



# Standard Specification for Precipitation-Hardening Stainless and Heat-Resisting Steel Plate, Sheet, and Strip<sup>1</sup>

This standard is issued under the fixed designation A693; 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<sup>2</sup> covers precipitation-hardening stainless steel plate, sheet, and strip. The mechanical properties of these steels are developed by suitable low-temperature heat treatments generally referred to as precipitation hardening.

1.2 These steels are used for parts requiring corrosion resistance and high strength at room temperature or at temperatures up to 600°F (315°C). Some of these steels are particularly suitable for moderate to severe drawing and forming in the solution-treated condition. Others are capable of mild forming only. They are suitable for machining in the solution-annealed condition, after which they may be hardened to the mechanical properties specified in this standard without danger of cracking or distortion.

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

## 2. Referenced Documents

2.1 *ASTM Standards*:<sup>3</sup>

**A480/A480M** Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

**E527** Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

2.2 *SAE Standard*:

**SAE J 1086** Recommended Practice for Numbering Metals and Alloys (UNS)<sup>4</sup>

<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> For ASME Boiler and Pressure Vessel Code applications see related Specification SA-693 in Section II of that Code.

<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.

<sup>4</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

## 3. General Requirements

3.1 The following requirements for orders for material furnished under this specification shall conform to the applicable requirements of the current edition of Specification **A480/A480M** or as specified in the following:

### 3.1.1 Ordering Information:

3.1.1.1 In addition to the requirements of Specification **A480/A480M**, the heat treatment (see Section 6) shall be specified on the purchase order if other than the solution-annealed condition is being ordered.

## 4. Materials and Manufacture

4.1 The steel shall be melted by one of the following processes:

4.1.1 Electric furnace (with separate degassing and refining optional),

4.1.2 Vacuum furnace, and

4.1.3 One of the former followed by:

4.1.3.1 Consumable remelting in vacuum, inert gas, or electroslag, or

4.1.3.2 Electron beam refining.

4.1.4 Other commercial melting methods as agreed upon between purchaser and seller are acceptable.

## 5. Chemical Composition

5.1 The steel shall conform to the requirements as to chemical composition specified in **Table 1**, and shall conform to applicable requirements specified in the current edition of Specification **A480/A480M**.

## 6. Heat Treatment of Product

6.1 Material of types other than Type UNS S46910 shall be furnished in the solution-annealed condition as noted in **Tables 2 and 3** unless otherwise specified by the purchaser on the purchase order.

