Standard Specification for Screws, Alloy Steel, Heat Treated, 170 ksi Minimum Tensile Strength

This standard is issued under the fixed designation F2882; 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 quenched and tempered alloy steel screws 0.060 through 1 1/2 inches in diameter having a minimum ultimate tensile strength of 170 KSI.

Note 1—This specification is the inch companion of Specification F2882M.

1.2 The following hazard caveat pertains only to the test method portion, Section 10, 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:

- A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products
- E112 Test Methods for Determining Average Grain Size
- F606 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
- F1940 Test Method for Process Control Verification to Prevent Hydrogen Embrittlement in Plated or Coated Fasteners
- F2282 Specification for Quality Assurance Requirements for Carbon and Alloy Steel Wire, Rods, and Bars for Mechanical Fasteners
- F2328 Test Method for Determining Decarburization and Carburization in Hardened and Tempered Threaded Steel Bolts, Screws and Studs

2.2 ASME Standards:

- B18.2.1 Square and Hex Bolts and Screws
- B18.2.5 12 Point Flange Screws
- B18.3 Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series)
- B18.24 Part Identifying Number (PIN) Code System Standard for B18 Fastener Products

3. Ordering Information

3.1 Orders for high strength screws under this specification shall include the following information:

3.1.1 Quantity (number of screws),
3.1.2 Nominal dimensions, including diameter, thread designation, thread, pitch, and nominal screw length,
3.1.3 Name of the screw including specification,
3.1.3.1 ASME B18.2.1, Square and Hex Bolts and Screws,
3.1.3.2 ASME B18.2.5, 12 Point Flange Screws,
3.1.3.3 ASME B18.3, Socket Cap, Shoulder, and Set Screws, Hex and Spline Keys (Inch Series),
3.1.4 ASTM designation and year of issue.

3.2 Orders for high strength screws may include the following optional requirements:

3.2.1 Inspection at point of manufacture.
3.2.2 Coating, if required (see 4.6).
3.2.3 Additional Testing (see 11.1).
3.2.4 Special Packaging (see 14.1.2).
3.2.5 Supplementary Requirement (see S1).
3.2.6 Special Requirements.
3.2.7 For establishment of a part identifying system, see ASME B18.24.

4. Materials and Manufacture

4.1 The screws shall be fabricated from steel made to fine grain practice and shall have an austenitic grain size of 5 or finer. In the event of controversy over grain size, referee tests on finished screws conducted in accordance with Test Methods E112 shall prevail.

---

1 This test method 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 Oct. 1, 2012. Published November 2012. DOI: 10.1520/F2882-12.

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 10016-5900.
4.2 High strength screws shall be heat treated by quenching in oil from above the transformation temperature and then tempered by reheating to at least 797°F to within the hardness range specified in Table 1.

4.2.1 The minimum tempering temperature may be verified by submitting screws to 777°F for 30 min at temperature. The mean cross-section hardness of three readings on the screw before and after retempering shall not differ by more than 2 points HRC.

4.3 Re-heat-treatment of screws for the purpose of carbon restoration is not permitted except for set screws.

4.4 Unless otherwise specified, threads of screws shall be rolled for diameters through 0.625 in. and for screw lengths through 1.5 in. For diameters and lengths other than this, threads may be rolled, cut, or ground with the exception of socket set screws. Set screws with thread diameters up to and including #5 and all other diameters with lengths less than seven thread pitches may be rolled, cut, or ground. Thread diameters #6 and larger with a minimum of seven thread pitches in length shall be rolled.

4.5 Standard Finishes—Unless otherwise specified, the screws shall be furnished with one of the following “standard surfaces as manufactured,” at the option of the manufacturer; (1) bright uncoated, (2) thermal black oxide, or (3) chemical black oxide. Hydrogen embrittlement tests shall not be required for screws furnished in these conditions.

