Designation: A 955/A 955M – 03

Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement[1]

This standard is issued under the fixed designation A 955/A 955M; 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 deformed and plain stainless steel bars for concrete reinforcement used in applications requiring resistance to corrosion or controlled magnetic permeability. The standard sizes and dimensions of deformed bars and their numerical designation shall be those listed in Table 1. The text of this specification references notes and footnotes which provide explanatory material. These notes and footnotes (excluding those in tables and figures) shall not be considered as requirements of the specification.

1.1.1 Supplementary requirement (S1) of an optional nature is provided. It shall apply only when specified by the purchaser. In order to obtain a controlled magnetic permeability product, steel conforming to Supplementary Requirement S1 should be ordered.

1.2 The chemical composition of the stainless steel alloy shall be selected for suitability to the application involved by agreement between the manufacturer and the purchaser. This is an important consideration in achieving the desired corrosion resistance and/or controlled magnetic permeability.

NOTE 1—The alloys shown in Table 2 have found the most use in North America. These and other stainless steel alloys specified in A 276 or other specifications are available for consideration in product selection. Consult with the steel manufacturer for stainless steel alloy availability.

1.3 Bars are generally of three minimum yield levels, namely, 40 000 [300 MPa], 60 000 [420 MPa], and 75 000 psi [520 MPa], designated as Grade 40 [300], Grade 60 [420], and Grade 75 [520], respectively.

1.4 Plain rounds in sizes up to and including 2 in. [50.8 mm] in diameter, when specified for dowels, spirals, structural ties, and supports, shall be furnished under this specification in Grade 40 [300], Grade 60 [420], and Grade 75 [520], respectively. Bending properties, when required, shall be by agreement between the manufacturer and purchaser. Requirements providing for deformations and marking shall not be applicable to plain bars.

1.5 Weldability of most stainless steel compositions is generally good, however, pre-weld or post-weld procedures, or both, are necessary. Where material is to be welded, a welding procedure suitable for the chemical composition and intended use or service shall be used. Retesting of physical properties should be considered following welding procedures depending upon the steel composition and welding operation involved.

NOTE 2—It is recommended that the user consult the manufacturer for information available from the Nickel Development Institute (NIDI) (Toronto, Canada).

1.6 This specification is applicable for orders in either inch-pound units (as Specification A 955) or in SI units (as Specification A 955M).

1.7 The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the standard.

2. Referenced Documents

2.1 *ASTM Standards:*

A 6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling[2]

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels[3]

A 276 Specification for Stainless Steel Bars and Shapes[3]

A 342 Test Methods for Permeability of Feebly Magnetic Materials[4]

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products[3]

A 484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings[3]

A 510/A510M Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel[3]

A 700 Practices for Packaging, Marking, and Loading

[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 A01.05 on Steel Reinforcement.

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[2] *Annual Book of ASTM Standards*, Vol 01.04.

[3] *Annual Book of ASTM Standards*, Vol 01.03.

[4] *Annual Book of ASTM Standards*, Vol 03.04.

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

TABLE 1 Deformed Bar Designation Numbers, Nominal Weights [Masses], Nominal Dimensions, and Deformation Requirements

Bar Designation No.[A]	Nominal Weight, lb/ft [Nominal Mass, kg/m][B]		Nominal Dimensions[C]			Deformation Requirements, in. [mm]		
	400 Series; Duplex Alloys	300 Series	Diameter, in. [mm]	Cross-Sectional Area, in.^{2}[mm^2]	Perimeter, in. [mm]	Maximum Average Spacing	Minimum Average Height	Maximum Gap (Chord of 12.5 % of Nominal Perimeter)
3 [10]	0.374 [0.556]	0.378 [0.562]	0.375 [9.5]	0.11 [71]	1.178 [29.9]	0.262 [6.7]	0.015 [0.38]	0.143 [3.6]
4 [13]	0.679 [1.011]	0.686 [1.021]	0.500 [12.7]	0.20 [129]	1.571 [39.9]	0.350 [8.9]	0.020 [0.51]	0.191 [4.9]
5 [16]	1.048 [1.559]	1.058 [1.575]	0.625 [15.9]	0.31 [199]	1.963 [49.9]	0.437 [11.1]	0.028 [0.71]	0.239 [6.1]
6 [19]	1.495 [2.225]	1.511 [2.248]	0.750 [19.1]	0.44 [284]	2.356 [59.8]	0.525 [13.3]	0.038 [0.97]	0.286 [7.3]
7 [22]	2.038 [3.032]	2.059 [3.064]	0.875 [22.2]	0.60 [367]	2.749 [69.8]	0.612 [15.5]	0.044 [1.12]	0.334 [8.5]
8 [25]	2.685 [3.995]	2.713 [4.037]	1.000 [25.4]	0.79 [510]	3.142 [79.8]	0.700 [17.8]	0.050 [1.27]	0.383 [9.7]
9 [29]	3.396 [5.053]	3.341 [5.106]	1.128 [28.7]	1.00 [645]	3.544 [90.0]	0.790 [20.1]	0.056 [1.42]	0.431 [10.9]
10 [32]	4.312 [6.416]	4.358 [6.484]	1.270 [32.3]	1.27 [819]	3.990 [101.3]	0.889 [22.6]	0.064 [1.63]	0.487 [12.4]
11 [36]	5.296 [7.880]	5.352 [7.964]	1.410 [35.8]	1.56 [1006]	4.430 [112.5]	0.987 [25.1]	0.071 [1.80]	0.540 [13.7]
14 [43]	7.64 [11.37]	7.72 [11.49]	1.693 [43.0]	2.25 [1452]	5.32 [135.1]	1.185 [30.1]	0.085 [2.16]	0.648 [16.5]
18 [57]	13.59 [20.22]	13.72 [20.43]	2.257 [57.3]	4.00 [2581]	7.09 [180.1]	1.58 [40.1]	0.102 [2.59]	0.864 [21.9]

