



Designation: ~~A555/A555M—21~~ A555/A555M – 22

## Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods<sup>1</sup>

This standard is issued under the fixed designation A555/A555M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

### 1. Scope\*

1.1 This specification covers general requirements that shall apply to stainless wire and wire rods. Wire rods are a semifinished product intended primarily for the manufacture of wire. Wire is intended primarily for cold forming, including coiling, stranding, weaving, heading and machining as covered under the latest revision of each of the following ASTM specifications: **A313/A313M**, **A368**, **A478**, **A492**, **A493**, **A580/A580M**, and **A581/A581M**.

1.2 In case of conflicting requirements, the individual material specification and this general requirement specification shall prevail in the order named.

1.3 General requirements for flat products other than wire are covered in Specification **A480/A480M**.

1.4 General requirements for bar and billet products are covered in Specification **A484/A484M**.

1.5 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

1.6 Unless the order specifies the applicable metric specification designation, the material shall be furnished in the inch-pound units.

1.7 *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:<sup>2</sup>

**A262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels**

**A313/A313M Specification for Stainless Steel Spring Wire**

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.17 on Flat-Rolled and Wrought Stainless Steel.

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<sup>2</sup> 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.

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



- A368 Specification for Stainless Steel Wire Strand
- A370 Test Methods and Definitions for Mechanical Testing of Steel Products
- A478 Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
- A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
- A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
- A492 Specification for Stainless Steel Rope Wire
- A493 Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
- A580/A580M Specification for Stainless Steel Wire
- A581/A581M Specification for Free-Machining Stainless Steel Wire and Wire Rods
- A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A751 Test Methods and Practices for Chemical Analysis of Steel Products
- A941 Terminology Relating to Steel, Stainless Steel, Related Alloys, and Ferroalloys
- E112 Test Methods for Determining Average Grain Size
- 2.2 *Federal Standard*:<sup>3</sup>
- Fed. Std. No. 123 Marking for Shipment (Civil Agencies)
- 2.3 *Military Standards*:<sup>3</sup>
- MIL-STD-129 Marking for Shipment and Storage
- MIL-STD-163 Preservation of Steel Products for Domestic Shipment
- 2.4 *Other Standard*:<sup>4</sup>
- Primary Metals Bar Code Standard

### 3. Terminology

#### 3.1 *Definitions*:

3.1.1 For definitions of terms pertaining to this standard, not otherwise listed in 3.2, reference should be made to Terminology A941.

#### 3.2 *Definitions of Terms Specific to This Standard*:

3.2.1 *bar, n*—wire that has been straightened and cut (see Specification A484/A484M); however, a straightened and cut small diameter product is often called straightened and cut wire.

3.2.2 *wire, n*—as covered by this specification and the specifications itemized in 1.1, is any round or shaped cold-reduced product, in coils only, produced by cold-finishing coiled wire rod.

3.2.3 *wire rods, n*—semifinished product intended primarily for the manufacture of wire; are hot-rolled generally to an approximate round cross section in continuous length coils.

### 4. Materials and Manufacture

4.1 The material may be furnished in one of the conditions detailed in the applicable material specification, that is, annealed, bright annealed, cold worked, or as otherwise specified on the purchase order.

4.2 A variety of finishes, coatings, and lubricants are available. The particular type used is dependent upon the specific end use. Unless otherwise specified, the finish, coating, and lubricant will be furnished as required by the individual material specification or purchase order.

### 5. Chemical Composition

5.1 *Heat or Cast Analysis*—The chemical analysis of each heat shall be determined in accordance with the applicable material specification and Test Methods, Practices, and Terminology A751.

5.1.1 The analysis of each heat shall be made from a test sample taken during the pouring of the melt, or from the in-process product later in the manufacturing flow.

<sup>3</sup> Available from U.S. Government Printing Office, Superintendent of Documents, 732 N. Capitol St., NW, Washington, DC 20401-0001, <http://www.access.gpo.gov>.

<sup>4</sup> Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48033-7156, <http://www.aiag.org>.



5.1.2 The heat analysis shall conform to the chemical requirements for each of the specified elements for the grade ordered, as listed in the applicable product specification.

