

SEMI F20-0997

SPECIFICATION FOR 316L STAINLESS STEEL BAR, EXTRUDED SHAPES, PLATE, AND INVESTMENT CASTINGS FOR COMPONENTS USED IN HIGH PURITY SEMICONDUCTOR MANUFACTURING APPLICATIONS

This Standard was technically approved by the Gases Global Technical Committee. Available at www.semi.org in September 1997; originally published in 1995.

1 Purpose

1.1 The purpose of this Specification is to define the restricted melting processes and material composition of 316L stainless steel required for use in the manufacture of components for high-purity chemical (gas or liquid) distribution systems.

2 Scope

2.1 This Specification defines the requirements for 316L stainless steel bar, forgings, and extruded shapes as specified in ASTM A276, plate stock as specified in ASTM A240, and investment castings as specified in ASTM A743/A743M, except as defined herein, for use in the manufacture of components used in high-purity chemical (gas or liquid) distribution systems in semiconductor manufacturing facilities.

NOTICE: SEMI Standards and Safety Guidelines do not purport to address all safety issues associated with their use. It is the responsibility of the users of the Documents to establish appropriate safety and health practices, and determine the applicability of regulatory or other limitations prior to use.

3 Referenced Standards and Documents

3.1 *ASTM Standards*¹

ASTM A182/A182M — Specification for Forged or Rolled Alloy-Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High Temperature Service

ASTM A240/A240M — Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels

ASTM A262 — Practices for Determining Susceptibility to Intergranular Attack in Austenitic Stainless Steels

ASTM A276 — Specification for Stainless and Heat-Resisting Steel Bars and Shapes

ASTM A479/A479M — Specification for Stainless and Heat-Resisting Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels

ASTM A480/A480M — Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip

ASTM A484/A484M — Specification for General Requirements for Stainless and Heat-Resisting Wrought Steel Products (Except Wire)

ASTM A743/A743M — Specification for Castings, Iron – Chromium, Iron – Chromium – Nickel, Corrosion Resistant, for General Application

ASTM A751 — Test Methods, Practices and Terminology for Chemical Analysis of Steel Products

ASTM E45 — Recommended Practice for Determining the Inclusion Content of Steel

ASTM E112 — Test Methods for Determining Average Grain Size

NOTICE: Unless otherwise indicated, all documents cited shall be the latest published versions.

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4 Ordering Information

4.1 Orders for bar, forgings, extruded shapes, plate, or investment castings under this Specification shall include:

- 4.1.1 Quantity (kilograms, pounds, meters, inches, or feet),
- 4.1.2 Cross section description (round, square, hex, etc. or detailed drawing),
- 4.1.3 Size (nominal diameter or shape dimensions for other than those identified with an extrusion drawing),
- 4.1.4 Length (specific or random),
- 4.1.5 This Specification number.

5 General Requirements

5.1 Bar stock, forgings, extruded shapes, or plate furnished under this Specification shall conform to the requirements of ASTM A182/A182M, ASTM A276, ASTM A479/A479M, ASTM A484/A484M, and the additional requirements herein.

5.2 Plate stock furnished under this Specification shall conform to the requirements of ASTM A240, A480/A480M, and the additional requirements herein.

5.3 Investment castings furnished under this Specification shall conform to the requirements of ASTM A743/A743M except yield/ultimate strengths shall be at least 80% of their respective minimum values.

6 Manufacture

6.1 The steel billet material used for processing shall be manufactured by such primary melting processes as Argon Oxygen Decarburization (AOD), Vacuum Oxygen Decarburization (VOD), or Vacuum Induction Melting (VIM), and such remelt processes as Vacuum Arc Remelt (VAR) or ElectroSlag Remelt (ESR), to conform with the purity requirements specified herein.

6.2 Processed bars shall be furnished annealed and cold-finished, and extruded shapes shall be furnished hot-finished, descaled, and stretch-straightened ('Condition A' in the section on Manufacture in ASTM A276, except elongation may be a minimum of 20% for 'lightly cold worked T316L').

6.3 The annealing temperature used to achieve the grain size requirement of ¶ 8.1 shall be 982°C (1800°F) minimum.

6.4 The steel billet material used for investment casting shall be manufactured by the Vacuum Induction Melting (VIM) plus Vacuum Arc Remelt (VAR) route per ¶¶ 6.1 and 6.2, and remelted and cast using VIM. Castings shall be furnished in the solution treated and Hot Isostatic Pressed (HIP) condition.

7 Chemical Composition

7.1 *Material Type* — Material shall be type 316L stainless steel, as specified in Table 1 of ASTM A182/A182M, ASTM A240, ASTM A276, ASTM A479/A479M, or ASTM A743/A743M except where otherwise specified herein.

7.2 *Composition Tolerance* — No deviations in material composition from the minimum or maximum values specified in the appropriate ASTM document or herein shall be allowed without approval by the purchaser.

7.3 *Sulfur Content* — Sulfur content shall range from 0.001 to 0.004 percent.

7.4 *Product Analysis* — A heat analysis shall be made in accordance with ASTM A751. The result of the heat analysis shall be reported to the purchaser. In addition to the elements listed in Table 1 of ASTM A276, the concentrations of the following elements shall be reported and are specified as:

- 7.4.1 *Aluminum* — 0.02 max.
- 7.4.2 *Calcium* — 0.02 max.
- 7.4.3 *Copper* — 0.25 max.
- 7.4.4 *Niobium* — 0.05 max.
- 7.4.5 *Selenium* — 0.02 max.
- 7.4.6 *Titanium* — 0.02 max.