



Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement¹

This standard is issued under the fixed designation A 996/A 996M; 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 rail-steel and axle-steel bars for concrete reinforcement. Three types of product are included, designated with a “rail symbol,” and an “R” for bars made of rail-steel and with an “A” for bars made of axle-steel. The standard sizes and dimensions of deformed bars and their number designations are given in **Table 1**. All sizes and grades of all types may not be readily available; manufacturers should be consulted to verify availability.

1.2 The text of this specification references notes and footnotes that provide explanatory material. These notes and footnotes, excluding those in tables and figures, shall not be considered as requirements of the specification.

1.3 Type “rail symbol” and Type R are of two minimum yield strength levels, namely 50 000 psi [350 MPa] and 60 000 psi [420 MPa] designated as Grade 50 [350] and Grade 60 [420], respectively. Type A is of two minimum yield levels, namely 40 000 psi [280 MPa] and 60 000 psi [420 MPa] designated as Grade 40 [280] and Grade 60 [420], respectively.

1.4 The weldability of the steel is not a requirement of this specification.

1.5 This specification is applicable for orders in either inch-pound units (Specification A 996) or SI units (Specification A 996M).

1.6 The values stated in either inch-pound units or SI units are to be regarded as standard. Within the text, the SI units are shown in brackets. The values stated must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.7 *This standard 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 standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*²

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

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

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

2.2 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage³

2.3 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)³

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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

3.1.1.1 *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.

3.1.2 *deformations, n*—protrusions on a deformed bar.

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

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],

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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, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS. Or visit: <http://assist.daps.dla.mil/online>.

*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]	Nominal Dimensions ^B			Deformation Requirements, in. [mm]		
		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]	0.376 [0.560]	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]	0.668 [0.994]	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]	1.043 [1.552]	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]	1.502 [2.235]	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]	2.044 [3.042]	0.875 [22.2]	0.60 [387]	2.749 [69.8]	0.612 [15.5]	0.044 [1.12]	0.334 [8.5]
8 [25]	2.670 [3.973]	1.000 [25.4]	0.79 [510]	3.142 [79.8]	0.700 [17.8]	0.050 [1.27]	0.383 [9.7]

^ABar 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 millimeters of the nominal diameter of the bar].

^BThe nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [meter] as the deformed bar.

4.1.2 Name of material (rail-steel or axle-steel deformed bars for concrete reinforcement),

4.1.3 Type,

4.1.4 Size,

4.1.5 Grade,

4.1.6 Packaging (see Section 20),

4.1.7 ASTM designation and year of issue, and

4.1.8 Certified mill test reports (if desired).

5. Materials and Manufacture

5.1 The bars shall be rolled from standard section Tee rails or from carbon steel axles for railway cars and locomotives. No other materials, such as those known by the terms “rerolled, rail-steel equivalent, and rail-steel quality” shall be substituted.

6. Carbon Determination

6.1 For axle-steel product, the manufacturer shall make a determination for the carbon content of each axle received for manufacture into reinforcing bars. Based on these carbon determinations, all steel axles shall be stocked for subsequent rolling in separated lots by carbon range. The ranges of carbon shall be determined by the manufacturer as those best suited to meet the mechanical requirements.

6.2 When requested by the purchaser, the manufacturer shall report the carbon range for each lot of bars furnished.

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 from 45° to 70° inclusive, the deformations shall reverse alternately in direction from those on the opposite side. Where the line of deformations is over 70°, reversal in direction shall not be 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 the deformations shall be such that the gap (measured as a chord) between the ends of the deformations shall not exceed 12.5 % of the nominal perimeter of the bar. Where the ends terminate in a rib, the width of the 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. 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. Measurements of Deformation

8.1 The average spacing of deformations shall be determined by measuring the length of a minimum of 10 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 involving letters or numbers.

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 on 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 1) 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 1—As used within the intent of 8.3 and 14.1, the term “lot” shall mean all the bars of one bar number and pattern of deformations 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 2.

9.2 The yield point or yield strength shall be determined by one of the following methods.

9.2.1 The yield point shall be determined by the drop of the beam or halt in the gage of the testing machine.

9.2.2 Where the steel tested does not have a well-defined yield point, the yield strength shall be determined at extension under load using an autographic diagram method or an



TABLE 2 Tensile Requirements

	Grade 40 [280]	Grade 50 [350]	Grade 60 [420]	
			Rail Symbol and R	Type A
Tensile strength, min, psi [MPa]	70 000 [500]	80 000 [550]	90 000 [620]	
Yield strength, min, psi [MPa]	40 000 [280]	50 000 [350]	60 000 [420]	
Elongation in 8 in. [200 mm], min, %				
Bar Designation no. 3 [10]	11	6	6	8
4, 5, 6 [13, 16, 19]	12	7	6	8
7 [22]	11	6	5	8
8 [25]	10	5	4.5	7

extensometer as described in 14.1.2 and 14.1.3 of Test Methods and Definitions A 370. The strain shall be 0.5 % within the gage length.

9.3 The percentage of elongation shall be as prescribed in Table 2.

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 3.

10.2 The bend test shall be made on specimens of sufficient length to ensure free bending and with an apparatus which 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 a pin during the bending operation.

10.3 It shall be permissible to use other acceptable, more severe methods of bend testing, such as placing a specimen across two pins free to rotate and applying the bending force with a fixed pin. When failures occur under more severe methods, retest shall be permitted under the bend test method prescribed in 10.2.