5.1.3 All commercial metals contain small amounts of elements other than those which are specified. It is neither practical nor necessary to specify limits for unspecified elements that can be present. The producer is permitted to analyze for unspecified elements and is permitted to report such analyses. The presence of an unspecified element and the reporting of an analysis for that element shall not be a basis for rejection unless the presence of that element causes the loss of a property typically expected for that metal for the type and quality ordered.

5.1.4 The purchaser is permitted to require in the purchase order a maximum limit for an individual element not specified in the product specification. Such a requirement for an element not listed in the product specification, when acknowledged in the order acceptance, shall be treated as a specified element, with determination of chemical analysis and reporting of that analysis.

5.1.5 The purchaser is permitted to make the requirements for any element more stringent, that is, require higher minimums for elements having minimum requirements or ranges with minimum requirements, or requiring lower maximums for elements having specified maximums, or ranges with maximums. The purchaser is not permitted to make chemical requirements less stringent.

5.1.6 Analysis limits shall be established for specific elements rather than groups of elements, including but not limited to “all others,” “rare earths,” and “balance,” unless all elements in such a group are similar in technical effect and are associated in typical methods of chemical analysis.

5.2 *Product Analysis*—When required, a product analysis shall be determined in accordance with Test Methods, Practices, and Terminology [A751](#). The chemical composition thus determined shall conform to the tolerances shown in [Table 1](#).

5.2.1 When the product requirement includes a ratio requirement that is the quotient of two, or more, elements, the minimum required ratio determined from product analysis shall be at least 0.90× the minimum in the product specification.

5.3 The steel shall not contain an unspecified element for the ordered grade to the extent that the steel conforms to the requirements of another grade in the referencing product specification, and any of the product specifications within the scope of this general specification, for which that element has a specified minimum.

## 6. Permissible Variations in Dimensions

6.1 Unless otherwise specified in the purchase order, the product shall conform to the permissible variations in dimensions as specified in [Tables 2-5](#) of this specification.

## 7. Workmanship, Finish, and Appearance

7.1 The material shall be of uniform quality consistent with good manufacturing and inspection practices. Imperfections that may be present shall be of such a nature or degree, for the type and quality ordered, that they will not adversely affect the forming, machining, or fabrication of finished parts.

## 8. Lot Size

8.1 A lot for product analysis shall consist of all wire made from the same heat.

8.2 For other tests required by the product specification, a lot shall consist of all product of the same size, same heat, and produced under the same processing conditions. All austenitic, ferritic, and free-machining stainless steels, as well as martensitic grades when annealed to Condition A and precipitation or age hardening grades when solution treated, may be heat treated in more than one charge in the same furnace or in several furnaces, utilizing controlled processing and equipment (see appendix). However, when heat treating martensitic stainless steels to Condition T or H and when age hardening the precipitation hardening stainless steels, a lot shall consist of the same size, same heat, and the same heat treat charge in a batch-type furnace or under the same conditions in a continuous furnace.



TABLE 1 Product Analysis Tolerances

NOTE 1—This table specifies tolerances over the maximum limits or under the minimum limits of the chemical requirements of the applicable material specification (see 1.1); it does not apply to heat analysis.

