



Designation: A955/A955M – 18a

Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement¹

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1. Scope*

1.1 This specification covers deformed and plain stainless steel bars for concrete reinforcement in cut lengths and coils 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 or controlled magnetic permeability, or both, because these properties are not provided by all stainless steels.

NOTE 1—The austenitic and austenitic-ferritic (duplex) alloys shown in **Table 2** are known to be sold by producers to the requirements of this specification. It provides guidance and is not a mandatory chemical composition table. Other alloys may also provide desired properties; consult with the manufacturer for stainless steel alloy properties and availability. After adoption of **Annex A5**, a mandatory chemical composition requirements table will be balloted in accordance with its requirements. This note and references to Specification **A276/A276M** will be simultaneously removed.

1.3 The requirements for introduction of new alloys into a mandatory chemical composition requirements table in this specification are given in **Annex A5**.

1.4 Requirements for the relative deformation area of three-sided deformed bars are contained in **Annex A4**.

1.5 Bars are of three minimum yield strength levels, namely, 60 000 psi [420 MPa], 75 000 psi [520 MPa], and 80 000 psi [550 MPa], designated as Grade 60 [420], Grade 75 [520], or Grade 80 [550], respectively.

1.6 Plain bars in sizes up to and including 2 in. [50.8 mm] in diameter in coils or cut lengths are furnished in accordance with this specification in Grade 60 [420], Grade 75 [520], and Grade 80 [550], respectively. Mechanical testing, when required, shall be to the nearest nominal deformed bar size. Requirements providing for deformations and marking shall not be applicable to plain bars.

1.7 When stainless steel is to be welded, use a procedure suitable for the chemical composition and intended use or service.

NOTE 2—Welding of stainless steel reinforcement would occur after shipment from the producer. Structural welding should be performed in accordance with the latest edition of AWS D1.6/D1.6M, any other internationally accepted stainless steel welding code, or a procedure suggested by the material producer. AWS D1.6/D1.6M describes the proper selection of the filler metals, temperature control, as well as, performance, procedure qualification and inspection requirements.

1.8 This specification is applicable for orders in either inch-pound units (as Specification A955) or in SI units (as Specification A955M).

1.9 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.

1.10 *This specification does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this specification to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.11 *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.*

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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*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.	Nominal Weight, lb/ft [Nominal Mass, kg/m] ^A		Nominal Dimensions ^B			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	Two-Sided Bar	Three-Sided Bar
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]	0.097 [2.5]
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]	0.129 [3.3]
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]	0.162 [4.1]
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]	0.194 [4.9]
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]	0.226 [5.8]
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]	0.259 [6.6]
9 [29]	3.396 [5.053]	3.441 [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]	0.292 [7.4]
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]	0.329 [8.3]
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]	0.365 [9.3]
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]	0.438 [11.1]
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]	0.584 [14.8]

^A The 400 and Duplex-Alloy Series is based on a density of 489.59 lb/ft³ [7833.4 kg/m³]. The 300 Series is based on a density of 494.78 lb/ft³ [7916.5 kg/m³]. Density varies with alloy content which may result in a variation of several percent.

^B 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.

^C The maximum gap (measured as a chord) between the ends of the deformations shall not exceed 25 %/n of the nominal perimeter of the bar, where n is the number of longitudinal gaps or longitudinal ribs around the perimeter of the 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	0.03 max	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	0.030	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.

2. Referenced Documents

2.1 ASTM Standards:²

A6/A6M Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling

A276/A276M Specification for Stainless Steel Bars and Shapes

A342/A342M Test Methods for Permeability of Weakly Magnetic Materials

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings

A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

C192/C192M Practice for Making and Curing Concrete Test Specimens in the Laboratory

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E290 Test Methods for Bend Testing of Material for Ductility

G3 Practice for Conventions Applicable to Electrochemical Measurements in Corrosion Testing

2.2 U.S. Military Standard:³
MIL-STD-129 Marking for Shipment and Storage

2.3 U.S. Federal Standard:³
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.4 AWS Standard:⁴
AWS D1.6/D1.6M Structural Welding Code – Stainless Steel

3. Terminology

3.1 Definitions of Terms Specific to This Specification:

3.1.1 *deformations, n*—transverse protrusions on a deformed bar.