11. Permissible Variation in Weight [Mass]

11.1 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 E 29, shall be at least 94% of the applicable weight [mass] per unit length prescribed in Table 1. In no case shall overweight [excess mass] of any deformed bar be cause for rejection.

TABLE 3 Bend Test Requirements

Bar Designation Nos.	Pin Diameter for Bend Test ^A		
	Type Rail Symbol	Type R	Type A
3, 4, 5 [10, 13, 16]	6d ^B	3½ d	3½ d
6, 7, 8 [19, 22, 25]	6d	5d	5d

^ATest bends 180°.

^Bd = nominal diameter of specimen.

12. Finish

12.1 The bars shall be free of detrimental surface imperfections.

12.2 Rust, seams, surface irregularities, or mill scale shall not be cause for rejection, provided the weight, dimensions, cross-sectional area, and tensile properties of a hand wire brushed test are not less than requirements of this specification.

12.3 Surface imperfections or flaws other than those specified in 12.2 shall be considered detrimental when specimens containing such imperfections fail to conform to either tensile or bending requirements. Examples include, but are not limited to, laps, seams, slivers, cooling or casting cracks, and mill or guide marks.

13. Test Specimens

13.1 All mechanical tests shall be conducted in accordance with Test Methods and Definitions A 370, including Annex A9.

13.2 Tension test specimens shall be the full section of bar as rolled.

13.3 The unit stress determinations on full-size specimens shall be based on the nominal bar area.

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

14. Number of Tests

14.1 For all bar sizes, one tension test, one bend test, and one set of dimensional property tests including bar weight [mass] and spacing, height, and gap of deformations shall be made from each lot (Note 1) of 10 tons [9 mg], or fraction thereof.

15. Retests

15.1 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 points of the required elongation, a retest shall be permitted on two random specimens for each original tension specimen failure from the lot. Both retest specimens shall meet the requirements of this specification.

15.2 If a bend test fails for reasons other than mechanical reasons or flaws in the specimen as described in 15.4.2 and 15.4.3, 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].

15.3 If a weight [mass] test fails for reasons other than flaws in the specimen as described in 15.4.3, a retest shall be permitted on two random specimens from the same lot. Both retest specimens shall meet the requirements of this specification.

15.4 If the original test or any of the random retests fails because of any reasons listed in 15.4.1, 15.4.2, or 15.4.3, the test shall be considered an invalid test:

15.4.1 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 2—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.

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

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

15.5 The original results from sections 15.4.1, 15.4.2, or 15.4.3 shall be discarded and the test shall be repeated on a new specimen from the same lot.

16. Inspection

16.1 The inspector representing the purchaser shall have free entry, at all times, while work on the contract of the purchaser is being performed, to all parts of the manufacturer's works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspection shall be made at the place of manufacture prior to shipment, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

16.2 *For Government Procurement Only*—Except as otherwise specified in the contract, the contractor shall be responsible for the performance of all inspection and test requirements specified herein and shall be permitted to use one's own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser at the time of purchase. The purchaser shall have the right to perform any of the inspections and tests at the same frequency as set forth in this specification where such inspections are deemed necessary to assure that material conforms to prescribed requirements.

17. Rejection

17.1 Material that shows injurious defects subsequent to its acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

18. Test Reports

18.1 When specified in the purchase order, the following information shall be reported on a per lot basis. It shall be permissible to report additional items as requested or desired.

18.1.1 Carbon level—Type A only.

18.1.2 Tensile properties.

18.1.3 Bend test.

18.2 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 3—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.

19. Marking

19.1 When loaded for mill shipment, bars shall be separated and tagged properly with the manufacturer's test identification number.

19.2 Each manufacturer shall identify the symbols of his marking system.

19.3 All bars produced to this specification shall be identified by a distinguishing set of marks legibly rolled onto the surface of one side of the bar to denote in the following order.

19.3.1 *Point of Origin*—Letter or symbol established as a manufacturer's mill designation.

19.3.2 *Size Designation*—Arabic number corresponding to Bar Designation Number in Table 1.

19.3.3 *Type of Steel*—Rail symbol, letter R or letter A indicating that the bar was produced from rail or axle steel.

19.3.4 *Minimum Yield Designation*—For Grade 60 [420] bars, either the number 60 [4] or a single continuous line through at least five spaces offset from the center of the bar (No marking designation for Grade 50 [350] or Grade 40 [280] bars).

19.3.5 It shall be permissible to substitute bars having sizes and grades in SI units for bars ordered to the corresponding sizes and grades in inch-pound units.

20. Packaging and Package Marking

20.1 Packaging, marking, and loading for shipment shall be in accordance with Practices A 700.

20.2 When specified in the contract or order, and for direct procurement by or direct shipment to the U.S. government, marking for shipment, in addition to requirements specified in the contract or order, shall be in accordance with MIL-STD-129 for military agencies and with Fed. Std. No. 123 for civil agencies.

21. Keywords

21.1 concrete reinforcement; deformations (protrusions); steel bars



SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A 996/A 996M-06) that may impact the use of this standard (approved May 1, 2006).

- (1) Revised sections 15.4, 15.4.1, and 15.4.2.
- (2) Added section 15.5.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 996/A 996M-05a) that may impact the use of this standard (approved March 1, 2006).

- (1) Revised section 2.2 and Section 20.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 996/A 996M-05) that may impact the use of this standard (approved July 1, 2005).

- (1) Revised Section 15.

Committee A01 has identified the location of selected changes to this standard since the last issue (A 996/A 996M-04) that may impact the use of this standard (approved April 1, 2005).

- (1) Revised sections 3.1.1 and 7.4.

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