ Finished products in the bags should be packed in the boxes for protection.
 - ⊙ Finished products' packaging markings and traceable information should be clear and visible before removing the packing.

References

ASTM Standards

ASTM A262, Standard Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
 ASTM A276, Standard Specification for Stainless Steel Bars and Shapes
 ASTM A380, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems
 ASTM A479, Standard Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels
 ASTM A484, Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
 ASTM A751, Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
 ASTM E45, Standard Test Methods for Determining the Inclusion Content of Steel
 ASTM E214, Standard Practice for Immersed Ultrasonic Examination by the Reflection Method Using Pulsed Longitudinal Waves
 ASTM E1558, Standard Guide for Electrolytic Polishing of Metallographic Specimens
 ASTM F1397, Standard Test Method for Determination of Moisture Contribution by Gas Distribution System Components

SEMI Standards

SEMI F19, Specification for the Surface Condition of the Wetted Surfaces of Stainless Steel Components
 SEMI F20, Specification for 316L Stainless Steel Bar, Forgings, Extruded Shapes, Plate, and Tubing for Components Used in General Purpose, High Purity and Ultra-High Purity Semiconductor Manufacturing Applications
 SEMI F37, Method for Determination of Surface Roughness Parameters for Gas Distribution System Components
 SEMI E49.6, Guide for Subsystem Assembly and Testing Procedures—Stainless Steel Systems
 SEMI F60, Test Method for ESCA Evaluation of Surface Composition of Wetted Surfaces of Passivated 316L Stainless Steel Components
 SEMI F72, Test Method for Auger Electron Spectroscopy (AES) Evaluation of Oxide Layer of Wetted Surfaces of Passivated 316L Stainless Steel Components
 SEMI F73, Test Method for Scanning Electron Microscopy (SEM) Evaluation of Wetted Surface Condition of Stainless Steel Components

ISO Standard

ISO 14644-1, Cleanrooms and Associated Controlled Environments

Fittings

Valves

Regulators

Filters

Tubing

Integrated
Systems

Other
Products

Technical
Information

FKG-17-TI-0001-EN

FITOK