Standard Specification for Martensitic Stainless Steel Bars for High-Temperature Service

This standard is issued under the fixed designation A565/A565M; 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.

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

1. Scope

1.1 This specification covers hot-finished and cold-finished martensitic chromium steel bars for high-temperature service. The mechanical properties are developed by suitable heat treatment, as indicated for each alloy.

1.2 Where strength at temperature is a factor, these steels are generally limited to a maximum service temperature of 1200°F [650°C]. For oxidation (scaling) resistance and at lower stresses, these steels are useful to 1450°F [790°C].

1.3 This specification is expressed in both inch-pound units and SI units; however, unless the purchase order or contract specifies the applicable M specification designation (SI units), the inch-pound units shall apply. The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

2. Referenced Documents

2.1 ASTM Standards:2
A370 Test Methods and Definitions for Mechanical Testing of Steel Products
A484/A484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
A751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products

A994 Guide for Editorial Procedures and Form of Product Specifications for Steel, Stainless Steel, and Related Alloys
E112 Test Methods for Determining Average Grain Size
E292 Test Methods for Conducting Time-for-Rupture Notch Tension Tests of Materials
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 SAE Document:3
SAE J1086 Recommended Practice for Numbering Metals and Alloys (UNS)

3. Ordering Information

3.1 It is the responsibility of the purchaser to specify all requirements that are necessary for material ordered under this specification. Such requirements may include, but are not limited to, the following:

3.1.1 Quantity (weight or number of pieces);
3.1.2 Name of material (martensitic stainless steel);
3.1.3 Form (bar, and so forth);
3.1.4 Condition;
3.1.5 Finish;
3.1.6 Size, or applicable dimension including diameter, thickness, width, length, and so forth;
3.1.7 Grade designation (Table 1); and
3.1.8 ASTM designation number and date of issue.

4. General Requirements

4.1 Product furnished to this specification shall conform to the requirements of Specification A484/A484M, including any supplementary requirements indicated in the purchase order.

1 This specification is under the jurisdiction of ASTM Committee A01 on Steel, Stainless Steel and Related Alloys and is the direct responsibility of Subcommittee A01.17 on Flat-Rolled and Wrought Stainless Steel.
3 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 Summary of Changes section appears at the end of this standard

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TABLE 1 Chemical Requirements

<table>
<thead>
<tr>
<th>Grade</th>
<th>UNS Designation</th>
<th>Carbon</th>
<th>Manganese</th>
<th>Phosphorus</th>
<th>Sulphur</th>
<th>Silicon</th>
<th>Chromium</th>
<th>Nickel</th>
<th>Molybdenum</th>
<th>Vanadium</th>
<th>Tungsten</th>
<th>Nitrogen</th>
<th>Alumin-</th>
<th>Niobium</th>
<th>Copper</th>
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<tr>
<td>XM-32</td>
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<td>0.50–0.90</td>
<td>0.025 max</td>
<td>0.025 max</td>
<td>0.35 max</td>
<td>11.00–12.50</td>
<td>2.00–3.00</td>
<td>1.50–2.00</td>
<td>0.25–0.40</td>
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<td>0.040 max</td>
<td>0.030 max</td>
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<td>12.00–14.00</td>
<td>1.80–2.20</td>
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<td>2.50–3.50</td>
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<tr>
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<td>0.50 max</td>
<td>11.00–12.50</td>
<td>0.50–1.00</td>
<td>0.90–1.25</td>
<td>0.20–0.30</td>
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<td>2.50–3.00</td>
<td>0.20–0.30</td>
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</table>

**Notes:**
- If straightened, a stress-relieving treatment is necessary. Stress-relieving temperature should be 50°F [28°C] below the final tempering temperature.
- Air or oil quenching depends on section size; heavier sections, approximately 3 in. [76.2 mm] or greater, should be oil quenched. Suitable synthetic quenchants may be substituted for oil.

### 5. Manufacture

#### 5.1 Heat Treatment:

5.1.1 The product forms covered in this specification may be furnished in one of the following conditions:

- **Condition A**—Annealed,
- **Condition T**—Heat treated (for machining),
- **Condition HT**—Heat treated (for high-temperature service), or
- **Condition H**—Heat treated.

#### 5.2 Condition and Finish:

- Bars may be furnished in one of the following cold-finished conditions:
  - Cold drawn,
  - Centerless ground (rounds only), or
  - Polished (rounds only).

6. Chemical Requirements

6.1 Each alloy covered by this specification shall conform to the chemical composition specified in Table 1.

6.2 Methods and practices relating to chemical analysis required by this specification shall be in accordance with Test Methods, Practices, and Terminology A751.

### 7. Metallurgical Requirements

7.1 The microstructure shall not contain more than 5% delta-ferrite after full heat treatment as described in Table 2. Visual examination for the volume fraction of delta ferrite of various representative areas of examination is acceptable. When the visual estimation method indicates the delta ferrite content is greater than the allowed limit, the manufacturer may employ Test Method E562 for determining the acceptability of the lot.

### 8. Mechanical Properties Requirements

8.1 The material shall conform to the mechanical properties listed in Table 3 for the ordered condition.