



Designation: F1314/F1314M – 13a

# Standard Specification for Wrought Nitrogen Strengthened 22 Chromium–13 Nickel–5 Manganese–2.5 Molybdenum Stainless Steel Alloy Bar and Wire for Surgical Implants (UNS S20910)<sup>1</sup>

This standard is issued under the fixed designation F1314/F1314M; 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 the chemical, mechanical, and metallurgical requirements for wrought nitrogen strengthened 22 chromium – 13 nickel – 5 manganese – 2.5 molybdenum stainless steel alloy bar and wire for surgical implants.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>2</sup>

- A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
- A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
- A555/A555M Specification for General Requirements for Stainless Steel Wire and Wire Rods
- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- E8/E8M Test Methods for Tension Testing of Metallic Materials
- E10 Test Method for Brinell Hardness of Metallic Materials
- E18 Test Methods for Rockwell Hardness of Metallic Materials
- E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E45 Test Methods for Determining the Inclusion Content of Steel

- E112 Test Methods for Determining Average Grain Size
- E354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys
- E407 Practice for Microetching Metals and Alloys
- F138 Specification for Wrought 18Chromium-14Nickel-2.5Molybdenum Stainless Steel Bar and Wire for Surgical Implants (UNS S31673)
- F746 Test Method for Pitting or Crevice Corrosion of Metallic Surgical Implant Materials
- IEEE/ASTM SI 10 American National Standard for Metric Practice
- 2.2 *Aerospace Materials Specification*:<sup>3</sup>
- AMS 2248 Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
- AMS 2630 Inspection, Ultrasonic Product Over 0.5 inch (12.7 mm) Thick
- AMS 2632 Ultrasonic Inspection of Thin Materials
- 2.3 *ISO Standards*:<sup>4</sup>
- ISO 6892 Metallic Materials Tensile Testing at Ambient Temperature
- ISO 9001 Quality Management Systems—Requirements

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

- 3.1.1 *bar, n*—round bars and flats from 0.1875 in. [4.75 mm] to 4.00 in. [101.60 mm] in diameter or thickness (other sizes and shapes by special order).
- 3.1.2 *forging bar, n*—as described in 3.1.2 used for production of forgings, may be furnished in the hot rolled condition.
- 3.1.3 *lot, n*—the total number mill products produced under the same melt heat under the same conditions at essentially the same time.
- 3.1.4 *wire, n*—rounds less than 0.1875 in. [4.75 mm] in diameter.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.12 on Metallurgical Materials.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

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

\*A Summary of Changes section appears at the end of this standard

## 4. Ordering Information

4.1 Inquiries and orders for material under this specification shall include the following information:

- 4.1.1 Quantity;
- 4.1.2 ASTM designation and date of issue;
- 4.1.3 Mechanical properties (if applicable for special conditions);
- 4.1.4 Form (bar or wire);
- 4.1.5 Applicable dimensions including size, thickness, width, and length (exact, random, or multiples) or drawing number;
- 4.1.6 Tolerances—unless otherwise specified by purchaser, tolerances must meet the requirements of Specification **A484/A484M**, **A555/A555M**, or both, as applicable;
- 4.1.7 Condition (see **5.1**);
- 4.1.8 Finish (see **5.2**);
- 4.1.9 Special tests (if any); and
- 4.1.10 Other requirements.

## 5. Materials and Manufacture

5.1 *Condition*—Bar and wire shall be furnished in the hot-worked, annealed, or cold-worked condition, as specified.

5.2 *Finish*—Bar and wire shall be furnished bright annealed, cold drawn, pickled, ground, or ground and polished, as specified by the purchaser.

## 6. Chemical Requirements

6.1 The supplier's heat analysis shall conform to the chemical requirements prescribed in **Table 1**. The supplier shall not ship material with chemistry outside the requirements specified in **Table 1**.

6.1.1 Requirements for the major and minor elemental constituents are listed in **Table 1**. Also listed are important residual elements. Analysis for elements not listed in **Table 1** is not required to verify compliance with this specification.