[A] Bar numbers are based on the number of eighths of an inch included in the nominal diameter of the bars [bar numbers approximate the number of millimetres of the nominal diameter of the bar].

[B] The 400 and Duplex alloy Series is based on a density of 489.59 lb/in.^{3}[7833.4 kg/m^3]. The 300 Series is based on a density of 494.78 lb/ft^3[7916.5 kg/m^3]. Density varies with alloy content which may result in a variation of several percent.

[C] The nominal dimensions of a deformed bar are equivalent to those of a round bar having the same weight [mass] per foot [metre] as the deformed bar.

TABLE 2 Chemical Requirements of Typical Alloys[A]

UNS Designation	Type	Composition %								
		Carbon	Manganese	Phosphorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Nitrogen
S24000	XM-29	0.08	11.50-14.50	0.060	0.030	1.00	17.00-19.00	2.25-3.75	....	0.20-0.40
S24100	XM-28	0.15	11.00-14.00	0.060	0.030	1.00	16.50-19.00	0.50-2.50	....	0.20-0.45
S30400	304	0.08	2.00	0.045	0.030	1.00	18.00-20.00	8.00-10.50	....	0.10
S31603	316L	0.03	2.00	0.045	0.030	1.00	16.00-18.00	10.00-14.00	2.00-3.00	0.10
S31653	316LN	0.08	2.00	0.045	0.030	1.00	16.00-18.00	10.00-14.00	2.00-3.00	0.10-0.16
S31803	....	0.03	2.00	0.045	0.020	1.00	21.00-23.00	4.50-6.50	2.50-3.50	0.08-0.20

[A] Maximum, unless otherwise indicated.

Methods for Steel Products for Domestic Shipment[5]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[6]

2.2 *U.S. Military Standards:*

MIL-STD-129 Marking for Shipment and Storage[7]

MIL-STD-163 Steel Mill Products Preparation for Shipment and Storage[7]

2.3 *U.S. Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[7]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *deformed bar*—steel bar with protrusions; a bar that is intended for use as reinforcement in reinforced concrete construction.

3.1.2 *Discussion*—The surface of the bar is provided with lugs or protrusions that inhibit longitudinal movement of the bar relative to the concrete surrounding the bar in such construction. The lugs or protrusions conform to the provisions of this specification.

3.1.3 *deformations*—protrusions on a deformed bar.

3.1.4 *plain bar*—steel bar without protrusions.

3.1.5 *rib*—longitudinal protrusion on a deformed bar.

3.1.6 *stainless steel*—a steel that contains 11 % or more chromium.

4. Ordering Information

4.1 Orders for material under this specification should include the following information:

4.1.1 Quantity (weight) [mass],

4.1.2 Name of material (deformed and plain stainless steel bars for concrete reinforcement),

4.1.3 Chemical composition (stainless steel alloy),

4.1.4 Heat treatment condition,

4.1.5 Size,

4.1.6 Length,

4.1.7 Deformed or plain,

4.1.8 Grade (strength level),

4.1.9 Packaging (see Section 24),

4.1.10 Supplementary requirement (if desired), and

[5] *Annual Book of ASTM Standards*, Vol 01.05.

[6] *Annual Book of ASTM Standards*, Vol 14.02.

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

4.1.11 ASTM designation and year of issue.

NOTE 3—A typical ordering description may be as follows:

20 tons, deformed and plain stainless steel bars for concrete reinforcement requiring corrosion resistance, No. 8, 32 ft 0 in. long, deformed 304 stainless (UNS 30400), Corrosion resistant anneal, Grade 60, in secured lifts, maximum bundle weight 1 ton, to ASTM 955 – _____.