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

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 DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

⁴ Available from American Welding Society (AWS), 8669 NW 36 St., #130, Miami, FL 33166-6672, http://www.aws.org.

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

3.1.3 *plain bar, n*—steel bar without protrusions.

3.1.4 *relative deformation area, n*—the ratio of the deformation bearing area (projected deformation area normal to the bar axis) to the shearing area (nominal bar perimeter times the average spacing of the deformations).

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

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

3.1.7 *three-sided bar, n*—deformed steel bar with three rows of transverse deformations.

3.1.8 *two-sided bar, n*—deformed steel bar with two rows of transverse deformations.

4. Ordering Information

4.1 It shall be the responsibility of the purchaser to specify all requirements that are necessary for material ordered to this specification. Such requirements shall include but are not limited to the following:

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 Cut lengths or coils,

4.1.7 Deformed or plain,

4.1.8 Grade (strength level),

4.1.9 Descaling method and finish,

4.1.10 Requirements for inspection (20.1),

4.1.11 Packaging (see Section 24),

4.1.12 Supplementary requirement (if desired), and

4.1.13 ASTM designation and year of issue.

5. Materials and Manufacture

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

5.2 Bars shall be furnished in one of the following heat treatment conditions, as shown in Specification **A276/A276M**, 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 3—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 The chemical analysis of each heat of steel shall be determined in accordance with Test Methods, Practices, and Terminology A751. The manufacturer shall make the analysis on test samples taken preferably during the pouring of the heat.

6.2 The chemical composition agreed to between manufacturer and purchaser shall conform to the requirements in Table 1 of Specification A276/A276M and shall conform to all applicable requirements in Specification A484/A484M.

7. Requirements for Deformations

7.1 Deformations shall be spaced along the bar at substantially uniform distances. The deformations on all 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 on a two-sided bar shall alternately reverse in direction on each side or those on one side shall be reversed in direction from those on the opposite side. The deformations on three-sided bars shall reverse on one of the three sides (see Fig. 1). 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 shall not exceed 25 %/n, where n is the number of longitudinal gaps or longitudinal ribs, of the nominal perimeter of the bar. Where the ends of the deformations terminate in a

longitudinal rib, the width of the longitudinal rib shall be considered as the gap between these ends. The summation of the 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 For three-sided bars, the relative deformation area, R_d , shall meet the requirements of Annex A4.

8.4 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 4) tested that typical deformation height, gap, or spacing does not conform to the minimum requirements prescribed in Section 7. No rejection shall be made on the basis of measurements if fewer than ten adjacent deformations on each side of the bar are measured.

NOTE 4—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.

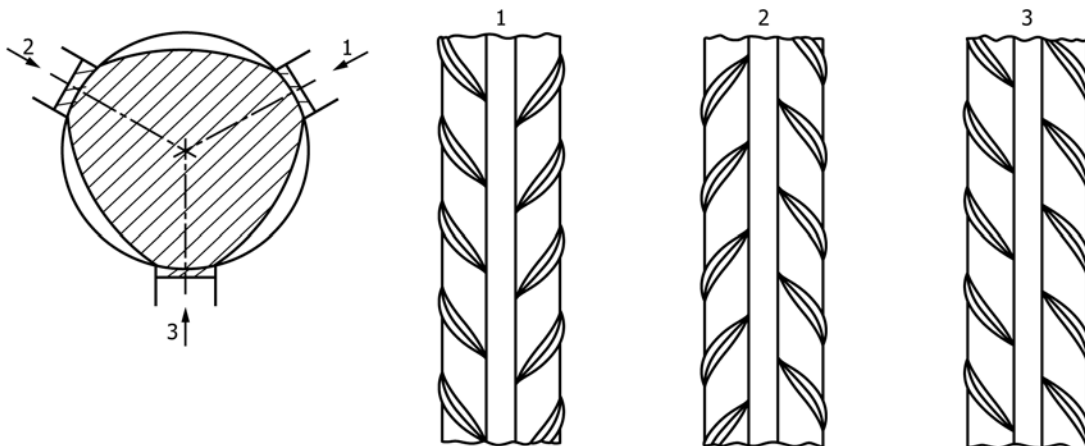


FIG. 1 Typical Three-Sided Deformed Bar

TABLE 3 Tensile Requirements^A

	Grade 60 [420]	Grade 75 [520]	Grade 80 [550]
Tensile strength, min, psi [MPa]	90 000 [620]	100 000 [690]	100 000 [690]
Yield strength, min, psi [MPa]	60 000 [420]	75 000 [520]	80 000 [550]
Ratio of actual tensile strength/actual yield strength, min	1.20	1.20	1.20
Elongation in 8 in. [200 mm], min, %			
Bar designation no.			
3, 4, 5 [10, 13, 16]	20	20	16
6 [19]	20	20	16
7, 8, 9, 10, 11, 14, 18 [22, 25, 29, 32, 36, 43, 57]	20	20	16

^A Consult with the manufacturer for availability of grades and bar sizes.

