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Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods[1]

This standard is issued under the fixed designation A 555/A 555M; 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.

This standard has been approved for use by agencies of the 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: A 313/A 313M, A 368, A 478, A 492, A 493, A 580/A 580M and A 581/A 581M.

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 A 480/A 480M.

1.4 General requirements for bar and billet products are covered in Specification A 484/A 484M.

1.5 The values stated in inch-pound units or SI (metric) units are to be regarded separately as standard; within the text and tables, the SI units are shown in brackets ([]). The values stated in each system are not exact equivalents; therefore, each system must be used independent of the other. Combining values from the two systems may result in nonconformance with the specification.

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

2. Referenced Documents

2.1 *ASTM Standards:*

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[2]

A 313/A 313M Specification for Stainless Steel Spring Wire[2]

A 368 Specification for Stainless Steel Wire Strand[3]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[2]

A 478 Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire[2]

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip[2]

A 484/A 484M Specification for General Requirements for Stainless and Heat-Resisting Bars, Billets, and Forgings[2]

A 492 Specification for Stainless Steel Rope Wire[3]

A 493 Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging[2]

A 580/A 580M Specification for Stainless Steel Wire[2]

A 581/A 581M Specification for Free-Machining Stainless and Heat-Resisting Steel Wire and Wire Rods[2]

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment[3]

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products[2]

E 112 Test Methods for Determining Average Grain Size[4]

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[5]

2.3 *Military Standards:*

MIL-STD-129 Marking for Shipment and Storage[5]

MIL-STD-163 Preservation of Steel Products for Domestic Shipment[5]

2.4 *Other Standard:*

Primary Metals Bar Code Standard[6]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

[1] 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 Stainless Steel Products.

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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] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094. Attn: NPODS.

[6] Automotive Industry Action Group, 26200 Lahser Road, Suite 200, Southfield, MI 48034.

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3.1.1 *bar*—wire that has been straightened and cut (see Specification A 484/A 484M). However, a straightened and cut small diameter product is often called straightened and cut wire.

3.1.2 *wire—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.

3.1.3 *wire rods*—semifinished product intended primarily for the manufacture of wire. They 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 A 751.

5.2 *Product Analysis*—When required, a product analysis shall be determined in accordance with Test Methods, Practices, and Terminology A 751. The chemical composition thus determined shall conform to the tolerances shown in Table 1.

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.

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.

9.4 If the results of any test lot are not in conformance with the requirements of this specification and the applicable product specification, a retest sample of two specimens may be tested to replace each failed specimen of the original sample. If one of the retest specimens fails, the lot shall be rejected.

10. Retreatment

10.1 Where failure of any lot is due to inadequate heat treatment, the material may be reheat treated and resubmitted for test.

11. Test Methods

11.1 The properties enumerated in applicable specifications shall be determined in accordance with the following ASTM methods:

11.1.1 *Chemical Analysis*—Test Methods, Practices, and Terminology A 751.

11.1.2 *Tension Test*—Test Methods and Definitions A 370.

11.1.3 *Intergranular Corrosion* (when required)—Practice E of Practices A 262.

11.1.4 *Grain Size* (when required)—Test Methods E 112.

12. Inspection

12.1 *For Civilian Procurement*—Inspection of the material shall be as agreed upon between the purchaser and the supplier as part of the purchase contract.

12.2 *For Government Procurement*—Unless otherwise specified in the contract or purchase order: (*1*) the seller is responsible for the performance of all inspection and test requirements in this specification, (*2*) the seller may use his own or other suitable facilities for the performance of the inspection and testing, and (*3*) the purchaser shall have the right to perform any of the inspection and tests set forth in this specification. The manufacturer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that

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TABLE 1 Product Analysis Tolerances

