
Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

AASHTO Designation: M 31M/M 31-24¹

Technically Revised: 2024

Technical Subcommittee: 4f, Metals

ASTM Designation: A615/A615M-22



**American Association of State Highway and Transportation Officials
555 12th Street NW, Suite 1000
Washington, DC 20004**

Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

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1. SCOPE

- 1.1. This specification covers deformed and plain carbon (Type S) and low-alloy steel (Type W) concrete reinforcement bars in cut lengths or coils (see Note 1). Steel bars containing alloy additions, such as with the AISI and SAE series of alloy steels, are permitted if the resulting product meets all the other requirements of this specification. The standard sizes and dimensions of deformed bars and their number designations shall be those listed in Table 1. 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 this specification.
- Note 1**—Type S bars are comparable to ASTM A615 bars and Type W bars are comparable to A706 bars.
- 1.2. Bars are of three minimum yield strength levels: namely, 280 MPa [40,000 psi], 420 MPa [60,000 psi], and 550 MPa [80,000 psi], designated as Grade 280 [40], Grade 420 [60], and Grade 550 [80], respectively. Controlled Tensile Properties and Chemical Requirements—Type W bars limit tensile properties (see Table 3) to provide the desired yield/tensile properties for controlled tensile property applications.
- 1.3. Hot-rolled plain rounds, in sizes up to and including 63.5 mm [2½ in.] in diameter in coils or cut lengths, when specified for dowels, spirals, and structural ties or supports, shall be furnished under this specification in Grade 280 [40], Grade 420 [60], and Grade 550 [80].
- For ductility properties (elongation and bending), test provisions of the nearest smaller nominal diameter deformed bar size shall apply. Requirements providing for deformations and marking shall not be applicable.
- 1.4. Welding of the material in this specification should be approached with caution since no specific provisions have been included to enhance its weldability. When the steel is to be welded, a welding procedure suitable for the chemical composition and intended use or service should be used (see Note 2).
- Note 2**—The use of the latest edition of ANSI/AWS D1.4 is recommended for welding reinforcing bars. This document describes the proper selection of the filler metals and preheat/interpass temperatures, as well as performance and procedure qualification requirements.

Table 1—Deformed Bar Designation Numbers, Nominal Masses, Nominal Dimensions, and Deformation Requirements

Bar Designation No. ^b	Nominal Mass, kg/m [lb/ft]	Nominal Dimensions ^a			Deformation Requirements, mm [in.]		
		Diameter, mm [in.]	Cross-Sectional Area, mm ² [in. ²]	Perimeter, mm [in.]	Maximum Average Spacing	Minimum Average Height	Maximum Gap (Chord of 12.5% of Nominal Perimeter)
10 [3]	0.560 [0.376]	9.5 [0.375]	71 [0.11]	29.9 [1.178]	6.7 [0.262]	0.38 [0.015]	3.6 [0.143]
13 [4]	0.994 [0.668]	12.7 [0.500]	129 [0.20]	39.9 [1.571]	8.9 [0.350]	0.51 [0.020]	4.9 [0.191]
16 [5]	1.552 [1.043]	15.9 [0.625]	199 [0.31]	49.9 [1.963]	11.1 [0.437]	0.71 [0.028]	6.1 [0.239]
19 [6]	2.235 [1.502]	19.1 [0.750]	284 [0.44]	59.8 [2.356]	13.3 [0.525]	0.97 [0.038]	7.3 [0.286]
22 [7]	3.042 [2.044]	22.2 [0.875]	387 [0.60]	69.8 [2.749]	15.5 [0.612]	1.12 [0.044]	8.5 [0.334]
25 [8]	3.973 [2.670]	25.4 [1.000]	510 [0.79]	79.8 [3.142]	17.8 [0.700]	1.27 [0.050]	9.7 [0.383]
29 [9]	5.060 [3.400]	28.7 [1.128]	645 [1.00]	90.0 [3.544]	20.1 [0.790]	1.42 [0.056]	10.9 [0.431]
32 [10]	6.404 [4.303]	32.3 [1.270]	819 [1.27]	101.3 [3.990]	22.6 [0.889]	1.63 [0.064]	12.4 [0.487]
36 [11]	7.907 [5.313]	35.8 [1.410]	1006 [1.56]	112.5 [4.430]	25.1 [0.987]	1.80 [0.071]	13.7 [0.540]
43 [14]	11.38 [7.65]	43.0 [1.693]	1452 [2.25]	135.1 [5.32]	30.1 [1.185]	2.16 [0.085]	16.5 [0.648]
57 [18]	20.24 [13.60]	57.3 [2.257]	2581 [4.00]	180.1 [7.09]	40.1 [1.58]	2.59 [0.102]	21.9 [0.864]
64 [20]	24.84 [16.69]	63.5 [2.500]	3167 [4.91]	199.5 [7.85]	44.5 [1.75]	2.86 [0.113]	24.3 [0.957]

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

^b Bar numbers are based on the number of millimeters included in the nominal diameter of the bars. [Bar designation numbers approximate the number of eighths of an inch of the nominal diameter of the bar.]

1.5. This specification is applicable for orders in either SI units (M 31M) or in inch-pound units (M 31). SI units and inch-pound units are not necessarily equivalent; therefore, each system must be used independently of the other. Combining values from the two systems may result in non-conformance with the specification. Inch-pound units are shown in brackets in the text for clarity, but they are the applicable values when the material is ordered to M 31.

1.6. *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. AASHTO Standards:

- T 244, Mechanical Testing of Steel Products
- T 285M/T 285, Bend Test for Bars for Concrete Reinforcement

2.2. ASTM Standards:

- A6/A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
- A510/A510M, Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel, and Alloy Steel
- A615/A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
- A700, Standard Guide for Packaging, Marking, and Loading Methods for Steel Products for Shipment
- A706/A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
- A751, Standard Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

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

2.3. *Military Standards:*

- MIL-STD-129, Marking for Shipment and Storage
- MIL-STD-163, Steel Mill Products Preparation for Shipment and Storage

2.4. *Federal Standard:*

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

2.5. *AWS Standard:*

- ANSI/AWS D1.4, Structural Welding Code—Reinforcing Steel

3. **TERMINOLOGY**

3.1. *Description of Terms Specific to This Standard:*

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

3.1.2. *deformed bar*—steel bar with 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. *plain bar*—steel bar without protrusions.

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

4. **ORDERING INFORMATION**

4.1. Orders for carbon or low-alloy steel bars for concrete reinforcement under this specification shall contain the following information:

4.1.1. Quantity (mass) [weight],

4.1.2. Deformed and plain,

4.1.3. Bar designation number (size) of deformed bars, or diameter of plain bars,

4.1.4. Cut length or coils,

4.1.5. Grade,

4.1.6. Type S or Type W, and

4.1.7. AASHTO designation and year of issue.

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