



Designation: **A490M—12** **A490M – 14**

# Standard Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)<sup>1</sup>

This standard is issued under the fixed designation A490M; 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.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification covers two types of quenched and tempered alloy steel, metric heavy hex structural bolts having a tensile strength of 1040 to 1210 MPa.

1.2 These bolts are intended for use in structural connections comparable to those covered under the requirements of the Specification for Structural Joints Using ASTM **A325** and **A490** bolts, approved by the Research Council on Structural Connections; endorsed by the American Institute of Steel Construction and by the Industrial Fastener Institute.<sup>2</sup>

1.3 The bolts are furnished in nominal bolt diameters M12 to M36, inclusive. They are designated by type denoting chemical composition as follows:

Type	Description
Type 1	Medium carbon alloy steel
Type 2	Withdrawn in 2002
Type 3	Weathering steel

1.4 This specification is applicable to metric heavy hex structural bolts and alternate designs as established by the Research Council in its publication, Specification for Structural Joints Using ASTM and bolts.

1.5 For inch-pound bolts, see Specification **A490**.

1.6 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.7 The following safety hazards caveat pertains only to the Test Methods portion, Section **13**, of this specification: *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:*<sup>3</sup>

- A325** Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
- A490** Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength
- A490M** Specification for High-Strength Steel Bolts, Classes 10.9 and 10.9.3, for Structural Steel Joints (Metric)
- A563M** Specification for Carbon and Alloy Steel Nuts (Metric)
- A751** Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- D3951** Practice for Commercial Packaging
- E384** Test Method for Knoop and Vickers Hardness of Materials
- E709** Guide for Magnetic Particle Testing
- E1444** Practice for Magnetic Particle Testing
- F436M** Specification for Hardened Steel Washers (Metric)

<sup>1</sup> 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.

Current edition approved April 1, 2012/Aug. 1, 2014. Published April 2012/December 2014. Originally approved in 1982. Last previous edition approved in 2011 as **A 490M – 11**. DOI:10.1520/A0490M-12. **A 490M – 12**. DOI:10.1520/A0490M-14.

<sup>2</sup> Available from American Institute of Steel Construction (AISC), One E. Wacker Dr., Suite 700, Chicago, IL 60601-2001, <http://www.aisc.org>.

<sup>3</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.

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

**TABLE 1 Chemical Requirements for Type 1 Bolts**

Alloy Steel		
Element	Heat Analysis, %	Product Analysis, %
Carbon		
For sizes through M30	0.30–0.48	0.28–0.50
For size M36	0.35–0.53	0.33–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.045
Sulfur, max	0.040	0.045
Alloying Elements	A	A
Alloy Steel with Boron Addition		
Element	Heat Analysis, %	Product Analysis, %
Carbon		
For sizes through M30	0.30–0.48	0.28–0.50
For size M36	0.35–0.53	0.35–0.55
Manganese, min	0.60	0.57
Phosphorus, max	0.040	0.045
Sulfur, max	0.040	0.045
Boron	0.0005–0.003	0.0005–0.003
Alloying Elements	A	A

<sup>A</sup>Steel, as defined by the American Iron and Steel Institute, shall be considered to be alloy when the maximum of the range given for the content of alloying elements exceeds one or more of the following limits: Manganese, 1.65 %; silicon, 0.60 %; copper, 0.60 % or in which a definite range or a definite minimum quantity of any of the following elements is specified or required within the limits of the recognized field of constructional alloy steels: aluminum, chromium up to 3.99 %, cobalt, columbium, molybdenum, nickel, titanium, tungsten, vanadium, zirconium, or any other alloying elements added to obtain a desired alloying effect.

**TABLE 2 Chemical Requirements for Type 3 Bolts**

Element	Heat Analysis, %	Product Analysis, %
Carbon		
Sizes M20 and smaller	0.20–0.53	0.19–0.55
Sizes larger than M20.	0.30–0.53	0.28–0.55
Manganese, min	0.40	0.37
Phosphorus, max	0.035	0.040
Sulfur, max	0.040	0.045
Copper	0.20–0.60	0.17–0.63
Chromium, min	0.45	0.42
Nickel, min	0.20	0.17
or		
Molybdenum, min	0.15	0.14

