



Designation: F3184 – 16 (Reapproved 2023)

Standard Specification for Additive Manufacturing Stainless Steel Alloy (UNS S31603) with Powder Bed Fusion¹

This standard is issued under the fixed designation F3184; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers additive manufacturing of UNS S31603 components by means of laser and electron beam-based full melt powder bed fusion processes. The components produced by these processes are used typically in applications that require mechanical properties similar to machined forgings and wrought products. Components manufactured to this specification are often, but not necessarily, post processed via machining, grinding, electrical discharge machining (EDM), polishing, and so forth to achieve desired surface finish and critical dimensions.

1.2 This specification is intended for the use of purchasers or producers, or both, of additively manufactured UNS S31603 components for defining the requirements and ensuring component properties.

1.3 Users are advised to use this specification as a basis for obtaining components that will meet the minimum acceptance requirements established and revised by consensus of the members of the committee.

1.4 User requirements considered more stringent may be met by the addition to the purchase order of one or more supplementary requirements, which may include, but are not limited to, those listed in Supplementary Requirements S1–S16.

1.5 The compositional requirements specified in this specification do not meet the compositional requirements for surgical implant grade UNS S31673.

1.6 The values stated in SI units are to be regarded as the standard. Other units are included only for informational purposes.

1.7 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appro-*

priate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:²

- [A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels](#)
- [A276/A276M Specification for Stainless Steel Bars and Shapes](#)
- [A479/A479M Specification for Stainless Steel Bars and Shapes for Use in Boilers and Other Pressure Vessels](#)
- [A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, Shapes, and Forgings](#)
- [A751 Test Methods and Practices for Chemical Analysis of Steel Products](#)
- [A1080 Practice for Hot Isostatic Pressing of Steel, Stainless Steel, and Related Alloy Castings](#)
- [B213 Test Methods for Flow Rate of Metal Powders Using the Hall Flowmeter Funnel](#)
- [B214 Test Method for Sieve Analysis of Metal Powders](#)
- [B243 Terminology of Powder Metallurgy](#)
- [B311 Test Method for Density of Powder Metallurgy \(PM\) Materials Containing Less Than Two Percent Porosity](#)
- [B769 Test Method for Shear Testing of Aluminum Alloys](#)
- [B855 Test Method for Volumetric Flow Rate of Metal Powders Using the Arnold Meter and Hall Flowmeter Funnel](#)
- [B964 Test Methods for Flow Rate of Metal Powders Using the Carney Funnel](#)
- [D3951 Practice for Commercial Packaging](#)
- [E3 Guide for Preparation of Metallographic Specimens](#)

¹ This specification is under the jurisdiction of ASTM Committee F42 on Additive Manufacturing Technologies and is the direct responsibility of Subcommittee F42.05 on Materials and Processes.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

E8/E8M Test Methods for Tension Testing of Metallic Materials

E9 Test Methods of Compression Testing of Metallic Materials at Room Temperature

E10 Test Method for Brinell Hardness of Metallic Materials

E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves

E18 Test Methods for Rockwell Hardness of Metallic Materials

E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials

E23 Test Methods for Notched Bar Impact Testing of Metallic Materials

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E238 Test Method for Pin-Type Bearing Test of Metallic Materials

E353 Test Methods for Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

E384 Test Method for Microindentation Hardness of Materials

E399 Test Method for Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials

E407 Practice for Microetching Metals and Alloys

E466 Practice for Conducting Force Controlled Constant Amplitude Axial Fatigue Tests of Metallic Materials

E606 Test Method for Strain-Controlled Fatigue Testing

E647 Test Method for Measurement of Fatigue Crack Growth Rates

E1019 Test Methods for Determination of Carbon, Sulfur, Nitrogen, and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Inert Gas Fusion Techniques

E1086 Test Method for Analysis of Austenitic Stainless Steel by Spark Atomic Emission Spectrometry

E1417 Practice for Liquid Penetrant Testing

E1450 Test Method for Tension Testing of Structural Alloys in Liquid Helium

E1479 Practice for Describing and Specifying Inductively Coupled Plasma Atomic Emission Spectrometers

E1742 Practice for Radiographic Examination

E1820 Test Method for Measurement of Fracture Toughness

E2368 Practice for Strain Controlled Thermomechanical Fatigue Testing

F2924 Specification for Additive Manufacturing Titanium-6 Aluminum-4 Vanadium with Powder Bed Fusion

F2971 Practice for Reporting Data for Test Specimens Prepared by Additive Manufacturing

F3049 Guide for Characterizing Properties of Metal Powders Used for Additive Manufacturing Processes

F3122 Guide for Evaluating Mechanical Properties of Metal Materials Made via Additive Manufacturing Processes

2.2 *ISO/ASTM Standards:*²

52900 Standard Terminology for Additive Manufacturing—General Principles—Terminology

52915 Specification for Additive Manufacturing File Format (AMF) Version 1.1

52921 Terminology for Additive Manufacturing—Coordinate Systems and Test Methodologies

2.3 *ASQ Standard:*³

ASQ C1 Specification of General Requirements for a Quality Program

2.4 *ISO Standards:*⁴

ISO 148-1 Metallic materials—Charpy pendulum impact test—Part 1: Test method

ISO 1099 Metallic materials—Fatigue testing—Axial force-controlled method

ISO 4545 Metallic materials—Knoop hardness test—Part 2: Verification and calibration of testing machines

ISO 6506-1 Metallic materials—Brinell hardness test—Part 1: Test method

ISO 6507-1 Metallic materials—Vickers hardness test—Part 1: Test method

ISO 6508 Metallic materials—Rockwell hardness test—Part 1: Test method (scales A, B, C, D, E, F, G, H, K, N, T)

ISO 6892-1 Metallic materials—Tensile testing at ambient temperature

ISO 6892-2 Metallic materials—Tensile testing—Part 2: Method of test at elevated temperature

ISO 9001 Quality management system—Requirements

ISO 9044 Industrial woven wire cloth—Technical requirements and testing

ISO 12108 Metallic materials—Fatigue testing—Fatigue crack growth method

ISO 12111 Metallic materials—Fatigue testing—Strain-controlled thermomechanical fatigue testing method

ISO 12135 Metallic materials—Unified method of test for the determination of quasistatic fracture toughness

ISO 12737 Metallic materials—Determination of plane-strain fracture toughness (withdrawn)

ISO 13485 Medical devices—Quality management systems—Requirements for regulatory purposes

ISO 19819 Metallic materials—Tensile testing in liquid helium

2.5 *SAE Standards:*⁵

AMS 2248 Chemical Check Analysis Limits, Corrosion and Heat-Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys

AMS 2759 Heat Treatment of Steel Parts General Requirements

AS 9100 Quality Systems—Aerospace—Model for Quality Assurance in Design, Development, Production, Installation and Servicing

2.6 *ASME Standard:*⁶

ASME B46.1 Surface Texture

³ Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, <http://www.asq.org>.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁵ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096, <http://www.sae.org>.

⁶ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Two Park Ave., New York, NY 10016-5990, <http://www.asme.org>.