Designation: A 555/A 555M – 05

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:* [2]

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels
A 313/A 313M Specification for Stainless Steel Spring Wire
A 368 Specification for Stainless Steel Wire Strand
A 370 Test Methods and Definitions for Mechanical Testing of Steel Products
A 478 Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire
A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
A 484/A 484M Specification for General Requirements for Stainless and Heat-Resisting Bars, Billets, and Forgings
A 492 Specification for Stainless Steel Rope Wire
A 493 Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging
A 580/A 580M Specification for Stainless Steel Wire
A 581/A 581M Specification for Free-Machining Stainless and Heat-Resisting Steel Wire and Wire Rods
A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment
A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
E 112 Test Methods for Determining Average Grain Size

2.2 *Federal Standard:*[3]

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

2.3 *Military Standards:*[3]

MIL-STD-129 Marking for Shipment and Storage
MIL-STD-163 Preservation of Steel Products for Domestic Shipment

2.4 *Other Standard:*[4]

Primary Metals Bar Code 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-Rolled and Wrought Stainless Steel.

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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.

[3] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

[4] Available from Automotive Industry Action Group (AIAG), 26200 Lahser Rd., Suite 200, Southfield, MI 48034.

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

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3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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.

5.1.1 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.

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, whether intentionally added unspecified elements, residual elements, or trace 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 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.

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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

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.

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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 ⅝ [16]	0.007 [0.18]	0.007 [0.18]	0.010 [0.25]
over ⅝ [16] to ⅞ [22]	0.008 [0.20]	0.008 [0.20]	0.012 [0.30]
over ⅞ [22] to 1-⅛ [28]	0.010 [0.25]	0.010 [0.25]	0.015 [0.38]
over 1-⅛ [28] to 1-⅜ [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.

TABLE 3 Permissible Variations in Diameter and Out-of-Round for Round Wire[A,B,C,D]

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 [25.00] to 0.500 [13.00]	0.002 [0.05]	0.002 [0.05]
Under 0.5000 [13.00] to 0.3125 [8.00] incl	0.0015 [0.04]	0.0015 [0.04]
Under 0.3125 [8.00] to 0.0440 [1.00] incl	0.001 [0.03]	0.001 [0.03]
Under 0.0440 [1.00] to 0.0330 [0.80] incl	0.0008 [0.02]	0.0008 [0.02]
Under 0.0330 [0.80] to 0.0240 [0.60] incl	0.0005 [0.015]	0.0005 [0.015]
Under 0.0240 [0.60] to 0.0120 [0.30] incl	0.0004 [0.010]	0.0004 [0.010]
Under 0.0120 [0.30] to 0.0080 [0.20] incl	0.0003 [0.008]	0.0003 [0.008]
Under 0.0080 [0.20] to 0.0048 [0.12] incl	0.0002 [0.005]	0.0002 [0.005]
Under 0.0048 [0.12] to 0.0030 [0.08] incl	0.0001 [0.003]	0.0001 [0.003]

[A] The maximum out-of-round for round wire is one half of the total size tolerance given in this table.

[B] 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.

[C] Size tolerances have not been evolved for wire produced by cold rolling.

[D] These tolerances apply to small diameter straightened and cut wire (sizes below approximately 1⁄16 in.). Refer to Table 5 in Specification A 484/A 484M for bars (greater than approximately 1⁄16 in.).

TABLE 4 Permissible Variations in Size for Drawn Wire in Hexagons, Octagons, and Squares[A]

Specified Size[B] in. [mm]	Size Tolerance, in. [mm]	
	Over	Under
1.000 [25.00] and over	0	0.005 [0.12]
Under 1.000 [25.00] to 0.500 [13.00] incl	0	0.004 [0.10]
Under ½ [13.00] to 5⁄16 [8.00] incl	0	0.003 [0.08]
Under 5⁄16 [8.00] to ⅛ [3.00] incl	0	0.002 [0.05]

[A] When it is necessary to heat treat or heat treat and pickle after cold finishing, size tolerances are double those shown above.

[B] Distance across flats.

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:

TABLE 5 Permissible Variations in Thickness and Width for Flat Wire

Width, in. [mm]	Permissible Variations in Width, Over and Under, in. [mm][A]	
	For Thicknesses ¼ in. [6.5 mm] and Under	For Thicknesses Over ¼ in. [6.5 mm]
1⁄16 [1.50] to ⅜ [9.0]	0.005 [0.12]	0.005 [0.12]
over ⅜ [9.0] to 1.0 [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][A]
Up to 0.029 [0.70], incl	0.001 [0.03]
Over 0.029 [1.70] to 0.035 [1.00], incl	0.0015 [0.04]
Over 0.035 [1.00]	0.002 [0.05]

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

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 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.