- [F568M Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners \(Metric\) \(Withdrawn 2012\)<sup>4</sup>](#)
- [F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, and Rivets \(Metric\)](#)
- [F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series](#)
- [F959M Specification for Compressible-Washer-Type Direct Tension Indicators for Use With Structural Fasteners \(Metric\)](#)
- [F1136M Specification for Zinc/Aluminum Corrosion Protective Coatings for Fasteners \(Metric\) \(Withdrawn 2011\)<sup>4</sup>](#)
- [F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection](#)
- [F1789 Terminology for F16 Mechanical Fasteners](#)
- [F2833 Specification for Corrosion Protective Fastener Coatings with Zinc Rich Base Coat and Aluminum Organic/Inorganic Type](#)
- [F2328M Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws, Studs, and Nuts \(Metric\)](#)
- [G101 Guide for Estimating the Atmospheric Corrosion Resistance of Low-Alloy Steels](#)
- 2.2 *ASME Standards*:<sup>5</sup>
- [B1.13M Metric Screw Threads](#)
- [B18.2.3.7M Metric Heavy Hex Structural Bolts](#)

<sup>4</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>5</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

**B18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products**

2.3 *ISO Standards*:<sup>5</sup>

**7412 Hexagon Bolts for High Strength Structural**

**Bolting With Large Width Across Flats (Short Thread Length)—Product Grade C—Property Classes 8.8 and 10.9**

2.4 *IFI Standard* <sup>6</sup>:

**IFI 144 Test Evaluation Procedures for Coating Qualification Intended for Use on High-Strength Structural Bolts**

**3. Terminology**

3.1 Terms used in this specification are defined in Terminology **F1789**, unless otherwise defined herein.

**4. Ordering Information**

4.1 Orders for bolts under this specification shall include the following (see **Note 1**):

- 4.1.1 Quantity (number of pieces of bolts and accessories);
- 4.1.2 Size, including nominal bolt diameter, thread pitch, and bolt length;
- 4.1.3 Name of product: metric heavy hex structural bolts;
- 4.1.4 Type of bolt (Type 1 or 3). When type is not specified, either Type 1 or Type 3 shall be furnished at the supplier’s option;
- 4.1.5 ASTM designation and year of issue;
- 4.1.6 Other components such as nuts, washers, and washer-type direct tension indicators, if required;
- 4.1.7 Certification, if required (see Section 16); and
- 4.1.8 Protective Coating per Specification **F1136M**, Grade 3, if required. See 5.3.
- 4.1.9 Protective coating per Specification **F2833**, Grade 1 if required. See 4.3.
- 4.1.10 Special requirements, if required.
- 4.1.11 For establishment of a part identifying system, see ASME B18.24.

**NOTE 1**—A typical ordering description follows: 1000 pieces M24 × 3 × 100 mm long, heavy hex structural bolt, Type 1, *ASTM A 490 M– 03*; each with two hardened washers, *ASTM F436M*, Type 1; and one heavy hex nut, *ASTM A563M*, Grade DH.

4.2 *Recommended Nuts*

4.2.1 Nuts conforming to the requirements of Specification **A563M** are the recommended nuts for use with Specification **A 490M** heavy hex structural bolts. The nuts shall be of the class and have a surface finish for each type of bolt as follows.

Bolt Type and Finish	Nut Class and Finish
1, plain (uncoated)	<b>A563M</b> —10S, 10S3, plain (uncoated)
1, coated in accordance with <b>F1136M</b> , Grade 3 or <b>F2833</b> Grade 1	<b>A563M</b> —10S, 10S3 coated in accordance with <b>F1136M</b> , Grade 3 or <b>F2833</b> Grade 1
3, weathering steel	<b>A563M</b> —10S3, weathering steel

4.3 *Recommended Washers*

4.3.1 Washers conforming to Specification **F436M** are the recommended washers for use with Specification **A490M** heavy hex structural bolts. The washers shall have a surface finish for each type of bolt as follows.

Bolt Type and Finish	Washer Finish
1, plain (uncoated)	plain (uncoated)
1, coated in accordance with <b>F1136M</b> , Grade 3 or <b>F2833</b> Grade 1	coated in accordance with <b>F1136M</b> , Grade 3 or <b>F2833</b> Grade 1
3, weathering steel	weathering steel

4.4 *Other Accessories*

4.4.1 When compressible washer type tension indicators are specified to be used with these bolts, they shall conform to Specification **F959M**, Type 10.9.