TABLE 4 Bend Test Requirements

Bar Designation No.	Pin Diameter for Bend Test ^A		
	Grade 60 [420]	Grade 75 [520]	Grade 80 [550]
3, 4, 5 [10, 13, 16]	3½ <i>d</i> ^B	3½ <i>d</i>	3½ <i>d</i>
6 [19]	5 <i>d</i>	5 <i>d</i>	5 <i>d</i>
7, 8 [22, 25]	5 <i>d</i>	5 <i>d</i>	5 <i>d</i>
9, 10, 11 [29, 32, 36]	7 <i>d</i>	7 <i>d</i>	7 <i>d</i>
14, 18 [43, 57] (90°)	9 <i>d</i>	9 <i>d</i>	9 <i>d</i>

^A Test bends 180° unless noted otherwise.

^B *d* = nominal diameter of specimen.

9.2 The yield strength shall be determined by the offset method (0.2 % offset), as described in Test Methods and Definitions **A370**.

9.3 When material is furnished in coils, the test specimen shall be taken from the coil and straightened prior to placing it in the jaws of the tensile test machine. Straightening of the test specimens shall be done carefully to avoid formation of local sharp bends and to minimize cold work. (See **Note 5**.)

9.3.1 Test specimens taken from post-fabricated material shall not be used to determine conformance to this specification.

NOTE 5—Insufficient straightening prior to attaching the extensometer can result in lower-than-actual yield strength readings. Multiple bending distortion from mechanical straightening and fabricating machines can lead to excessive cold work, resulting in higher magnetic permeability, higher yield strengths, lower elongation values, and a loss in deformation height.

9.4 The percentage of elongation shall be as prescribed in **Table 3**. When the actual percentage of elongation meets or exceeds 25 %, the bending requirements in Section **10** shall be waived.

10. Bending Requirements

10.1 The bend test specimen shall withstand being bent around a pin without cracking on the outside radius of the bent portion. The requirements for degree of bending and sizes of pins are prescribed in **Table 4**.

10.2 The bend test shall be made on specimens of sufficient length to ensure free bending and with apparatus that provides the following:

10.2.1 Continuous and uniform application of force throughout the duration of the bending operation.

10.2.2 Unrestricted movement of the specimen at points of contact with the apparatus and bending around a pin free to rotate.

10.2.3 Close wrapping of the specimen around the pin during the bending operation.

10.3 It shall be permissible to use other methods of bend testing as described in Test Methods **E290**, such as placing a specimen across two round bearings free to rotate and applying the bending force with a fixed round-tip mandrel conforming to the specified bend radius, allowing the bar to pass through with sufficient clearance. When failures occur under other methods of bend testing, retests shall be permitted under the bend-test method prescribed in **10.2**.

11. Hardness Requirements

11.1 Martensitic grades shall meet the minimum hardness requirements shown in Specification **A276/A276M**, or other referenced specifications.

12. Corrosion Resistance Requirements

12.1 Corrosion resistance testing shall be performed one time in accordance with **Annex A1** for each stainless steel alloy processed as reinforcement by each manufacturer. Corrosion performance for the alloy shall be redemonstrated if the processing method is significantly altered.

13. Magnetic Properties

13.1 Controlled magnetic permeability shall be specified by invoking Supplementary Requirement S1.

14. Permissible Variation in Weight [Mass]

14.1 Deformed reinforcing bars shall be evaluated on the basis of nominal weight [mass]. The weight [mass] determined using the measured weight [mass] of the test specimen and rounding in accordance with Practice **E29**, shall be at least 94 % of the applicable weight [mass] per unit prescribed in **Table 1**. In no case shall overweight [excess mass] of any deformed bar be the cause for rejection. Weight [mass] variation for plain rounds shall be computed on the basis of permissible variation in diameter in accordance with Specifications **A6/A6M** or **A484/A484M**.

