



Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength¹

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1. Scope*

1.1 This specification covers straight and bent, headed and headless, carbon, carbon boron, alloy, or high-strength low-alloy steel anchor bolts (also known as anchor rods). The anchor bolts are furnished in three strength grades, two thread classes, and in the sizes specified in Section 4.

1.2 The anchor bolts are intended for anchoring structural supports to concrete foundations. Such structural supports include building columns, column supports for highway signs, street lighting and traffic signals, steel bearing plates, and similar applications.

1.3 Supplementary requirements are included to provide for Grade 55 weldable steel, permanent manufacturers and grade identification, and impact properties for Grades 55 and 105.

1.4 Zinc coating requirements are included in Section 7 for applications requiring corrosion protection.

1.5 The recommended grade and style of nut and washer are included in 6.6 and 6.7 for each grade.

1.6 This specification does not cover the requirements for mechanical expansion anchors, powder-activated nails or studs, or anchor bolts fabricated from deformed bar.

1.7 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:²

A 194/A 194M Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both

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

A 563 Specification for Carbons and Alloy Steel Nuts

A 673/A 673M Specification for Sampling Procedure for Impact Testing of Structural Steel

¹ This specification is under the jurisdiction of ASTM Committee F16 on Fasteners and is the direct responsibility of Subcommittee F16.02 on Steel Bolts, Nuts, Rivets and Washers.

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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.

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
B 695 Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel
D 3951 Practice for Commercial Packaging
F 436 Specification for Hardened Steel Washers
F 606 Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets
F 2329 Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
2.2 *Research Council on Structural Connections Standard*:³

Specification for Structural Joints Using ASTM A325 or A490 Bolts

2.3 ASME Standards:⁴

B 1.1 Unified Screw Threads

B 1.3 Screw Thread Gaging Systems for Dimensional Acceptability

B 18.2.2 Square and Hex Nuts

B 18.18.2M Inspection and Quality Assurance for High Volume Machine Assembly Fasteners

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *anchor bolt*—steel rod or bar, one end of which is intended to be cast in concrete, while the opposite end is threaded and projects from the concrete, for anchoring other material to the concrete. The end cast in concrete may be either straight or provided with an anchor such as a bent hook, forged head, or a tapped or welded attachment to resist forces imposed on the anchor bolt, as required.

3.1.2 *manufacturer*—manufacturer of the anchor bolt; the party that performs the cutting, bending, and threading operations.

3.1.3 *producer*—manufacturer of the steel rods or bars.

3.1.4 *purchaser*—purchaser of the finished anchor bolt, or his designated agent.

³ Available from Research Council on Structural Connections, c/o Industrial Fasteners Institute, 1717 East 9th Street, Cleveland, OH 44114.

⁴ Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

*A Summary of Changes section appears at the end of this standard.

3.1.5 *responsible party*—see Section 18; this may be the manufacturer or supplier.

3.1.6 *supplier*—agent who furnishes the finished anchor bolt and nuts to the purchaser; this may be the manufacturer.

4. Classification

4.1 The anchor bolts are furnished in three grades denoting minimum yield strength and two classes denoting thread class as follows:

| Grade | Tensile Strength, ksi (MPa) | Description Yield Strength, min, ksi (MPa) | Size Range, in. (mm) |
|-----------------|------------------------------------|--|----------------------|
| 36 ^A | 58-80 (400-558) | 36 (248) | ¼ -4 (6.4-102) |
| 55 | 75-95 (517-655) | 55 (380) | ¼ -4 (6.4-102) |
| 105 | 125-150 (862-1034) | 105 (724) | ¼ -3 (6.4-76) |
| Class | | | |
| 1A | anchor bolts with Class 1A threads | | |
| 2A | anchor bolts with Class 2A threads | | |

^A When Grade 36 is specified, a weldable Grade 55 may be furnished at the supplier's option.

4.2 Weldable steel for Grade 55 is provided for in Supplementary Requirement SI.

5. Ordering Information

5.1 Orders for anchor bolts should include the following information:

5.1.1 *Quantity (Number of Pieces)*—If the purchaser intends to perform destructive tests on finished anchor bolts, the manufacturer should be advised so that an adequate number are produced, especially for the sizes and types not readily available from stock.

5.1.2 Name of product (steel anchor bolt).

5.1.3 ASTM designation and year of issue.

5.1.4 Grade and class, that is, Grade 36, 55, or 105 and Class 1A or 2A. Weldable Grade 55 may be furnished when Grade 36 is ordered (see 4.1).

