Designation: F2403 – 09

# Standard Specification for Inch Series Machine Screws, Carbon Steel, 60 000 psi Tensile Strength[1]

This standard is issued under the fixed designation F2403; 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 the requirements for non-heat treated carbon steel machine screws with nominal diameters of No. 0000 through ¾ in. having a minimum ultimate tensile strength of 60 000 psi.

1.2 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

## 2. Referenced Documents

2.1 *ASTM Standards:*[2]

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

F606/F606M Test Methods for Determining the Mechanical Properties of Externally and Internally Threaded Fasteners, Washers, Direct Tension Indicators, and Rivets

F788/F788M Specification for Surface Discontinuities of Bolts, Screws, and Studs, Inch and Metric Series

F1470 Practice for Fastener Sampling for Specified Mechanical Properties and Performance Inspection

F1941 Specification for Electrodeposited Coatings on Threaded Fasteners (Unified Inch Screw Threads (UN/UNR))

F2282 Specification for Quality Assurance Requirements for Carbon and Alloy Steel Wire, Rods, and Bars for Mechanical Fasteners

2.2 *ASME Standards:*[3]

B1.1 Unified Screw Threads

B1.3M Screw Thread Gauging Systems Dimensional Acceptability Inch and Metric Screw Threads—UN UNR UNJ M MJ

B18.6.3 Machine Screws and Machine Screw Nuts

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

B18.6.4 Thread Forming and Thread Cutting Tapping Screws and Metallic Drive Screws

B18.18.2M Inspection and Quality Assurance for High-Volume Machine Assembly Fasteners

2.3 *Industrial Fasteners Institute:*[4]

IFI–138 Straightness Gaging Method and Straightness Limits for Machine, Tapping, and Thread Rolling Screws

2.4 *ISO Standards:*[5]

ISO 3269:2000 Fasteners–Acceptance Inspection

2.5 *National Aerospace Standards:*[6]

NASM 1312-8 Fastener Test Methods, Method 8, Tensile Strength

## 3. Ordering Information

3.1 Orders for machine screws under this specification shall include the following (see Note 1):

3.1.1 ASTM specification number and date of issue,

3.1.2 Quantity (number of pieces),

3.1.3 Head style and drive (ASME B18.6.3),

3.1.4 Size (nominal diameter, threads per inch and length) (see 7.3), and

3.1.5 Stress relieve anneal, if required (see 4.2).

3.1.6 *Finish*—Specify protective finish type, if required. If required, specify applicable coating specification, thickness, and type.

3.1.7 Certification, if required (Section 11).

3.1.8 Supplementary requirements, if required.

3.1.9 Other special requirements, if required.

3.1.10 *Part Identifying Numbering (PIN) System (optional)*—Part Identifying Number will be determined in accordance with ASME B18.24, if required.

[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.

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

[4] Available from Industrial Fasteners Institute (IFI), 6363 Oak Tree Boulevard Independence, Ohio 44131, www.industrial-fasteners.org.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[6] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401.

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

**TABLE 1 Chemical Composition Requirements**

| Chemical Element | Heat Analysis |
|---|---|
| Carbon, max., % | 0.29 |
| Phosphorous, max., % | 0.035 |
| Sulfur, max., % | 0.040 |

**TABLE 2 Tensile Load Requirements For Machine Screws**

| Nominal Size or Basic Major Diameter of Thread and Threads per in. | | Stress Area, in.$^2$ | Tensile Strength,[A] lb, min |
|---|---|---|---|
| No. 0000-160 | 0.021 | . . . | . . . |
| 000-120 | 0.034 | . . . | . . . |
| 00-90 | 0.047 | . . . | . . . |
| 00-96 | 0.047 | . . . | . . . |
| 0-80 | 0.060 | . . . | . . . |
| 1-64 | 0.073 | 0.00263 | 160 |
| No. 1-72 | 0.073 | 0.00278 | 170 |
| 2-56 | 0.086 | 0.00370 | 220 |
| 2-64 | 0.086 | 0.00394 | 240 |
| 3-48 | 0.099 | 0.00487 | 290 |
| 3-56 | 0.099 | 0.00523 | 310 |
| No. 4-40 | 0.112 | 0.00604 | 360 |
| 4-48 | 0.112 | 0.00661 | 390 |
| 5-40 | 0.125 | 0.00796 | 470 |
| 5-44 | 0.125 | 0.00830 | 490 |
| 6-32 | 0.138 | 0.00909 | 550 |
| 6-40 | 0.138 | 0.01015 | 600 |
| 8-32 | 0.164 | 0.0140 | 850 |
| 8-36 | 0.164 | 0.01474 | 880 |
| 10-24 | 0.190 | 0.0175 | 1050 |
| 10-32 | 0.190 | 0.0200 | 1200 |
| 12-24 | 0.216 | 0.0242 | 1450 |
| No. 12-28 | 0.216 | 0.0258 | 1550 |
| ¼-20 | 0.250 | 0.0318 | 1900 |
| ¼-28 | 0.250 | 0.0364 | 2200 |
| 5⁄16-18 | 0.312 | 0.0524 | 3150 |
| 5⁄16-24 | 0.312 | 0.0580 | 3500 |
| ⅜-16 | 0.375 | 0.0775 | 4650 |
| ⅜-24 | 0.375 | 0.0878 | 5250 |
| 7⁄16-14 | 0.438 | 0.1063 | 6400 |
| 7⁄16-20 | 0.438 | 0.1187 | 7100 |
| ½-13 | 0.500 | 0.1419 | 8500 |
| ½-20 | 0.500 | 0.1599 | 9600 |
| 9⁄16-12 | 0.562 | 0.182 | 10 900 |
| 9⁄16-18 | 0.562 | 0.203 | 12 200 |
| ⅝-11 | 0.625 | 0.226 | 13 600 |
| ⅝-18 | 0.625 | 0.256 | 15 400 |
| ¾-10 | 0.750 | 0.334 | 20 100 |
| ¾-16 | 0.750 | 0.373 | 22 400 |