6.2 Type UNS S46910 shall be furnished in cold-worked condition.

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

TABLE 1 Chemical Requirements<sup>A</sup>

| UNS Designation <sup>B</sup> | Type  | Carbon    | Manga-<br>nese | Phos-<br>phorus | Sulfur | Silicon | Composition, % |           |           |           |           | Copper    | Titanium  | Molyb-<br>denum | Aluminum | Nickel | Chromium | Other<br>Elements <sup>C</sup> |
|------------------------------|-------|-----------|----------------|-----------------|--------|---------|----------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------------|----------|--------|----------|--------------------------------|
|                              |       |           |                |                 |        |         |                |           |           |           |           |           |           |                 |          |        |          |                                |
| S17400                       | 630   | 0.07      | 1.00           | 0.040           | 0.030  | 1.00    | 15.0–17.5      | 3.0–5.0   | ...       | ...       | ...       | ...       | ...       | ...             | ...      | ...    | ...      | D                              |
| S17700                       | 631   | 0.09      | 1.00           | 0.040           | 0.030  | 1.00    | 16.0–18.0      | 6.5–7.7   | 0.75–1.50 | ...       | ...       | ...       | ...       | ...             | ...      | ...    | ...      | ...                            |
| S15700                       | 632   | 0.09      | 1.00           | 0.040           | 0.030  | 1.00    | 14.0–16.0      | 6.5–7.7   | 0.75–1.50 | 2.00–3.00 | ...       | ...       | ...       | ...             | ...      | ...    | ...      | E                              |
| S35000                       | 633   | 0.07–0.11 | 0.50–1.25      | 0.040           | 0.030  | 0.50    | 16.0–17.0      | 4.0–5.0   | ...       | ...       | ...       | ...       | ...       | ...             | ...      | ...    | ...      | E                              |
| S35500                       | 634   | 0.10–0.15 | 0.50–1.25      | 0.040           | 0.030  | 0.50    | 15.0–16.0      | 4.0–5.0   | ...       | ...       | ...       | ...       | ...       | ...             | ...      | ...    | ...      | E                              |
| S17600                       | 635   | 0.08      | 1.00           | 0.040           | 0.030  | 1.00    | 16.0–17.5      | 6.0–7.5   | 0.40      | ...       | ...       | 0.40–1.20 | ...       | ...             | ...      | ...    | ...      | ...                            |
| S36200                       | XM-9  | 0.05      | 0.50           | 0.030           | 0.030  | 0.30    | 14.0–14.5      | 6.5–7.0   | 0.10      | 0.30      | ...       | 0.60–0.90 | ...       | ...             | ...      | ...    | ...      | ...                            |
| S15500                       | XM-12 | 0.07      | 1.00           | 0.040           | 0.030  | 1.00    | 14.0–15.5      | 3.5–5.5   | 0.90–1.35 | ...       | ...       | ...       | ...       | ...             | ...      | ...    | ...      | D                              |
| S13800                       | XM-13 | 0.05      | 0.20           | 0.010           | 0.008  | 0.10    | 12.3–13.2      | 7.5–8.5   | ...       | ...       | 2.00–2.50 | ...       | ...       | ...             | ...      | ...    | ...      | G                              |
| S45500                       | XM-16 | 0.05      | 0.50           | 0.040           | 0.030  | 0.50    | 11.0–12.5      | 7.5–9.5   | ...       | ...       | 0.50      | 0.80–1.40 | 1.50–2.50 | ...             | ...      | ...    | ...      | F                              |
| S45000                       | XM-25 | 0.05      | 1.00           | 0.030           | 0.030  | 1.00    | 14.0–16.0      | 5.0–7.0   | ...       | ...       | 0.50–1.00 | ...       | 1.25–1.75 | ...             | ...      | ...    | ...      | H                              |
| S46500                       | ...   | 0.02      | 0.25           | 0.015           | 0.010  | 0.25    | 11.0–12.5      | 10.8–11.2 | ...       | ...       | 0.75–1.25 | 1.50–1.80 | ...       | ...             | ...      | ...    | ...      | G                              |
| S46910                       | ...   | 0.030     | 1.00           | 0.030           | 0.015  | 0.70    | 11.0–13.0      | 8.0–10.0  | 0.15–0.50 | ...       | 3.0–5.0   | 0.50–1.20 | 1.5–3.5   | ...             | ...      | ...    | ...      | ...                            |

<sup>A</sup> Limits are in percent maximum unless shown as a range or stated otherwise.<sup>B</sup> Designation established in accordance with Practice E527 and SAE J 1086.<sup>C</sup> The terms Columbium (Cb) and Niobium (Nb) both refer to the same element.<sup>D</sup> Niobium 0.15–0.45.<sup>E</sup> Nitrogen 0.07–0.13.<sup>F</sup> Niobium 0.10–0.50.<sup>G</sup> Nitrogen 0.01.<sup>H</sup> Niobium 8 times carbon minimum.