[19 tons, deformed and plain stainless steel bars for concrete reinforcement requiring corrosion resistance, No. 24, 9.7 m long, deformed 304 stainless (UNS 30400), Corrosion resistant anneal, Grade 420, in secured lifts, maximum bundle weight 1 tonne, to ASTM 955M – _____.]

5. Materials and Manufacture

5.1 The bars shall be rolled from properly identified heats of mold or strand cast steel.

5.2 Bars may be furnished in one of the following heat treatment conditions, as shown in Specification A 276, and as needed to meet the requirements of this specification.

5.2.1 Annealed (A).

5.2.2 Hot rolled (HR).

5.2.3 Strain hardened (B).

NOTE 4—The mechanical properties of the material result from the heat treat condition of the material. Any further heat treatment of the material may alter those properties and affect their ability to meet the specified strength level. No re-treatment should be imposed without retesting to the requirements of this specification.

6. Chemical Composition

6.1 An analysis of each heat of steel shall be made by the manufacturer from test samples taken during the pouring or casting of the steel. Such analysis shall meet the chemical composition requirements specified in Table 2, Specification A 276, or other referenced specification or stainless steel alloy.

6.2 When specified by the purchaser, an analysis of the product shall be made by the manufacturer and shall conform to the analysis tolerances specified in Table 1 of Specification A 484/A 484M.

6.3 An analysis may be made by the purchaser from the finished product and shall meet the specification tolerances of Specification A 484/A 484M.

7. Requirements for Deformations

7.1 Deformations shall be spaced along the bar at substantially uniform distances. The deformations on opposite sides of the bar shall be similar in size, shape, and pattern.

7.2 The deformations shall be placed with respect to the axis of the bar so that the included angle is not less than 45°. Where the line of deformations forms an included angle with the axis of the bar of from 45 to 70° inclusive, the deformations shall alternately reverse in direction on each side or those on one side shall be reversed in direction from those on the opposite side. Where the line of deformation is over 70°, a reversal in direction is not required.

7.3 The average spacing or distance between deformations on each side of the bar shall not exceed seven tenths of the nominal diameter of the bar.

7.4 The overall length of deformations shall be such that the gap (measured as a chord) between the ends of the deformations on opposite sides of the bar shall not exceed 12½ % of the nominal perimeter of the bar. Where the ends terminate in a longitudinal rib, the width of the longitudinal rib shall be considered the gap. Where more than two longitudinal ribs are involved, the total width of all longitudinal ribs shall not exceed 25 % of the nominal perimeter of the bar. Furthermore, the summation of gaps shall not exceed 25 % of the nominal perimeter of the bar. The nominal perimeter of the bar shall be 3.1416 times the nominal diameter.

7.5 The spacing, height, and gap of deformations shall conform to the requirements prescribed in Table 1.

8. Measurement of Deformations

8.1 The average spacing of deformations shall be determined by measuring the length of a minimum of ten spaces and dividing that length by the number of spaces included in the measurement. The measurement shall begin from a point on a deformation at the beginning of the first space to a corresponding point on a deformation after the last included space. Spacing measurements shall not be made over a bar area containing bar marking symbols.

8.2 The average height of deformations shall be determined from measurements made on not less than two typical deformations. Determinations shall be based on three measurements per deformation, one at the center of the overall length and the other two at the quarter points of the overall length.

8.3 Insufficient height, insufficient circumferential coverage, or excessive spacing of deformations shall not constitute cause for rejection unless it has been clearly established by determinations on each lot (Note 5) tested that typical deformation height, gap, or spacing does not conform to the minimum requirements prescribed in Section 7. No rejection may be made on the basis of measurements if fewer than ten adjacent deformations on each side of the bar are measured.

NOTE 5—A lot, *for this purpose*, is defined as all the bars of one bar number and pattern of deformation contained in an individual shipping release or shipping order.

9. Tensile Requirements

9.1 The material, as represented by the test specimens, shall conform to the requirements for tensile properties prescribed in Table 3 or by agreement between the manufacturer and the purchaser.

9.2 The yield strength shall be determined by reading the stress corresponding to the prescribed strain using the autographic diagram method or an extensometer as described in

TABLE 3 Tensile Requirements

NOTE 1—Check with producer for availability of grades and sizes.

	Grade 40 [300]	Grade 60 [420]	Grade 75 [520]
Tensile strength, min, psi [MPa]	70 000 [500]	90 000 [620]	100 000 [690]
Yield strength, min, psi [MPa]	40 000 [300]	60 000 [420]	75 000 [520]
Elongation in 8 in. [203.2 mm], min, %:			
Bar designation no.			
3 [10]	11	9	. . .
4, 5 [13, 16]	12	9	. . .
6 [19]	12	9	7
7, 8 [22, 25]	. . .	9	7
9, 10, 11 [29, 32, 36]	. . .	8	6
14, 18 [43, 57]	. . .	7	6