4.6 Protective Coatings:  
4.6.1 When a protective finish other than as specified in 4.5 is required, it shall be specified on the purchase order with the applicable finish specification.

4.6.2 When protective or decorative coatings are applied to the screws, precautions specified by the coating requirements to minimize internal hydrogen embrittlement shall be exercised. When specified in the purchase order, testing shall be conducted in accordance with Test Methods F606 or F1940. In the event that hardness reductions occur in test specimens due to coating curing times and temperatures, testing shall be conducted alternatively in accordance with Test Method F1624.

5. Chemical Composition

5.1 The screws shall be alloy steel conforming to the chemical composition specified in Table 2 and the requirements in Specification F2282. See Supplementary Requirement S1 when additional alloy steel grades are required.

5.2 One or more of the following alloying elements: chromium, nickel, molybdenum, or vanadium shall be present in sufficient quantity to ensure that the specified strength properties are met after oil quenching and tempering. As a guide for selecting material, an alloy steel should be capable of meeting the specified mechanical requirements if the “as oil quenched” core hardness one diameter from the point is equal to or exceeds 25 HRC + (55 × carbon content).

5.3 When product analyses are made by the purchaser from finished screws representing each lot, the chemical composition shall conform to the requirements for product analysis in Table 2.

5.4 Steel to which bismuth, selenium, tellurium, or lead has been intentionally added shall not be permitted for cold headed parts.

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

6. Mechanical Properties

6.1 Screws shall be tested meet the mechanical requirements in Table 1, and Table 3 or Table 4.

6.2 Screws other than set screws and flat countersink head screws in sizes 0.060 through 1½ in. diameter shall be wedge tensile tested using wedge angles as specified in Table 5.

6.3 The hardness limits shall be met anywhere on the cross section through the threads, one diameter from the screw point.

6.4 Mechanical properties shall be determined using Test Methods F606.

7. Dimensions

7.1 Unless otherwise specified, the product shall conform to the dimensional specification detailed in the purchase order.

8. Workmanship, Finish, and Appearance

8.1 There shall be no evidence of carburization or gross decarburization on the surfaces of the heat-treated screws when measured in accordance with F2328.

8.2 The depth of partial decarburization shall be limited to the values in F2328 (Class 3 Product).

8.3 The surface discontinuities for these products shall conform to Specification F788/F788M.
9. Sampling and Number of Tests

9.1 Practice F1470 shall be used to determine the necessary sampling plan and the number of tests that must be performed to demonstrate that all of the requirements of this standard are met for each lot.

10. Test Methods

10.1 Conduct tests for proof load, wedge tensile, and ultimate tensile strength in accordance with Test Method F606.

10.2 Decarburization and carburization tests shall be conducted in accordance with Test Method F2328.

10.3 Surface discontinuities including thread lap inspection shall be conducted in accordance with Standard F788/F788M.

11. Inspection

11.1 If the additional tests described in 11.2 are required by the purchaser, it shall be specified in the inquiry, order, or contract.

11.2 The inspector representing the purchaser, upon reasonable notice, shall have free entry to all parts of the manufacturer’s works that concern the manufacture of the material ordered. The manufacturer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspection required by the specification that are requested by the purchaser’s representative shall be made before shipment, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

12. Product Marking

12.1 All screws with nominal diameters of 0.2 in. and larger shall be permanently marked to identify the material grade, 170 or F2882 and the manufacturer’s or private label distributor’s identification symbol.

12.2 Material grade and manufacturer’s or private label distributor’s identification shall be separate and distinct. Marks
shall preferably be in different locations and, when on the same level, shall be separated by a distinctive mark such as a forward or backward slash, colon, dash, dot, or space.

13. Responsibility

13.1 The party responsible for the fastener shall be the organization that supplies the fastener to the purchaser.

14. Packaging and Package Marking

14.1 Packaging:
14.1.1 Unless otherwise specified, product shall be packaged according to the manufacturer’s practice to prevent damage before and during shipment.
14.1.2 When special packaging requirements are required, they shall be defined at the time of the inquiry and order.