NOTE— 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)
Carbon	to 0.010, incl	0.002
	over 0.010 to 0.030, incl	0.005
	over 0.030 to 0.20, incl	0.01
	over 0.20 to 0.60, incl	0.02
	over 0.60 to 1.20, incl	0.03
Manganese	to 1.00, incl	0.03
	over 1.00 to 3.00, incl	0.04
	over 3.00 to 6.00, incl	0.05
	over 6.00 to 10.00, incl	0.06
	over 10.00 to 15.00, incl	0.10
	over 15.00 to 20.00, incl	0.15
Phosphorus	to 0.040, incl	0.005
	over 0.040 to 0.20, incl	0.010
Sulfur	to 0.040, incl	0.005
	over 0.040 to 0.20, incl	0.010
	over 0.20 to 0.50, incl	0.020
Silicon	to 1.00, incl	0.05
	over 1.00 to 3.00, incl	0.10
Chromium	over 4.00 to 10.00, incl	0.10
	over 10.00 to 15.00, incl	0.15
	over 15.00 to 20.00, incl	0.20
	over 20.00 to 30.00, incl	0.25
Nickel	to 1.00, incl	0.03
	over 1.00 to 5.00, incl	0.07
	over 5.00 to 10.00, incl	0.10
	over 10.00 to 20.00, incl	0.15
	over 20.00 to 30.00, incl	0.20
	over 30.00 to 40.00, incl	0.25
	over 40.00	0.30
Molybdenum	over 0.20 to 0.60, incl	0.03
	over 0.60 to 2.00, incl	0.05
	over 2.00 to 7.00, incl	0.10
	over 7.00 to 15.00, incl	0.15
	over 15.00 to 30.00, incl	0.20
Titanium	to 1.00, incl	0.05
	over 1.00 to 3.00, incl	0.07
	over 3.00	0.10
Cobalt	over 0.05 to 0.50, incl	0.01
	over 0.50 to 2.00, incl	0.02
	over 2.00 to 5.00, incl	0.05
	over 5.00 to 10.00, incl	0.10
	over 10.00 to 15.00, incl	0.15
	over 15.00 to 22.00, incl	0.20
	over 22.00 to 30.00, incl	0.25
Columbium + tantalum	to 1.50, incl	0.05
	over 1.50 to 5.00, incl	0.10
	over 5.00	0.15
Tantalum	to 0.10, incl	0.02
Copper	to 0.50, incl	0.03
	over 0.50 to 1.00, incl	0.05
	over 1.00 to 3.00, incl	0.10
	over 3.00 to 5.00, incl	0.15
	over 5.00 to 10.00, incl	0.20
Aluminum	to 0.15, incl	–0.005, +0.01
	over 0.15 to 0.50, incl	0.05
	over 0.50 to 2.00, incl	0.10
	over 2.00 to 5.00, incl	0.20
	over 5.00 to 10.00, incl	0.35
Nitrogen	to 0.02, incl	0.005
	over 0.02 to 0.19, incl	0.01
	over 0.19 to 0.25, incl	0.02
	over 0.25 to 0.35, incl	0.03
	over 0.35 to 0.45, incl	0.04
Tungsten	to 1.00, incl	0.03
	over 1.00 to 2.00, incl	0.05
	over 2.00 to 5.00, incl	0.07
	over 5.00 to 10.00, incl	0.10
	over 10.00 to 20.00, incl	0.15
Vanadium	to 0.50, incl	0.03
	over 0.50 to 1.50, incl	0.05
Selenium	all	0.03

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,[A] in. [mm]
	Over	Under	
under ¼ [6.35]	0.008 [0.20]	0.008 [0.20]	0.011 [0.28]
¼ [6.35] to 7⁄16 [10]	0.006 [0.15]	0.006 [0.15]	0.009 [0.23]
over 7⁄16 [10] to 5⁄8 [16]	0.007 [0.18]	0.007 [0.18]	0.010 [0.25]
over 5⁄8 [16] to 7⁄8 [22]	0.008 [0.20]	0.008 [0.20]	0.012 [0.30]
over 7⁄8 [22] to 1-1⁄8 [28]	0.010 [0.25]	0.010 [0.25]	0.015 [0.38]
over 1-1⁄8 [28] to 1-3⁄8 [34]	0.012 [0.30]	0.012 [0.30]	0.018 [0.45]

[A] Out-of-round is the difference between the maximum and minimum diameters of the wire rod measured at the same cross section.

the material is being furnished in accordance with the inspection. Inspection by the purchaser shall not interfere unnecessarily with the manufacturer.

13. Rejection and Rehearing

13.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly, preferably in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

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