**TABLE 2 Heat Treatment, °F**

| UNS Designation               | Type             | Solution Treatment                                                                                                                                                                    | Precipitation Hardening Treatment <sup>A</sup>                                                                                                                                                                                                     |
|-------------------------------|------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S17400                        | 630              | 1925 ± 50°F (cool as required)                                                                                                                                                        | 900 ± 15°F, 1 h, air cool.<br>925 ± 15°F, 4 h, air cool.<br>1025 ± 15°F, 4 h, air cool.<br>1075 ± 15°F, 4 h, air cool.<br>1100 ± 15°F, 4 h, air cool.<br>1150 ± 15°F, 4 h, air cool.<br>(1400 ± 15°F, 2 h, air cool + 1150 ± 15°F, 4 h, air cool). |
| S17700                        | 631              | 1950 ± 25°F (cool as required)                                                                                                                                                        | 1750 ± 15°F, hold 10 min, cool rapidly to room temperature. Cool within 24 h, to –100 ± 10°F, hold not less than 8 h. Warm in air to room temperature. Heat to 950 ± 10°F, hold 1 h, air cool.                                                     |
| <i>Alternative Treatment:</i> |                  |                                                                                                                                                                                       |                                                                                                                                                                                                                                                    |
|                               |                  | 1400 ± 25°F, hold 90 min, cool to 55 ± 5°F within 1 h. Hold not less than 30 min, heat to 1050 ± 10°F, hold for 90 min, air cool.                                                     |                                                                                                                                                                                                                                                    |
| S15700                        | 632              | 1950 ± 25°F (cool as required)                                                                                                                                                        | Same as Type 631                                                                                                                                                                                                                                   |
| S35000                        | 633              | 1900 ± 50°F (quench)                                                                                                                                                                  | 1710 ± 25°F for not less than 10 min, but not more than 1 h, quench. Cool to not higher than –100°F, hold for not less than 3 h. Temper at 850 ± 15°F, 3 h, air cool, or 1000 ± 15°F, 3 h, air cool.                                               |
| S35500                        | 634 <sup>B</sup> | 1900 ± 25°F (quench)                                                                                                                                                                  | 1750 ± 10°F for not less than 10 min, but not more than 1 h, quench. Cool to not higher than –100°F, hold for not less than 3 h. Temper at 1000 ± 25°F, holding for not less than 3 h.                                                             |
| S17600                        | 635              | 1900 ± 25°F (air cool)                                                                                                                                                                | 950 ± 15°F, 30 min, air cool.<br>1000 ± 15°F, 30 min, air cool.<br>1050 ± 15°F, 30 min, air cool.                                                                                                                                                  |
| S36200                        | XM-9             | 1550 ± 25°F (air cool)                                                                                                                                                                | 900 ± 10°F, 8 h, air cool.                                                                                                                                                                                                                         |
| S15500                        | XM-12            | 1900 ± 25°F (cool as required)                                                                                                                                                        | Same as Type 630                                                                                                                                                                                                                                   |
| S13800                        | XM-13            | 1700 ± 25°F (cool as required to below 60°F)                                                                                                                                          | 950 ± 10°F, 4 h, air cool.<br>1000 ± 10°F, 4 h, air cool.                                                                                                                                                                                          |
| S45500                        | XM-16            | 1525 ± 25°F (water quench)                                                                                                                                                            | 900 ± 10°F, 4 h, air cool. or 950 ± 10°F, 4 h, air cool.                                                                                                                                                                                           |
| S45000                        | XM-25            | 1900 ± 25°F (cool rapidly)                                                                                                                                                            | 900 ± 15°F, 4 h, air cool.<br>1000 ± 15°F, 4 h, air cool.<br>1150 ± 15°F, 4 h, air cool.                                                                                                                                                           |
| S46500                        | ...              | 1875 ± 25°F (cool rapidly to room temperature) followed by subzero cooling within 24 h after solution treatment; –100 ± 10°F, hold not less than 8 h; warm in air to room temperature | 900 ± 10°F, 4 h, air cool.<br>950 ± 15°F, 4 h, air cool.<br>1000 ± 15°F, 4 h, air cool.<br>1050 ± 15°F, 4 h, air cool.<br>1100 ± 15°F, 4 h, air cool.                                                                                              |
| S46910 <sup>C</sup>           |                  |                                                                                                                                                                                       | 890 ± 15°F, 4 h, air cool                                                                                                                                                                                                                          |

<sup>A</sup> Times refer to time material is at temperature.

<sup>B</sup> Equalization and over-tempering treatment: 1425 ± 50°F for not less than 3 h, cool to room temperature, heat to 1075 ± 25°F for not less than 3 h.

<sup>C</sup> Furnished in cold-worked condition.

## 7. Mechanical Properties

7.1 The material, as represented by mechanical test specimens, shall conform to the mechanical property requirements specified in [Table 4](#) and shall be capable of developing the properties in [Table 5](#) when heat treated as specified in [9.1](#).

## 8. Bending Requirements

8.1 Samples cut from the solution-annealed plate, sheet, or strip shall withstand cold bending as specified in [Table 6](#) without cracking on the outside of the bent portion.

## 9. Heat Treatment of Test Specimens

9.1 Samples cut from the plate, sheet, or strip shall conform to the mechanical properties of [Table 5](#) when precipitation hardened as specified in [Table 2](#) and [Table 3](#).