14.2 Package Marking:
14.2.1 Unless otherwise agreed between the purchaser and supplier, the container shall be marked to permit identification of the lot. Each shipping unit shall also include or be plainly marked with the following information:

14.2.1.1 ASTM designation,
14.2.1.2 Size,
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 alloy steel; bolts; screws

SUPPLEMENTARY REQUIREMENTS

The following Supplementary Requirement shall apply only when specified by the purchaser in the contract or purchase order. Supplementary requirements shall in no way negate any requirement of the specification itself.

S1. Specific Grade Chemical Compositions

S1.1 When Supplementary Requirement S1 is specified on the order, the chemical composition shall conform to one of the compositions in Table S1.1 at the option of the supplier, unless a specific composition (Grade) has been specified on the purchase order.
<table>
<thead>
<tr>
<th>Grade Designation</th>
<th>4037</th>
<th>4042</th>
<th>4137</th>
<th>4140</th>
<th>4142</th>
<th>4145</th>
<th>4340</th>
<th>8740</th>
<th>5137M</th>
<th>51B37M</th>
</tr>
</thead>
<tbody>
<tr>
<td>UNS Number</td>
<td>G40370</td>
<td>G40420</td>
<td>G41370</td>
<td>G41400</td>
<td>G41420</td>
<td>G41450</td>
<td>G43400</td>
<td>G87400</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carbon:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.35–0.40</td>
<td>0.40–0.45</td>
<td>0.35–0.40</td>
<td>0.38–0.43</td>
<td>0.40–0.45</td>
<td>0.43–0.48</td>
<td>0.38–0.43</td>
<td>0.38–0.43</td>
<td>0.35–0.40</td>
<td>0.33–0.40</td>
</tr>
<tr>
<td>Product Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Manganese:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.70–0.90</td>
<td>0.70–0.90</td>
<td>0.70–0.90</td>
<td>0.75–1.00</td>
<td>0.75–1.00</td>
<td>0.75–1.00</td>
<td>0.60–0.80</td>
<td>0.75–1.00</td>
<td>0.30–0.50</td>
<td>0.30–0.50</td>
</tr>
<tr>
<td>Product Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorus, max.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
<td>0.035</td>
</tr>
<tr>
<td>Product Analysis</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>Sulfur, max.:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
<td>0.040</td>
</tr>
<tr>
<td>Product Analysis</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
<td>0.045</td>
</tr>
<tr>
<td>Silicon:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
<td>0.15–0.35</td>
</tr>
<tr>
<td>Product Analysis</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
<td>0.13–0.37</td>
</tr>
<tr>
<td>Nickel:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.65–2.00</td>
<td>0.40–0.70</td>
</tr>
<tr>
<td>Product Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chromium:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0.80–1.10</td>
<td>0.80–1.10</td>
</tr>
<tr>
<td>Product Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molybdenum:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td>0.20–0.30</td>
<td>0.20–0.30</td>
<td>0.15–0.25</td>
<td>0.15–0.25</td>
<td>0.15–0.25</td>
<td>0.15–0.25</td>
<td>0.20–0.30</td>
<td>0.20–0.30</td>
<td>0.18–0.32</td>
<td>0.18–0.32</td>
</tr>
<tr>
<td>Product Analysis</td>
<td>0.18–0.32</td>
<td>0.18–0.32</td>
<td>0.13–0.27</td>
<td>0.13–0.27</td>
<td>0.13–0.27</td>
<td>0.13–0.27</td>
<td>0.18–0.32</td>
<td>0.18–0.32</td>
<td>0.15–0.25</td>
<td>0.15–0.25</td>
</tr>
<tr>
<td>Boron:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product Analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Elements shown with an “A” are not applicable to that grade designation. Boron is not subject to product analysis.