14. Certification

14.1 A certified report of the test results shall be furnished at the time of shipment. The report shall include the ASTM designation, year date, and revision letter, if any.

14.2 A document printed from or used in electronic form from an electronic data interchange (EDI) transmission shall be regarded as having the same validity as a counterpart printed in the certifiers' facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any existing EDI agreement between the purchaser and the supplier. Notwithstanding the

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15. Identification of Material

15.1 *For Civilian Procurement*—Each lift, bundle, or box shall be marked using durable tags (metal, plastic, or equivalent) showing heat number, type, condition, product specification number, and size.

15.2 *For U.S. Government Procurement*—In addition to any requirements specified in the contract or order, marking shall be in accordance with MIL-STD-129 for military agencies and in accordance with Fed. Std. No. 123 for civil agencies.

16. Preparation for Delivery

16.1 Unless otherwise specified, the wire shall be packaged and loaded in accordance with Practices A 700.

16.2 When specified in the contract or order, and for direct procurement by or direct shipment to the Government, when Level A is specified, preservation, packaging, and packing shall be in accordance with the Level A requirements of MIL-STD-163.

17. Keywords

17.1 general delivery requirements; stainless steel wire; stainless steel wire rods

ANNEX

(Mandatory Information)

A1. REQUIREMENTS FOR THE INTRODUCTION OF NEW MATERIALS

A1.1 New materials may be proposed for inclusion in specifications referencing this specification subject to the following conditions:

A1.1.1 Application for the addition of a new grade to a specification shall be made to the chairman of the subcommittee which has jurisdiction over that specification.

A1.1.2 The application shall be accompanied by a statement from at least one user indicating that there is a need for the new grade to be included in the applicable specification.

A1.1.3 The application shall be accompanied by test data as required by the applicable specification. Test data from a minimum of three test lots, as defined by the specification, each from a different heat, shall be furnished.

A1.1.4 The application shall provide recommendations for all requirements appearing in the applicable specification.

A1.1.5 The application shall state whether the new grade is covered by patent.

APPENDIXES

(Nonmandatory Information)

X1. RATIONALE REGARDING DEFINITION OF LOT FOR MECHANICAL PROPERTIES AND CORROSION TESTING

X1.1 It is generally recognized that material described as a lot must be "produced under the same processing conditions," which means the same manufacturing order number, same size, same heat, same heat treating procedure, and same subsequent processing. Under those conditions, single samples can be selected to be representative of the total lot, with at least one sample for each 20 000 pounds of material.

X1.2 Following the principle described in X1.1 generally requires that the producer control each of several furnace loads constituting the same lot so that

X1.2.1 Set point temperature and process tolerance match,

X1.2.2 Time at temperature for all thermal treatment shall match within 10 %,

X1.2.3 All furnaces used be similar in size and meet the uniformity requirements of a documented furnace quality assurance program, and

X1.2.4 The quench systems are the same with respect to volume, type of quenchant, and circulation rate.

X1.2.5 Further, it would be expected that grouped loads be handled within a relatively short time period, and that hardness testing be performed on at least one sample per charge.

X1.3 The old definition of a lot for mechanical testing based on simply the words "same size, heat, and heat treatment charge in a batch furnace" assumes that heat treating is the only process affecting properties. This kind of definition ignores the effects of other processing, prior to and subsequent to heat treating. Moreover, it assumes that each heat treat batch will be uniform and unique rather than reproducible. In reality, heat treating is a process which can be controlled easily throughout a batch and from batch to batch, with the net result that multiple batches can be considered part of a single lot if equipment and processing parameters meet the mandates of X1.1 and X1.2.

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X1.4 The sampling specified for mechanical properties is not a statistical sampling plan. Therefore, it provides only typical data. Assurance of uniformity within the lot can be obtained only by the producer adequately controlling the processing parameters.

X2. BAR CODING

X2.1 Bar coding to identify steel is not specifically addressed in Committee A01 specifications. Committee A01 endorses the AIAG Bar Code Standard for primary metals for steel products and proposes that this bar coding standard be considered as a possible auxiliary method of identification.

SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes made to this standard since the last issue, A 555/A 555M – 97 (2002), that may impact the use of this standard. (Approved Sept. 1, 2005.)

(*1*) Revised Section 5 to address chemical requirements as applicable to different categories of elements.

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