



Designation: A996/A996M – 16

# Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement<sup>1</sup>

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 ( $\epsilon$ ) 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.*

<sup>1</sup> 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 Jan. 15, 2016. Published March 2016. Originally approved in 1998. Last previous edition approved in 2015 as A996/A996M – 15. DOI: 10.1520/A0996\_A0996M-16.

## 2. Referenced Documents

### 2.1 *ASTM Standards:*<sup>2</sup>

[A370 Test Methods and Definitions for Mechanical Testing of Steel Products](#)

[A700 Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment](#)

[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](#)

[E290 Test Methods for Bend Testing of Material for Ductility](#)

### 2.2 *Military Standard:*<sup>3</sup>

[MIL-STD-129 Marking for Shipment and Storage](#)

### 2.3 *Federal Standard:*<sup>3</sup>

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

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

## 4. Ordering Information

4.1 Orders for rail-steel or axle-steel reinforcing bars under this specification shall contain the following information:

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard’s Document Summary page on the ASTM website.

<sup>3</sup> 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. <sup>B</sup>	Nominal Weight, lb/ft [Nominal Mass, kg/m]	Nominal Dimensions <sup>A</sup>			Deformation Requirements, in. [mm]			
		Diameter, in. [mm]	Cross-Sectional Area in. <sup>2</sup> [mm <sup>2</sup> ]	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]	

<sup>A</sup> 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.

<sup>B</sup> 9 [29] – 11 [36] axle-steel bars only.

4.1.1 Quantity (weight) [mass],

4.1.2 Type “rail symbol” or Type R for rail steel, or Type A for axle steel,

4.1.3 Bar designation number (size),

4.1.4 Grade (see [Table 2](#)),

4.1.5 Requirements for inspection ([16.1](#)),

4.1.6 Packaging (see [Section 20](#)), and

4.1.7 ASTM designation and year of issue.

4.2 The purchaser shall have the option to specify additional requirements, including but not limited to, the following:

4.2.1 Carbon range for each lot of bars ([6.2](#)), and

4.2.2 Other special requirements, if any.

## 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 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.

**TABLE 2 Tensile Requirements**

	Grade 40 [280]	Grade 50 [350]	Grade 60 [420]
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]

  

Type	A	Rail Symbol and R	A	Rail Symbol and R
Elongation in 8 in. [200 mm], min, %				
Bar Designation no.				
3 [10]	11	6	8	6
4, 5, 6 [13, 16, 19]	12	7	8	6
7 [22]	11	6	8	5
8 [25]	10	5	7	4.5
9, 10, 11 [29, 32, 36]	...	...	7	...