14.2 The specified limit of variation shall be evaluated in accordance with Practice **E29** (rounding method).

15. Finish

15.1 The bars shall be free of detrimental surface imperfections.

15.2 Seams, surface irregularities, or mill oxidation shall not be cause for rejection, provided the mass, dimensions, cross-sectional area, and tensile properties of a test specimen are not less than the requirements of this specification.

15.3 Surface imperfections other than those specified in 15.1 shall be considered detrimental when specimens containing such imperfections fail to conform to either tensile or bending requirements.

15.4 Unless otherwise specified by the purchaser, after rolling, the bars shall be pickled to remove mill scale and surface oxidation.

NOTE 6—Pickling has been shown to be needed for the corrosion resistance of most stainless steel reinforcement.

16. Number of Tests

16.1 For all bar sizes, one tension test, one bend test, if required (see 9.4), and one set of dimensional property tests including bar weight [mass] and spacing, height, and gap of deformations shall be made of each bar size rolled from each heat and of the same heat treatment condition.

16.2 For martensitic material, two hardness tests shall be taken per lot of material. A manufacturing lot is defined as material from one heat of material heat treated in one furnace at one time. For continuous furnaces used for tempering or aging, a manufacturing lot is defined as material from one heat of material heat treated in one continuous run but not to exceed 10 000 lbs [4500 kg].

17. Retests

17.1 If the results of an original tension specimen fail to meet the specified minimum requirements and are within 2000 psi [14 MPa] of the required tensile strength, within 1000 psi [7 MPa] of the required yield strength, or within two percentage units of the required elongation, a retest shall be permitted on two random specimens for each original tension specimen failure from the lot. All retest specimens shall meet the requirements of this specification.

17.2 If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in 17.5.2 and 17.5.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification. The retest shall be performed on test specimens that are at air temperature but not less than 60°F [16°C].

17.3 If a weight [mass] test fails for reasons other than flaws in the specimen as described in 17.5.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.

17.4 If a corrosion resistance test fails for reasons other than flaws as described in 17.5.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.

17.5 If the original test or any of the random retests fails because of any reasons listed in 17.5.1, 17.5.2, or 17.5.3, the test shall be considered an invalid test:

17.5.1 The elongation property of any tension test specimen is less than that specified, and any part of the fracture is outside the middle half of the gage length, as indicated by scribe marks on the specimen before testing,

NOTE 7—Marking specimens with multiple scribe or punch marks can reduce the occurrence of fracture outside or near these marks and the need for declaring the test invalid.

17.5.2 Mechanical reasons such as failure of testing equipment or improper specimen preparation,

17.5.3 Flaws are detected in a test specimen, either before or during the performance of the test.

17.6 The original results from 17.5.1, 17.5.2, or 17.5.3 shall be discarded and the test shall be repeated on a new specimen from the same lot.

18. Test Specimens

18.1 Tension test specimens shall be the full section of the bar as rolled. The unit stress shall be based on the nominal bar area.

18.2 The bend test specimens shall be the full section of the bar rolled.

19. Report

19.1 The following information shall be reported on a per heat or per lot basis as is appropriate.

19.1.1 Stainless steel type and name,

19.1.2 Chemical composition and product check (if appropriate),

19.1.3 Heat treat condition,

19.1.4 Descaling method and finish,

19.1.5 Bar size and number of sides,

19.1.6 Tensile properties,

19.1.7 Bend test (if required),

19.1.8 Hardness (if appropriate),

19.1.9 Corrosion test (if appropriate), and

19.1.10 Magnetic permeability (if appropriate).

19.2 A Material Test Report, Certificate of Inspection, or similar 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 certifier's facility. The content of the EDI transmitted document must meet the requirements of the invoked ASTM standard(s) and conform to any 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.

NOTE 8—The industry definition invoked here is: EDI is the computer to computer exchange of business information in a standard format such as ANSI ASC X12.

20. Inspection

20.1 Inspection of the stainless steel reinforcing bars shall be agreed upon between the purchaser and the manufacturer as part of the purchase order or contract.

21. Rejection

21.1 Unless otherwise specified, any rejection based on tests made in accordance with Section 6 shall be reported to the manufacturer within five days from the receipt of samples by the purchaser.