Element	Upper Limit or Maximum of Specified Range, %	Tolerances over the Maximum (Upper Limit) or Under the Minimum (Lower Limit)		Element	Upper Limit or Maximum of Specified Range, %	Tolerances over the Maximum (Upper Limit) or Under the Minimum (Lower Limit)	
		Over	Under			Over	Under
Carbon	to 0.010, incl	0.002		Cobalt	over 0.05 to 0.50, incl		0.01
	over 0.010 to 0.030, incl	0.005			over 0.50 to 2.00, incl		0.02
	over 0.030 to 0.20, incl	0.01			over 2.00 to 5.00, incl		0.05
	over 0.20 to 0.60, incl	0.02			over 5.00 to 10.00, incl		0.10
	over 0.60 to 1.20, incl	0.03			over 10.00 to 15.00, incl		0.15
Manganese	to 1.00, incl	0.03		over 15.00 to 22.00, incl		0.20	
	over 1.00 to 3.00, incl	0.04		over 22.00 to 30.00, incl		0.25	
	over 3.00 to 6.00, incl	0.05		Columbium <sup>A</sup> + Tantalum	to 1.50, incl		0.05
	over 6.00 to 10.00, incl	0.06			over 1.50 to 5.00, incl		0.10
	over 10.00 to 15.00, incl	0.10			over 5.00		0.15
Phosphorus	to 0.040, incl	0.005		Tantalum	to 0.10, incl		0.02
	over 0.040 to 0.20, incl	0.010		Copper	to 0.50, incl		0.03
Sulfur	to 0.040, incl	0.005		over 0.50 to 1.00, incl		0.05	
	over 0.040 to 0.20, incl	0.010		over 1.00 to 3.00, incl		0.10	
	over 0.20 to 0.50, incl	0.020		over 3.00 to 5.00, incl		0.15	
Silicon	to 1.00, incl	0.05		over 5.00 to 10.00, incl		0.20	
	over 1.00 to 3.00, incl	0.10		Aluminum	to 0.15, incl		−0.005, +0.01
Chromium	over 4.00 to 10.00, incl	0.10			over 0.15 to 0.50, incl		0.05
	over 10.00 to 15.00, incl	0.15			over 0.50 to 2.00, incl		0.10
	over 15.00 to 20.00, incl	0.20			over 2.00 to 5.00, incl		0.20
	over 20.00 to 30.00, incl	0.25			over 5.00 to 10.00, incl		0.35
Nickel	to 1.00, incl	0.03		Nitrogen	to 0.02, incl		0.005
	over 1.00 to 5.00, incl	0.07			over 0.02 to 0.19, incl		0.01
	over 5.00 to 10.00, incl	0.10			over 0.19 to 0.25, incl		0.02
	over 10.00 to 20.00, incl	0.15			over 0.25 to 0.35, incl		0.03
	over 20.00 to 30.00, incl	0.20		over 0.35 to 0.45, incl		0.04	
	over 30.00 to 40.00, incl	0.25		Tungsten	to 1.00, incl		0.03
over 40.00	0.30		over 1.00 to 2.00, incl			0.05	
Molybdenum	over 0.20 to 0.60, incl	0.03			over 2.00 to 5.00, incl		0.07
	over 0.60 to 2.00, incl	0.05		over 5.00 to 10.00, incl		0.10	
	over 2.00 to 7.00, incl	0.10		over 10.00 to 20.00, incl		0.15	
	over 7.00 to 15.00, incl	0.15		Vanadium	to 0.50, incl		0.03
over 15.00 to 30.00, incl	0.20		over 0.50 to 1.50, incl			0.05	
Titanium	to 1.00, incl	0.05		Selenium	all		0.03
	over 1.00 to 3.00, incl	0.07					
	over 3.00	0.10					

<sup>A</sup> Columbium (Cb) and niobium (Nb) are considered interchangeable names for element 41 in the periodic table and both names are acceptable for use.

TABLE 2 Permissible Variations in Size of Hot Finished Round Wire Rods

Specified Size, in. [mm]	Permissible Variations Specified Size, in. [mm]		Out-of-Round, <sup>A</sup> in. [mm]
	Over	Under	
Under ¼ [6.35]	0.008 [0.20]	0.008 [0.20]	0.011 [0.28]
¼ to ⅜ [6.35 to 10]	0.006 [0.15]	0.006 [0.15]	0.009 [0.23]
Over ⅜ to ½ [10 to 16]	0.007 [0.18]	0.007 [0.18]	0.010 [0.25]
Over ½ to ⅝ [16 to 22]	0.008 [0.20]	0.008 [0.20]	0.012 [0.30]
Over ⅝ to 1-⅛ [22 to 28]	0.010 [0.25]	0.010 [0.25]	0.015 [0.38]
Over 1-⅛ to 1-¾ [28 to 34]	0.012 [0.30]	0.012 [0.30]	0.018 [0.45]

<sup>A</sup> Out-of-round is the difference between the maximum and minimum diameters of the wire rod measured at the same cross section.