[A] Tensile strength is based on 60 000 psi.

NOTE 1—A typical order description follows: ASTM F XXXX – XX, 5000 pieces; Machine Screws: Type I Cross Recessed Flat Countersunk Head; ¼ 20 × 3 UNC-2A; Certifications Required.

## 4. Materials and Manufacture

4.1 *Materials:*

4.1.1 Steel for machine screws shall be made by the open-hearth, basic-oxygen, or electric-furnace process.

4.1.2 Unless otherwise specified, Specification F2282 shall be used for procurement control of the material used to manufacture machine screws, except chemical composition shall be as specified in Section 5.

4.2 *Manufacture:*

4.2.1 Unless otherwise specified, the method of manufacture shall be cold forming.

4.2.2 Machine screw threads shall be rolled.

4.2.3 When specified by the purchaser, machine screws shall be stress relieve annealed.

## 5. Chemical Composition

5.1 Machine screws shall have a heat analysis conforming to the requirements specified in Table 1.

5.2 The IFI Steel Grade Designations specified in the table titled Carbon Steels, Chemical Ranges and Limits, % of Specification F2282 are suitable grades, providing the carbon content shall not exceed 0.29 %.

5.3 Product analyses shall be permitted to be conducted on finished screws in each lot. The composition thus determined shall not vary from the heat analysis by more than the allowable limits in the table titled Permissible Variations from Specified Chemical Ranges, and Limits for Carbon Steel of Specification F2282.

5.4 In case of conflict or for referee purposes, the product analysis shall take precedence.

5.5 Screws are customarily furnished from stock, in which case individual heats of steel cannot be identified.

## 6. Mechanical Properties

6.1 *Tensile:*

6.1.1 Machine screws shall have a tensile strength of 60 000 psi minimum.

6.1.2 The machine screws shall meet the tensile load requirements in Table 2 when tested in accordance with 10.2 using the method below.

| Nominal Size | Length | Tensile Test Requirements, Head Style: Hex | Tensile Test Requirements, Head Style: Other than Hex |
|---|---|---|---|
| No. 0 and smaller | Shorter than 3D[A] | Not required[B] | Not required[B] |
| Larger than No. 0 | Shorter than 3D[A] | Not required[B] | Not required[B] |
| No.1 to No. 5 incl. | 3D and longer | Axial | Axial |
| No. 6 and larger | 3D and longer | Wedge | Axial |

[A] *D* denotes the nominal diameter.
[B] Use Hardness, see 6.2

6.1.3 Tensile testing is not required unless Supplementary Requirement S1 is specified in the inquiry and order, or as stated in 6.1.2.

6.2 *Hardness:*

6.2.1 Machine screws subjected to tensile testing in accordance with 6.1.1 shall have a Rockwell Hardness of HRB 100 maximum.

6.2.2 Screws that are exempted from tensile testing in accordance with 6.1.2 shall have a Rockwell Hardness of HRB 70 to HRB 100.

6.3 *Ductility*—Ductility testing is not required unless Supplementary Requirement S34 is specified in the inquiry and order.

## 7. Dimensions

7.1 Unless otherwise specified, the dimensions shall be in accordance with the requirements of ASME B18.6.3.

7.2 *Gauging*—Unless otherwise specified, screw threads shall be gauged in accordance with ASME B1.3M, System 21.

7.3 Unless otherwise specified, threads prior to plating shall be Unified Coarse Thread Series as specified in the latest issue of ASME B1.1 for sizes #0 through ¾ in., and shall have Class 2A thread tolerances. Thread sizes smaller than #0 shall comply with the dimensions in the Appendix of ASME B18.6.3.