**5. Materials and Manufacture**

5.1 *Heat Treatment*—Type 1 and Type 3 bolts shall be heat treated by quenching in oil from the austenitic temperature and then tempered by reheating to a temperature of not less than 425°C.

5.2 *Threading*—The threads shall be cut or rolled.

<sup>6</sup> Available from Industrial Fastener Institute (IFI), 6363 Oak Tree Boulevard, Independence, OH 44131, www.industrial-fasteners.org.

### 5.3 Protective Coatings:

5.3.1 When a protective coating is required and specified, the bolts shall be coated with Zinc/Aluminum Corrosion Protective Coatings in accordance with **F1136M** Grade 3 or 3, both chromium and non-chromium versions, or Specification **F2833** Grade 1, which have been qualified in accordance with IFI 144.<sup>7</sup>

5.3.2 No other metallic coatings are permitted unless authorized by Committee F16. Future consideration of any coating will be based on a review of test results submitted to Committee F16 in accordance with the requirements of IFI 144.

## 6. Chemical Composition

6.1 Type 1 bolts shall be alloy steel conforming to the chemical composition requirements in **Table 1**. The steel shall contain sufficient alloying elements to qualify it as an alloy steel (see **Table 1**, Footnote A).

6.2 Type 3 bolts shall be weathering steel conforming to the chemical composition requirements in **Table 2**. See Guide **G101** for methods of estimating the atmospheric corrosion resistance of low alloy steel.

6.3 Product analyses made on finished bolts representing each lot shall conform to the product analysis requirements specified in **Table 1** or **Table 2**, as applicable.

6.4 Applications of heats of steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted for bolts. Compliance with this requirement shall be based on a statement on the steel certificate indicating that these elements were not intentionally added.

6.5 Chemical analyses shall be performed in accordance with Test Methods, Practices, and Terminology **A751**.

## 7. Mechanical Properties

7.1 *Hardness*—The bolts shall conform to the hardness specified in **Table 3**.

### 7.2 Tensile Properties:

7.2.1 Except as permitted in **7.2.2** for long bolts and **7.2.3** for short bolts, nominal bolt diameters M24 and smaller having a length of  $2\frac{1}{4}D$  and longer, and nominal bolt diameters larger than M24 having a length of  $3D$  and longer shall be wedge tested full size and shall conform to the minimum and maximum wedge tensile load, and proof load or alternative proof load specified in **Table 4**. The load achieved during proof load testing shall be equal to or greater than the specified proof load.

7.2.2 When the length of the bolt makes full-size testing impractical, machined specimens shall be tested and shall conform to the requirements specified in **Table 5**. When bolts are tested by both full-size and machined specimen methods, the full-size test shall take precedence.

7.2.3 Nominal bolt diameters M24 and smaller having a length shorter than  $2\frac{1}{4}D$  down to  $2D$  inclusive, which cannot be wedge tensile tested shall be axially tension tested full size and shall conform to the minimum tensile load and proof load or alternate proof load specified in **Table 4**. Nominal bolt diameters M24 and smaller having a length shorter than  $2D$  which cannot be axially tensile tested shall be qualified on the basis of hardness.

7.2.4 For bolts on which both hardness and tension tests are performed, acceptance based on tensile requirements shall take precedence in the event of low hardness readings.

## 8. Carburization/Decarburization

8.1 *Definition*—This test is intended to evaluate the presence or absence of carburization and decarburization as determined by the difference in microhardness near the surface and core.

### 8.2 Requirements:

<sup>7</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report **RR:F16-1001**, **RR:F16-1002**, and **RR:F16-1003**.

**TABLE 3 Hardness Requirements for Bolt Sizes  
M12 to M36 Inclusive**

Nominal Bolt Diameter, mm	Length <sup>A</sup>	Brinell		Rockwell C	
		min	max	min	max
M12 to M24, inclusive	Less than $2D$	311	352	33	38
	$2D$ and longer	...	352	...	38
Over M24 to M36, inclusive	Less than $3D$	311	352	33	38
	$3D$ and longer	...	352	...	38

<sup>A</sup> Heavy hex structural bolts M24 and smaller and shorter than  $2D$  are subject only to minimum and maximum hardness. Heavy hex structural bolts larger than M24 to M36 inclusive and shorter than  $3D$  are subject only to minimum and maximum hardness.