**TABLE 3 Permissible Variations in Diameter and Out-of-round for Round Wire<sup>A,B,C,D</sup>**

Specified Diameter, in. [mm]	Diameter Tolerances, in. [mm]	
	Over	Under
1.000 [25.00] and over	0.0025 [0.06]	0.0025 [0.06]
Under 1.000 to 0.500 [25.00 to 13.00]	0.002 [0.05]	0.002 [0.05]
Under 0.5000 to 0.3125 [13.00 to 8.00], incl	0.0015 [0.04]	0.0015 [0.04]
Under 0.3125 to 0.0440 [8.00 to 1.00], incl	0.001 [0.03]	0.001 [0.03]
Under 0.0440 to 0.0330 [1.00 to 0.80], incl	0.0008 [0.02]	0.0008 [0.02]
Under 0.0330 to 0.0240 [0.80 to 0.60], incl	0.0005 [0.015]	0.0005 [0.015]
Under 0.0240 to 0.0120 [0.60 to 0.30], incl	0.0004 [0.010]	0.0004 [0.010]
Under 0.0120 to 0.0080 [0.30 to 0.20], incl	0.0003 [0.008]	0.0003 [0.008]
Under 0.0080 to 0.0048 [0.20 to 0.12], incl	0.0002 [0.005]	0.0002 [0.005]
Under 0.0048 to 0.0030 [0.12 to 0.08], incl	0.0001 [0.003]	0.0001 [0.003]

<sup>A</sup> The maximum out-of-round for round wire is one half of the total size tolerance given in this table.

<sup>B</sup> When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown above for sizes 0.024 in. [0.60 mm] and over.

<sup>C</sup> Size tolerances have not been evolved for wire produced by cold rolling.

<sup>D</sup> These tolerances apply to small diameter straightened and cut wire (sizes below approximately  $\frac{1}{16}$  in.). Refer to Table 5 in Specification A484/A484M for bars (greater than approximately  $\frac{1}{16}$  in.).

**TABLE 4 Permissible Variations in Size for Drawn Wire in Hexagons, Octagons, and Squares<sup>A</sup>**

Specified Size <sup>B</sup> in. [mm]	Size Tolerance, in. [mm]	
	Over	Under
1.000 [25.00] and over	0	0.005 [0.12]
Under 1.000 to 0.500 [25.00 to 13.00], incl.	0	0.004 [0.10]
Under $\frac{1}{2}$ to $\frac{5}{16}$ [13.00 to 8.00], incl	0	0.003 [0.08]
Under $\frac{5}{16}$ to $\frac{1}{8}$ [8.00 to 3.00], incl	0	0.002 [0.05]

<sup>A</sup> When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown above.

<sup>B</sup> Distance across flats.

**TABLE 5 Permissible Variations in Thickness and Width for Flat Wire**

Width, in. [mm]	Permissible Variations in Width, Over and Under, in. [mm] <sup>A</sup>	
	For Thicknesses $\frac{1}{4}$ in. [6.5 mm] and Under	For Thicknesses Over $\frac{1}{4}$ in. [6.5 mm]
$\frac{1}{16}$ to $\frac{3}{8}$ [1.50 to 9.0]	0.005 [0.12]	0.005 [0.12]
Over $\frac{3}{8}$ to 1.0 [9.0 to 25.00]	0.004 [0.10]	0.004 [0.10]
Over 1.0 [25.00]	0.006 [0.15]	0.004 [0.10]
Thickness, in. [mm]	Permissible Variations in Thickness, Over and Under, in. [mm] <sup>A</sup>	
Up to 0.029 [0.70], incl	0.001 [0.03]	
Over 0.029 to 0.035 [1.70 to 1.00], incl	0.0015 [0.04]	
Over 0.035 [1.00]	0.002 [0.05]	

<sup>A</sup> When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown in the table.

## 9. Number of Tests and Retests

9.1 Unless otherwise specified in the product specification, one sample per heat shall be selected for chemical analysis and one mechanical test sample shall be selected from each lot of wire. All tests shall conform to the chemical and mechanical requirements of the material specification.

9.2 One intergranular corrosion test, when required, and one grain size test, when required, shall be made from each lot. It is often convenient to obtain test material from the specimen selected for mechanical testing.

9.3 If any test specimen shows imperfections that may affect the test results, it may be discarded and another specimen substituted.