5.1.5 Copper, if copper bearing steel is required.

5.1.6 *Size and Dimensions*—Include the diameter and threads (based on nominal thread diameter), bolt length, thread length, and length of hook if a hook is required, or provide a drawing showing the required information.

5.1.7 Zinc coatings in accordance with 7.1. When zinc coatings in accordance with 7.1 are required, specify the zinc coating process to be used, that is, hot dip, mechanically deposited, or no preference (see 7.1). Also, specify the length to be coated as measured from the exposed end.

5.1.8 *Other Coatings*—Specify other protective coatings, if required (see 7.2).

5.1.9 Number of nuts, either the total number or number per bolt.

5.1.10 Number of washers, either the total number or number per bolt, and dimensions if other than standard.

5.1.11 Inspection at place of manufacture, if required (see 15.1).

5.1.12 Color coding, if different from the standard in 19.1.

5.1.13 Test reports, if required (see 17.1).

5.1.14 Supplementary requirements, if required.

5.1.15 Special requirements, if required.

NOTE 1—An example of a typical order follows: 5000 pieces; steel anchor bolts; ASTM designations including issue date; Grade 55; Class 2A; Supplementary Requirement S 1; 1.0-8-in. thread size by 15-in. long, 3.0-in. thread length, 4.0-in. hook; zinc coated by hot dipping 5.0 in. from exposed end; each with one zinc-coated nut and washer; test report required.

6. Materials and Manufacture

6.1 *Process*—Steel for anchor bolts shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

6.2 *Threading*—Threads shall be rolled, cut, or ground at the option of the manufacturer, unless otherwise specified.

6.3 *Heat Treatment:*

6.3.1 When required, the anchor bolts may be heat treated to develop the specified properties. Heat treatment shall be at the option of the manufacturer.

6.3.2 Heat treatment may be performed prior to or after bending or threading.

6.3.3 When heat treatment is required, the anchor bolts shall be heat treated by quenching in a liquid medium from above the transformation temperature and then tempering by reheating to a temperature not less than 800°F (425°C) for Grade 55 and 1100°F (593°C) for Grade 105.

6.4 *Bending:*

6.4.1 When required, hooks, shall be made by cold bending or hot bending. The bent portion shall be free from cracks when examined at 10× magnification after bending.

6.4.2 Hot bending performed on bar stock without heat treatment shall not have the temperature exceed 1300°F (705°C) at any location during hot bending and shall be allowed to air cool after bending.

6.4.3 Hot bending performed on heat-treated bar stock shall not have the temperature come within 100°F (56°C) of the tempering (stress relieve) temperature of the heat-treat process at any location during hot bending and shall be allowed to air cool after bending.

6.4.4 The bending shall not reduce the cross-sectional area below that required in 10.3.

6.5 *Secondary Processing*—If a subcontractor, or party other than the manufacturer or producer, performs heat treatment, coating, welding, machining, or other process affecting the properties or performance of the anchor bolts, the anchor bolts shall be inspected and tested after such processing by the party responsible for supplying the anchor bolts to the purchaser.

6.6 *Recommended Nuts:*

6.6.1 Unless otherwise specified, all nuts used on these anchor bolts shall conform to the requirements of Specifications A 194/A 194M or A 563 and shall be of the grade, surface finish, and style for each grade and size of anchor bolt as follows:

| Anchor Bolt Grade and Size, in. (mm) | | Specification A 563 Plain | | Recommended Nut Hot-Dip or Mechanical Zinc Coated in accordance with 7.1 | |
|--------------------------------------|---|---------------------------|-----------|--|---------|
| Grade | Size, in. (mm) | Grade | Style | Grade | Style |
| 36 | ¼ - 1½ (6.4-38) over 1½ - 4.0 (38-102) | A | Hex | A | Hex |
| | | A | Heavy Hex | A | Hvy Hex |
| 55 | ¼ - 1½ (6.4-38) over 1½ - 4.0 (38-102) | A | Hex | A | Hvy Hex |
| | | A | Heavy Hex | A | Hvy Hex |
| 105 | ¼ - 1½ (6.4-38) over 1½ - 3.0 (38-76) | D | Hex | DH | Hvy Hex |
| | | DH | Heavy Hex | DH | Hvy Hex |

6.6.2 The requirements for the recommended grade and style of nut may be fulfilled by furnishing a nut of one of the grades or styles listed in Specifications A 194/A 194M or A 563 having a proof load stress equal to or higher than the minimum tensile strength specified for the anchor bolt.