## 10. Keywords

10.1 plate; precipitation hardening; sheet; stainless steel; strip



TABLE 3 Heat Treatment, °C

| UNS Designation              | Type             | Solution Treatment                                                                                                                                                                   | Precipitation Hardening Treatment <sup>A</sup>                                                                                                                                                                                       |
|------------------------------|------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| S17400                       | 630              | 1050 ± 25°C (cool as required)                                                                                                                                                       | 482 ± 8°C, 1 h, air cool.<br>496 ± 8°C, 4 h, air cool.<br>552 ± 8°C, 4 h, air cool.<br>579 ± 8°C, 4 h, air cool.<br>593 ± 8°C, 4 h, air cool.<br>621 ± 8°C, 4 h, air cool.<br>(760 ± 8°C, 2 h, air cool + 621 ± 8°C, 4 h, air cool). |
| S17700                       | 631              | 1065 ± 15°C (water quench)                                                                                                                                                           | 954 ± 8°C, hold 10 min, cool rapidly to room temperature. Cool within 24 h to –73°C ± 6°C, hold not less than 8 h. Warm in air to room temperature. Heat to 510 ± 6°C, hold 1 h, air cool.                                           |
| <i>Alternative Treatment</i> |                  |                                                                                                                                                                                      |                                                                                                                                                                                                                                      |
|                              |                  | 760 ± 15°C, hold 90 min, cool to 15 ± 3°C within 1 h. Hold not less than 30 min, heat to 566 ± 6°C, hold for 90 min, air cool.                                                       |                                                                                                                                                                                                                                      |
| S15700                       | 632              | 1038 ± 15°C (water quench)                                                                                                                                                           | Same as Type 631                                                                                                                                                                                                                     |
| S35000                       | 633              | 1038 ± 25°C (quench)                                                                                                                                                                 | 930 ± 15°C for not less than 10 min, but not more than 1 h, quench. Cool to not higher than –73°C, hold for not less than 3 h. Temper at 455 ± 8°C, 3 h, air cool, or<br>540 ± 8°C, 3 h, air cool.                                   |
| S35500                       | 634 <sup>B</sup> | 1038 ± 15°C (quench).                                                                                                                                                                | 954 ± 6°C for not less than 10 min, but not more than 1 h, quench. Cool to not higher than –73°C, hold for not less than 3 h. Temper at 538 ± 15°C, holding for not less than 3 h.                                                   |
| S17600                       | 635              | 1038 ± 15°C (air cool)                                                                                                                                                               | 510 ± 8°C, 30 min, air cool.<br>538 ± 8°C, 30 min, air cool.<br>566 ± 8°C, 30 min, air cool.                                                                                                                                         |
| S36200                       | XM-9             | 843 ± 15°C (air cool)                                                                                                                                                                | 482 ± 8°C, 8 h, air cool.                                                                                                                                                                                                            |
| S15500                       | XM-12            | 1038 ± 15°C (cool as required)                                                                                                                                                       | Same as Type 630                                                                                                                                                                                                                     |
| S13800                       | XM-13            | 927 ± 15°C (cool as required to below 60°C)                                                                                                                                          | 510 ± 6°C, 4 h, air cool.<br>538 ± 6°C, 4 h, air cool.                                                                                                                                                                               |
| S45500                       | XM-16            | 829 ± 15°C (water quench)                                                                                                                                                            | 482 ± 6°C, 4 h, air cool. or 510 ± 6°C, 4 h, air cool.                                                                                                                                                                               |
| S45000                       | XM-25            | 1038 ± 15°C (cool rapidly)                                                                                                                                                           | 482 ± 8°C, 4 h, air cool.<br>538 ± 8°C, 4 h, air cool.<br>621 ± 8°C, 4 h, air cool.                                                                                                                                                  |
| S46500                       | ...              | 1024 ± 15°C, (cool rapidly to room temperature) followed by subzero cooling within 24 h after solution treatment; –73 ± 6°C; hold not less than 8 h; warm in air to room temperature | 482 ± 6°C, 4 h, air cool<br>510 ± 8°C, 4 h, air cool<br>538 ± 8°C, 4 h, air cool<br>566 ± 8°C, 4 h, air cool<br>593 ± 8°C, 4 h, air cool<br>475 ± 8°C, 4 h, air cool                                                                 |
| S46910 <sup>C</sup>          |                  |                                                                                                                                                                                      |                                                                                                                                                                                                                                      |

<sup>A</sup> Times refer to time material is at temperature.<sup>B</sup> Equalization and over-tempering treatment: 774 ± 25°C for not less than 3 h, cool to room temperature, heat to 579 ± 15°C for not less than 3 h.<sup>C</sup> Furnished in cold-worked condition.