7.4 *Coated or Plated Product*—Unless otherwise specified, coated and plated threads shall conform with the latest issue of ASME B1.1 and be within the limits of Class 3A high limit (3A GO) and the lower limit of Class 2A (2A NOGO).

7.5 *Straightness*—Unless otherwise specified, the straightness shall be in accordance with the requirements of IFI-138.

## 8. Workmanship, Finish, and Appearance

8.1 *Workmanship*—Surface discontinuities for machine screws with nominal diameters of No. 5 and larger shall conform to the limits of Specification F788/F788M.

8.2 *Finish*—Unless otherwise specified, the machine screws shall be supplied with a natural (as processed) finish, unplated or uncoated.

8.3 When electrodeposited coatings are specified, they shall be in accordance with Specification F1941.

## 9. Number of Tests

9.1 *Chemical*—Sampling for chemical analyses shall be in accordance with Guide F1470.

9.2 *Mechanical*—Sample size shall conform to Guide F1470 when lot control is applied, or to ISO 3269 when shipping lots are applied.

9.3 *Dimensions*—Sampling for dimensional compliance shall be in accordance with ASME B18.18.2M, unless otherwise specified in the referenced dimensional standard.

9.4 When tests of individual lots are required prior to shipment, Supplementary Requirement S2 shall be specified in the inquiry and order.

9.5 The requirements of this specification shall be met in continuous mass production for stock, and the manufacturer shall make sample inspections to ensure that the product conforms to the specified requirements. Additional tests of individual shipments of material are not ordinarily contemplated.

## 10. Test Methods

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

10.2 *Tensile*—Sizes No. 6 and larger shall be tension tested in accordance with Test Methods F606/F606M and sizes smaller than Sizes No. 6 in accordance with NASM 1312, Test Number 8.

10.3 *Ductility*—Ductility testing shall be tested in accordance with the section on Ductility Test of ASME B18.6.4.

10.4 *Hardness*—Hardness tests shall be conducted in accordance with Test Methods F606/F606M. For screws smaller than No. 10 size, a referee test may be made at mid-radius using microhardness measurement techniques.

## 11. Certification and Test Reports

11.1 Certification shall not be required unless specifically requested in the purchase document. When specified in the purchase order, a producer certification shall be furnished to the purchaser, stating that the fastener was manufactured, sampled, tested, and inspected in accordance with this specification and meets all of its requirements.

## 12. Responsibility

12.1 The party responsible for the machine screws shall be the organization that supplies the machine screws to the purchaser.

## 13. Product Marking

13.1 Individual hex and hex washer head machine screws with nominal diameter No. 6 and up to including ¾ in. shall be marked with the manufacturer's identification marking. At the discretion of the manufacturer, other machine screw head styles can be marked with the manufacturer's identification marking.

## 14. Packing and Package Marking

14.1 *Packaging:*

14.1.1 Unless otherwise specified, packaging shall be in accordance with the manufacturers practice and shall be adequate to prevent damage during shipment.

14.1.2 When the purchaser requires special packing requirements, they shall be defined at the time of inquiry and order.

14.2 *Package Marking:*

14.2.1 Each shipping container shall include or plainly be marked with the following information:

14.2.1.1 ASTM specification and date,

14.2.1.2 Nominal diameter and length, product name, and head and drive style,

14.2.1.3 Name and brand or trademark of the manufacturer,

14.2.1.4 Number of pieces,

14.2.1.5 Purchase order number, and

14.2.1.6 Country of origin.

## 15. Keywords

15.1 carbon steel; machine screws

## SUPPLEMENTARY REQUIREMENTS

One or more of the following supplementary requirements shall apply only when specified by the purchaser in the inquiry and order (see 3.1.8). Supplemental requirements shall in no way negate any requirement of the specification itself.

### S1. Tensile Testing

S1.1 When specified on the inquiry or purchase order, tensile testing shall be performed on each lot (manufacturing or shipping) of machine screws except those specified in 6.1.2. Tensile testing shall be performed and meet the requirements of 6.1, 9.2 and 10.2.

### S2. Inspection

S2.1 When specified on the inquiry or purchase order, machine screw shall be subject to inspection by the purchaser at the place of manufacture. This will take place prior to shipment. The manufacturer shall afford the purchaser's representative all reasonable facilities to satisfy him that the machine screws are being furnished in accordance with this specification.

### S3. Ductility

S3.1 When specified on the inquiry or purchase order, ductility testing shall be performed on each lot (manufacturing or shipping) of machine screws. Ductility testing shall be performed and meet the requirements of 9.2 and 10.3.

## SUMMARY OF CHANGES

Committee F16 has identified the location of selected changes to this standard since the last issue, F2403 – 06, that may impact the use of this standard.

*(1)* 14.1.1 was revised, removed reference to Practice D3951.