6.7 Recommended Washers:

6.7.1 The washer material and dimensions shall be specified in the inquiry and the order (see Note 2).

6.7.2 Unless the requirement of 6.7.1 is met, washers conforming to the requirements of Specification F 436, Type 1 shall be furnished.

6.7.3 When anchor bolts are specified to be zinc coated, the washers shall be zinc coated as specified in 7.1, except that the coating process for the washers need not be the same as that for the anchor bolts and nuts.

NOTE 2—Washers used on anchor bolts, installed in holes with dimensions greater than oversize or short slot as defined by the Research Council on Structural Connections, require design consideration. (For guidance refer to Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.)

7. Protective Coatings

7.1 Zinc, Hot Dip or Mechanically Deposited—Specification F 2329, and mechanically deposited, Specification B 695, Class 50.

7.1.1 When zinc-coated anchor bolts with the coating specified in 7.1 are required, the purchaser shall specify the zinc coating process, for example, hot dip, mechanically deposited, or no preference.

7.1.2 When hot-dip is specified, the fasteners shall be zinc coated by the hot-dip process in accordance with the requirements of Specification F 2329.

7.1.3 When mechanically deposited is specified, the fasteners shall be zinc coated by the mechanical deposition process in accordance with the requirements of Class 50 of Specification B 695.

7.1.4 When no preference is specified, the supplier may furnish either a hot-dip zinc coating in accordance with Specification F 2329, or a mechanically deposited zinc coating in accordance with Specification B 695, Class 50. Threaded components (bolts and nuts) shall be coated by the same zinc-coating process, and the supplier's option is limited to one process per item, with no mixed processes in a lot.

7.2 Other Coatings:

7.2.1 Coatings other than the zinc coatings specified in 7.1 shall be as specified by the purchaser on the purchase order.

7.2.2 The complete specification shall be included as part of the purchase order when other coatings are specified.

8. Chemical Composition

8.1 Anchor bolts shall have a chemical composition conforming to the requirements listed in Table 1 for Grade 36 and Table 2 for Grades 55 and 105.

8.2 Grade 55 ordered as weldable shall conform to the requirements specified in Supplementary Requirement S1.

8.3 Anchor bolts made from low-carbon martensitic steel shall not be permitted.

8.4 The application of heats of steel to which bismuth, selenium, tellurium, or lead has been added intentionally shall not be permitted.

8.5 Product analyses may be made by the purchaser from finished anchor bolts representing each heat. The chemical composition thus determined shall conform to the requirements specified in 8.1 through 8.4.

9. Mechanical Properties

9.1 Bars—The bars or rods from which the anchor bolts are made shall conform to the tensile properties listed in Table 3, except when heat treated after bending or threading.

9.2 Anchor Bolts—The finished anchor bolts shall conform to the tensile properties listed in Table 3 for tests on machined specimens and Table 4 for axial tests on full-size threaded anchor bolts.

10. Anchor Bolt Dimensions

10.1 Nominal Size—The nominal anchor bolt diameter shall be the same as the nominal thread diameter.

10.2 Body Diameter:

10.2.1 When threads are rolled, the body diameter shall not be less than the minimum pitch diameter for the thread class, 1A or 2A, designated by the purchaser and specified in ANSI/ASME B 1.1. Class 2A shall be furnished when the thread class is not specified.

10.2.2 The body diameter shall not be less than the minimum major diameter when threads are cut.

10.2.3 The minimum body diameters are listed in Table 5 based on the requirements specified in 10.2.1 and 10.2.2.

TABLE 1 Chemical Requirements for Grade 36

| Element | Diameter, in. (mm) | | |
|---------------------------------|--------------------|----------------------------------|--------------------------------------|
| | To ¾ (20), incl | Over ¾ to 1½ (20 to 40), incl | Over 1½ to 4 (40 to 100), incl |
| Carbon, max, % | | | |
| Heat | 0.26 | 0.27 | 0.28 |
| Product | 0.29 | 0.30 | 0.31 |
| Manganese, % | | | |
| Heat | A | 0.60-0.90 | 0.60-0.90 |
| Product | A | 0.54-0.98 | 0.54-0.98 |
| Phosphorus, max, % | | | |
| Heat | 0.04 | 0.04 | 0.04 |
| Product | 0.05 | 0.05 | 0.05 |
| Sulfur, max, % | | | |
| Heat | 0.05 | 0.05 | 0.05 |
| Product | 0.06 | 0.06 | 0.06 |
| Copper, min, % (when specified) | | | |
| Heat | 0.20 | 0.20 | 0.20 |
| Product | 0.18 | 0.18 | 0.18 |

A Optional with the manufacturer but shall be compatible with weldable steel.