Designation: ~~A996/A996M – 14~~ A996/A996M – 14a

Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement[1]

This standard is issued under the fixed designation A996/A996M; 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 A996) or SI units (Specification A996M).

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]

A370 Test Methods and Definitions for Mechanical Testing of Steel Products

A700 Practices for Packaging, Marking, and Loading Methods for Steel Products for Shipment (Withdrawn 2014)[3]

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

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

2.2 *Military Standard:*[4]

MIL-STD-129 Marking for Shipment and Storage

2.3 *Federal Standard:*[4]

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

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

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

---

[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.

Current edition approved ~~March 1, 2014~~Oct. 1, 2014. Published ~~March 2014~~October 2014. Originally approved in 1998. Last previous edition approved in ~~2009~~2014 as ~~A996/A996M – 09b.~~A996/A996M – 14. DOI: ~~10.1520/A0996_A0996M-14.~~10.1520/A0996_A0996M-14A.

[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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

***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]~~	~~Nominal Dimensions[A]~~			~~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]~~

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

Bar Designation No.[B]	Nominal Weight, lb/ft [Nominal Mass, kg/m]	Nominal Dimensions[A]			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]
9 [29]	3.400 [5.060]	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]	4.303 [6.404]	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]	5.313 [7.907]	1.410 [35.8]	1.56 [1006]	4.430 [112.5]	0.987 [25.1]	0.071 [1.80]	0.540 [13.7]

[A] The nominal dimensions of a deformed bar are equivalent to those of a plain round bar having the same weight [mass] per foot [metre] as the deformed bar.
[B] 9 [29] – 11 [36] axle-steel bars only.

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

3.1.2.1 *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.

3.1.3 *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],
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 The chemical analysis of the material, as described below, shall be determined in accordance with Test Methods, Practices, and Terminology A751. 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 permeter 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 tensile testing machine.

9.2.2 Where the steel tested does not have a well-defined yield point, the yield strength shall be determined by the offset method (0.2 % offset), as described in Test Methods and Definitions A370.

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.