



Standard Specification for General Requirements for Stainless Steel Wire and Wire Rods¹

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 Steels²

A 313/A 313M Specification for Stainless Steel Spring Wire²

A 368 Specification for Stainless Steel Wire Strand³

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products²

A 478 Specification for Chromium-Nickel Stainless Steel Weaving and Knitting Wire²

A 480/A 480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip²

A 484/A 484M Specification for General Requirements for Stainless and Heat-Resisting Bars, Billets, and Forgings²

A 492 Specification for Stainless Steel Rope Wire³

A 493 Specification for Stainless Steel Wire and Wire Rods for Cold Heading and Cold Forging²

A 580/A 580M Specification for Stainless Steel Wire²

A 581/A 581M Specification for Free-Machining Stainless and Heat-Resisting Steel Wire and Wire Rods²

A 700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Domestic Shipment³

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products²

E 112 Test Methods for Determining Average Grain Size⁴

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 Storage⁵

MIL-STD-163 Preservation of Steel Products for Domestic Shipment⁵

2.4 Other Standard:

Primary Metals Bar Code Standard⁶

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.

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

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)	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	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	Columbium + tantalum	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		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,	
Chromium	over 4.00 to 10.00, incl	0.10		over 0.15 to 0.50, incl	+0.01	
	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		
Nickel	over 20.00 to 30.00, incl	0.25	over 5.00 to 10.00, incl	0.35		
	Molybdenum	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
over 40.00		0.30	over 1.00 to 2.00, incl			0.05
Titanium	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				

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 ⅜ [10]	0.006 [0.15]	0.006 [0.15]	0.009 [0.23]
over ⅜ [10] to ½ [16]	0.007 [0.18]	0.007 [0.18]	0.010 [0.25]
over ½ [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 1-¾ [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.

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 1/2 [13.00] to 5/16 [8.00] incl	0	0.003 [0.08]
Under 5/16 [8.00] to 1/8 [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.

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

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 1/4 in. [6.5 mm] and Under	For Thicknesses Over 1/4 in. [6.5 mm]
1/16 [1.50] to 3/8 [9.0]	0.005 [0.12]	0.005 [0.12]
over 3/8 [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.

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 absence of a signature, the organization submitting the EDI transmission is responsible for the content of the report.

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.

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.

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