6.1.2 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods **A751**.

6.2 *Product Analysis*—The product analysis is either for the purpose of verifying the composition of a heat or manufacturing lot or to determine variations in the composition within the heat.

**TABLE 1 Chemical Composition**

| Element    | Composition, %<br>(Mass/Mass) |
|------------|-------------------------------|
| Carbon     | 0.030 max                     |
| Manganese  | 4.00 to 6.00                  |
| Phosphorus | 0.025 max                     |
| Sulfur     | 0.010 max                     |
| Silicon    | 0.75 max                      |
| Chromium   | 20.50 to 23.50                |
| Nickel     | 11.50 to 13.50                |
| Molybdenum | 2.00 to 3.00                  |
| Nitrogen   | 0.20 to 0.40                  |
| Niobium    | 0.10 to 0.30                  |
| Vanadium   | 0.10 to 0.30                  |
| Copper     | 0.50 max                      |
| Iron       | balance <sup>A</sup>          |

<sup>A</sup> Approximately equal to the difference of 100 % and the sum percentage of the other specified elements. Reporting of the iron difference is not required.

6.2.1 Acceptance or rejection of a heat or lot of material may be made by the purchaser on the basis of this product analysis.

6.2.2 Product analysis tolerances do not broaden the specified heat analysis requirements but cover variations between laboratories in the measurement of chemical content. Product analysis limits shall be as specified in **Table 2**.

6.2.3 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods **E354**.

## 7. Metallurgical Requirements

7.1 The material shall contain no delta ferrite, chi, or sigma phases when it is examined metallographically at 100× magnification in accordance with Practice **E407**.

7.2 The microcleanliness of the material, as determined by Practice **E45**, Method A, except using Plate Ir, on representative billet or bar samples from the heat shall not exceed the following:

| Inclusion Type | A<br>(Sulfide) | B<br>(Alumina) | C<br>(Silicate) | D (Globular Oxide) |
|----------------|----------------|----------------|-----------------|--------------------|
| Thin           | 1.5            | 2.5            | 2.5             | 2.5                |
| Heavy          | 1.5            | 1.5            | 1.5             | 1.5                |

## 8. Mechanical Requirements

### 8.1 Tensile Properties:

8.1.1 Tensile properties shall be determined in accordance with Test Methods **E8/E8M**.

8.1.2 The mechanical properties of test specimens shall conform to the requirements specified in **Table 3**.

### 8.2 Hardness:

8.2.1 Hardness values shall be determined in accordance with Test Method **E10** or Test Methods **E18**.

8.2.2 When desired, hardness limits may be specified by the purchaser. Hardness determinations shall be made on a product cross section, midway between the center and surface, if the cross section is adequate.

**TABLE 2 Product Analysis Tolerances<sup>A</sup>**

| Element                | Permissible Variation<br>Under the<br>Minimum Limit or Over<br>the Maximum Limit,<br>% (Mass/Mass) <sup>B</sup> |
|------------------------|-----------------------------------------------------------------------------------------------------------------|
| Carbon                 | 0.005                                                                                                           |
| Manganese <sup>C</sup> | 0.05                                                                                                            |
| Phosphorus             | 0.005                                                                                                           |
| Sulfur                 | 0.005                                                                                                           |
| Silicon                | 0.05                                                                                                            |
| Chromium               | 0.25                                                                                                            |
| Nickel                 | 0.15                                                                                                            |
| Molybdenum             | 0.10                                                                                                            |
| Nitrogen <sup>C</sup>  | 0.02 under min;<br>0.04 over max                                                                                |
| Niobium                | 0.05                                                                                                            |
| Vanadium               | 0.03                                                                                                            |
| Copper                 | 0.03                                                                                                            |

<sup>A</sup>Refer to AMS 2248 for chemical check analysis limits (except nitrogen).

<sup>B</sup>For elements in which only a maximum percentage is indicated, the "under minimum limit" is not applicable.

<sup>C</sup>The specified range for this element is not covered by AMS 2248 and permissible variation has been established through industrial practice.