



Designation: F 1314 – 01

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)¹

This standard is issued under the fixed designation F 1314; 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 inch-pound units are to be regarded as the standard. The SI equivalents of the inch-pound units may be approximate.

2. Referenced Documents

2.1 ASTM Standards:

- A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels²
- A 484 Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings³
- A 555 Specification for General Requirements for Stainless Steel Wire and Wire Rods²
- A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products²
- E 8 Test Methods for Tension Testing of Metallic Materials⁴
- E 10 Test Methods for Brinell Hardness of Metallic Materials⁴
- E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials⁴
- E 45 Test Method for Determining the Inclusion Content of Steel⁴
- E 112 Test Methods for Determining Average Grain Size⁴
- E 354 Test Methods for Chemical Analysis of High Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys⁵

F 138 Specification for Wrought 18 Chromium – 14 Nickel – 2.5 Molybdenum Stainless Steel Bar and Wire for Surgical Implants (UNS 31673)⁶

F 746 Test Method for Pitting and Crevice Corrosion of Metallic Surgical Implant Materials⁶

2.2 Aerospace Materials Specification:

AMS 2248 Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys⁷

2.3 ASQC Standard:

ASQ C1 Specification of General Requirements for a Quality Program⁸

2.4 ISO Standard:

ISO 6892 Metallic Materials Tensile Testing at Ambient Temperature⁹

3. General Requirements for Delivery

3.1 In addition to the requirements of this specification, all requirements of the current editions of Specifications A 484 and A 555 shall apply.

3.2 In cases in which a conflict exists between this specification and the standards listed in Section 2, this specification shall take precedence.

4. Ordering Information

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

- 4.1.1 Quality,
- 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),

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² *Annual Book of ASTM Standards*, Vol 01.03.

³ *Annual Book of ASTM Standards*, Vol 01.05.

⁴ *Annual Book of ASTM Standards*, Vol 03.01.

⁵ *Annual Book of ASTM Standards*, Vol 03.05.

⁶ *Annual Book of ASTM Standards*, Vol 13.01.

⁷ Available from the American Society of Automotive Engineers, 400 Commonwealth Dr., Warrendale, PA 15096-0001.

⁸ Available from the American Society for Quality, 600 N. Plankinton Ave., Milwaukee, WI 53203.

⁹ Available from American National Standards Institute, 25 W. 43rd St., 4th Floor, New York, NY 10036.

4.1.5 Applicable dimensions including size, thickness, width, and length (exact, random, or multiples) or drawing number,

- 4.1.6 Condition (see 5.1),
- 4.1.7 Finish (see 5.2),
- 4.1.8 Special tests (if applicable), and
- 4.1.9 Other requirements.

5. Materials and Manufacture

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

5.2 *Finish*—Types of bar and wire finishes available are cold-drawn, pickled, ground, ground and polished, or 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 that is outside the limits 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, Practices, and Terminology A 751.

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

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.

7. Metallurgical Requirements

7.1 The material shall exhibit no delta ferrite when it is examined metallographically at 100× magnification.

TABLE 2 Product Analysis Tolerances^{A,B}

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

^ASee Test Methods E 354.

^BRefer to AMS 2248 for chemical check analysis limits (except nitrogen).

^CFor elements in which only a maximum percentage is indicated, the "under minimum limit" is not applicable.

^DThe specified range for this element is not covered by AMS 2248 and permissible variation has been established through industrial practice.

7.2 The microcleanliness of the material, as determined by Practice E 45, Method A, except using Plate Ir, on representative billet or bar samples from the heat shall not exceed the following:

Inclusion Type	A (Sulfide)	B (Alumina)	C (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 E 8.

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

8.2 Hardness:

8.2.1 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 cross section is adequate.

8.2.2 Hardness values shall be determined in accordance with Test Method E 10 or Test Methods E 18.

9. Special Tests

9.1 Material conforming to this specification shall be capable of passing the intergranular corrosion susceptibility test in accordance with Practice E of Practices A 262. The test shall be performed on a sample sensitized at 1250°F for 1 h.

9.2 Material conforming to this specification shall have a homogeneous microstructure with an average grain size of ASTM No. 5 or finer when measured in accordance with Test Method E 112.

9.2.1 It is preferred that samples for grain size determination be selected after the hot working operation or after the final annealing operation prior to the final cold working operation.

9.2.2 If grain size samples are selected after a final cold working, specimens shall be tested according to Test Method E 112 or as agreed upon between supplier and purchaser.

TABLE 1 Chemical Composition

Element	Composition, % (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 ^A

^AApproximately equal to the difference of 100 % and the sum percentage of the other specified elements. The percentage of iron difference is not required to be reported.