

SEMI F16-94 (Withdrawn 0304) SPECIFICATION FOR 316L STAINLESS STEEL TUBING WHICH IS TO BE FINISHED AND ELECTROPOLISHED FOR HIGH PURITY SEMICONDUCTOR MANUFACTURING APPLICATIONS

NOTICE: This document was balloted and approved for withdrawal in 2004.

1 Purpose

The purpose of this specification is to identify the applicable ASTM tubing specification requirements and to define the special material composition, wall thickness, ordering, and quality assurance requirements for 316L stainless steel tubing which is to be finished into electropolished tubing, component tube stubs, and fittings made from tubing for use in high purity semiconductor manufacturing facility applications.

2 Scope

This specification defines the special criteria for procuring nominal sizes of unfinished 316L stainless steel tubing which is to be finished into tubing, component tube stubs, and fittings made from tubing for use in high purity chemical (gas or liquid) distribution systems in semiconductor manufacturing facilities.

3 Referenced Documents

The referenced documents are to be their current editions as published by their sponsors.

3.1 *ASTM Standards*¹

A 262 — Practices for Determining Susceptibility to Intergranular Attack in Austenitic Stainless Steels

A 269 — Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service

A 270 — Seamless and Welded Austenitic Stainless Steel Sanitary Tubing

A 450/A 450M — Specification for General Requirements for Carbon, Ferritic Alloy, and Austenitic Alloy Steel Tubes

A 632 — Specification for Seamless and Welded Austenitic Stainless Steel Tubing (Small Diameter) for General Service

E 112 — Methods for Determining Average Grain Size

3.2 *Military Standards*²

3.3 MIL-STD-105 — Sampling Procedures and Tables for Inspection by Attributes

3.4 *ANSI/ASME Standards*³

B31.1 — Power Piping

B31.3 — Chemical Plant and Petroleum Refinery Piping

Boiler and Pressure Vessel Code — Section III NCA, The Rules for Construction of Nuclear Power Plant Components

4 General Requirements

Tubing furnished under this specification shall conform to the requirements of ASTM A 450 and A 269 for nominal sizes 1/2 inch diameter and larger and to the requirements of ASTM A 450 and A 632 for nominal sizes smaller than 1/2 inch diameter, and to the additional requirements herein.

5 Ordering Information

5.1 Orders for material under this specification shall include the following, as required to describe the material adequately:

- Quantity (meters, feet, or number of lengths)
- Grade per Table 1 of ASTM A 269
- Size (nominal outside diameter and nominal wall thickness)
- This specification number
- Surface condition (if applicable)
- Special requirements and any supplementary requirements selected

6 Process

The steel shall be processed in accordance with the section on Process of ASTM A 269.

2 Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120

3 American National Standards Institute, 1430 Broadway, New York, NY 10018

1 American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959

7 Manufacture

7.1 Tubing shall be made by the seamless process for all sizes, except that welded tubing may be acceptable for nominal sizes 3 inches and above in diameter if the permissible variations in outside diameter are in accordance with Table 2 of ASTM A 270 and the other criteria specified herein are met.

7.2 Tubing must be cold finished.

8 Heat Treatment

8.1 All tubing shall be furnished in the heat treated condition in accordance with the section on Heat Treatment in ASTM A 269. If grain size is restricted by the supplementary requirement specified in Section 17.2 of this specification, the minimum annealing temperature shall not apply, provided that the tubing passes the intergranular corrosion test of Section 13 of this specification.

8.2 All tubing shall be vacuum annealed, or bright annealed in an undiluted hydrogen atmosphere, followed by rapid cooling. The adequacy of the cooling rate shall be confirmed by the intergranular corrosion test of Section 13 of this specification.

9 Surface Condition

The surface condition of tubing shall be in accordance with the requirements of the section on Finish of ASTM A 270.

10 Cleanliness

10.1 Tubing shall be supplied in accordance with the supplementary requirement for Cleanliness of ASTM A 632.

10.2 Tubing surface shall be sealed with polyethylene caps after being purged with nitrogen or a suitable inert gas. Capped tubing shall be heat sealed in a single 0.15 mm (6 mil) polyethylene bag.

11 Chemical Composition

11.1 Chemical composition of the steel shall conform to the requirements of the section on Chemical Composition in ASTM A 269 for nominal sizes 1/2 inch diameter and larger and to the section on Chemical Composition in ASTM A 632 for nominal sizes smaller than 1/2 inch diameter.

11.2 Sulfur content shall be from 0.003% to 0.010% for all nominal sizes.

12 Mechanical Properties

12.1 Tubing shall conform to the applicable requirements of ASTM A 450/A 450M unless otherwise provided herein.

12.2 Hardness of all sizes shall conform to the section on Hardness Requirements of ASTM A 269.

12.3 Tensile properties of all sizes shall conform to the section on Mechanical Properties of ASTM A 632.

13 Metallurgical Requirements

Tubing shall pass an intergranular corrosion test conducted in accordance with the supplementary requirement for Intergranular Corrosion Test of ASTM A 262. A minimum of two samples per lot shall be tested.

14 Nondestructive Testing Requirement

14.1 Eddy current testing shall be performed in accordance with the procedure and evaluation outlined in the section on Nondestructive Electric Test of ASTM A 450/A 450M except that the calibration reference notches shall not exceed 10% of the specified wall thickness of the tubing or 0.075 mm (0.003 inches), whichever is greater. If the form of product supplied makes this test technically infeasible, alternative non-destructive testing methods shall be agreed upon by the purchaser and supplier.

14.2 At the option of the purchaser, hydrostatic testing shall be conducted and evaluated in accordance with the requirements of the section on Hydrostatic Test of ASTM A 450A/450M.

15 Permissible Variations in Dimensions

15.1 Sampling for dimensional variations shall be performed in accordance with MIL-STD-105 with double normal sampling and a 2 1/2% Acceptable Quality Level (AQL).

15.2 The permissible variations in dimensions shall be as outlined in Table 2 of ASTM A 270 for all sizes.

15.3 Nominal wall thickness for tubing to be finished as shown in Table 1. The finished thicknesses must also comply with ANSI/ASME B31.1 and B31.3 specifications for the intended service temperature and pressure. A tolerance of $\pm 10\%$ shall apply to the wall thicknesses specified.

Table 1 Nominal Wall Thickness for Various Tube Nominal Sizes

Nominal O.D.	Tube Wall Thickness
1/4", 3/8"	1.02 mm (0.040")