



Designation: A 565 – 03b

## Standard Specification for Martensitic Stainless Steel Bars for High-Temperature Service<sup>1</sup>

This standard is issued under the fixed designation A 565; 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 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 [649°C]. For oxidation (scaling) resistance and at low stresses, these steels are useful to 1450°F [788°C].

1.3 The values stated in inch-pound units are to be regarded as the standard.

### 2. Referenced Documents

#### 2.1 ASTM Standards:

A 370 Test Methods and Definitions for Mechanical Testing of Steel Products<sup>2</sup>

A 484/A 484M Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings<sup>3</sup>

A 751 Test Methods, Practices, and Terminology for Chemical Analysis of Steel Products<sup>2</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>4</sup>

#### 2.2 Other Documents:

SAE J1086 Recommended Practice for Numbering Metals and Alloys (UNS)<sup>5</sup>

### 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, etc.);
- 3.1.4 Condition;
- 3.1.5 Finish;
- 3.1.6 Size, or applicable dimension including diameter, thickness, width, length, etc.;
- 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 A 484/A 484M, including any supplementary requirements indicated in the purchase order. Failure to comply with the general requirements of Specification A 484/A 484M constitutes nonconformance with this specification. In case of conflict between the requirements of this specification and Specification A 484/A 484M, this specification shall prevail.

### 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:

5.1.1.1 *Condition A*—Annealed,

5.1.1.2 *Condition T*—Heat treated (for machining),

5.1.1.3 *Condition HT*—Heat treated (for high-temperature service), or

5.1.1.4 *Condition H*—Heat treated.

#### 5.2 Condition and Finish:

5.2.1 Bars may be furnished in one of the following hot-finished conditions:

5.2.1.1 Hot rolled, or

5.2.1.2 Rough turned (rounds only).

5.2.2 Bars may be furnished in one of the following cold-finished conditions:

5.2.2.1 Cold drawn,

5.2.2.2 Centerless ground (rounds only), or

5.2.2.3 Polished (rounds only).

<sup>1</sup> 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.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 01.05.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 01.01.

<sup>5</sup> Available from Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.

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

**TABLE 1 Chemical Requirements**

Grade	UNS Designation <sup>A</sup>	Carbon	Man-ganese	Phos-phorus	Sulfur	Silicon	Chromium	Nickel	Molybdenum	Vana-dium	Tungsten	Nitrogen	Alumi-num	Colum-bium	Copper
XM-32	S64152	0.08–0.15	0.50–0.90	0.025 max	0.025 max	0.35 max	11.00–12.50	2.00–3.00	1.50–2.00	0.25–0.40	...	0.01–0.05	...	...	...
...	S41041	0.13–0.18	0.40–0.60	0.030 max	0.030 max	0.50 max	11.50–13.00	0.50 max	0.20 max	...	...	...	0.05 max	0.15–0.45	...
...	S41425	0.05 max	0.50–1.00	0.02 max	0.005 max	0.50 max	12.00–15.00	4.00–7.00	1.50–2.00	...	...	0.06–0.12	...	...	0.30 max
615	S41800	0.15–0.20	0.50 max	0.040 max	0.030 max	0.50 max	12.00–14.00	1.80–2.20	0.50 max	...	2.50–3.50	...	...	...	...
616	S42200	0.20–0.25	0.50–1.00	0.025 max	0.025 max	0.50 max	11.00–12.50	0.50–1.00	0.90–1.25	0.20–0.30	0.90–1.25	...	...	...	...
619	S42300	0.27–0.32	0.95–1.35	0.025 max	0.025 max	0.50 max	11.00–12.00	0.50 max	2.50–3.00	0.20–0.30	...	...	...	...	...

<sup>A</sup> New designation established in accordance with Practice E 527 and SAE J1086.

## 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 A 751.

## 7. Metallurgical Requirements

7.1 The microstructure shall not contain more than 5 % delta-ferrite after full heat treatment as described in Table 2.

## 8. Mechanical Properties Requirements

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

8.2 Material furnished in Condition A or T shall be capable of developing the room-temperature properties specified for Condition HT when subjected to heat treatment as specified in Table 2.

8.3 The yield strength shall be determined by the offset method as described in the current edition of Test Methods and Definitions A 370.

8.4 The impact strength shall be determined at 70 to 80°F [21 to 27°C], by Charpy V-notch specimen Type A as described in Test Methods and Definitions A 370.

## 9. Keywords

9.1 martensitic stainless steel; stainless steel bars; stainless steel billets; stainless steel forgings; temperature service applications—high

**TABLE 2 Heat Treatment**

NOTE 1— If straightened, a stress-relieving treatment is necessary. Stress-relieving temperature should be 50°F [28°C] below the final tempering temperature.

NOTE 2—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.

Grade	UNS Designation <sup>A</sup>	Condition	Heat Treatment
615	S41800	HT	1800 to 1850 °F [981 to 1008 °C], quench in air or oil and double temper at 1150 °F [620 °C] min for 2 h min for each tempering treatment.
...	S41425	HT	1700 to 1800 °F [925 to 981 °C], quench in air and temper at 1100 °F min for 1 h, min, per inch thickness.
616	S42200	HT	1875 to 1925 °F [1022 to 1050 °C], quench in air or oil and temper at 1150 °F [620 °C] min for 2 h min.
		H	1875 to 1925 °F [1022 to 1050 °C], quench in air or oil and temper at 1250 °F [677 °C] min for 2 h min.
619	S42300	HT	1875 to 1925 °F [1022 to 1050 °C], quench in air or oil and temper at 1150 °F [620 °C] min for 2 h min.
XM-32	K64152	HT	1825 to 1875 °F [995 to 1022 °C], quench in air or oil and temper at 1050 °F [565 °C] min for 2 h min.
...	S41041	HT	2075 to 2125 °F [1136 to 1163 °C] for 2 h min, quench in air or oil and temper at 1250 °F [677 °C] min for 2 h min.

<sup>A</sup> New designation established in accordance with Practice E 527 and SAE J1086.