TABLE 4 Mechanical Test Requirements in Solution-Treated Condition

| Type               |                                              | Tensile Strength, max |      | Yield Strength, max |      | Elongation in<br>2 in. or 50 mm,<br>min, % | Hardness, max |         |
|--------------------|----------------------------------------------|-----------------------|------|---------------------|------|--------------------------------------------|---------------|---------|
|                    |                                              | ksi                   | MPa  | ksi                 | MPa  |                                            | Rockwell      | Brinell |
| 630                | 0.015 to 4.0 in. (0.38 to 102 mm)            | ...                   | ...  | ...                 | ...  | ...                                        | C38           | 363     |
| 631                | 0.010 in. (0.25 mm) and under                | 150                   | 1035 | 65                  | 450  | ...                                        | ...           | ...     |
|                    | Over 0.010 to 4.0 in. (0.25 to 102 mm)       | 150                   | 1035 | 55                  | 380  | 20                                         | B92           | ...     |
| 632                | 0.0015 to 4.0 in. (0.038 to 102 mm)          | 150                   | 1035 | 65                  | 450  | 25                                         | B100          | ...     |
| 633                | 0.001 to 0.0015 in. (0.03 to 0.038 mm), excl | 200                   | 1380 | 90                  | 620  | 8                                          | C30           | ...     |
|                    | 0.0015 to 0.002 in. (0.03 to 0.05 mm), excl  | 200                   | 1380 | 88                  | 605  | 8                                          | C30           | ...     |
|                    | 0.002 to 0.005 in. (0.05 to 0.13 mm), excl   | 200                   | 1380 | 86                  | 595  | 8                                          | C30           | ...     |
|                    | 0.005 to 0.010 in. (0.13 to 0.25 mm), excl   | 200                   | 1380 | 85                  | 585  | 8                                          | C30           | ...     |
|                    | Over 0.010 in. (0.254 mm)                    | 200                   | 1380 | 85                  | 585  | 12                                         | C30           | ...     |
| 634 <sup>A</sup>   | Plate                                        | ...                   | ...  | ...                 | ...  | ...                                        | C40           | ...     |
| 635                | 0.030 in. (0.76 mm) and under                | 120                   | 825  | 75                  | 515  | 3                                          | C32           | ...     |
|                    | Over 0.030 to 0.060 in. (0.76 to 1.52 mm)    | 120                   | 825  | 75                  | 515  | 4                                          | C32           | ...     |
|                    | Over 0.060 in. (1.52 mm)                     | 120                   | 825  | 75                  | 515  | 5                                          | C32           | ...     |
|                    | Over 0.010 in. (0.25 mm)                     | 150                   | 1035 | 125                 | 860  | 4                                          | C28           | ...     |
| XM-9               | 0.0015 to 4.00 in. (0.038 to 101.6 mm)       | ...                   | ...  | ...                 | ...  | ...                                        | C38           | 363     |
| XM-12              | 0.0015 to 4.00 in. (0.038 to 101.6 mm)       | ...                   | ...  | ...                 | ...  | ...                                        | C38           | 363     |
| XM-16              | 0.010 in. (0.25 mm) and greater              | 175                   | 1205 | 160                 | 1105 | 3                                          | C36           | 331     |
| XM-25 <sup>B</sup> | 0.010 in. (0.25 mm) and greater              | 165                   | 1205 | 150                 | 1035 | 4                                          | C33           | 311     |
| S46500             | 0.140 in. (3.56 mm) and under                | 160                   | 1105 | 150                 | 1035 | 4                                          | C33           | ...     |

<sup>A</sup> Solution-treated, equalized, and over-tempered plate only.<sup>B</sup> XM-25 also furnished to the following minimum properties:

|     |     |    |     |   |     |     |
|-----|-----|----|-----|---|-----|-----|
| 130 | 895 | 90 | 620 | 4 | C25 | 255 |
|-----|-----|----|-----|---|-----|-----|



TABLE 5 Mechanical Test Requirements After Precipitation Hardening Treatment

| Grade            | Hardening or<br>Precipitation<br>Treatment or<br>both, °F(°C) | Thickness, in. (mm)               | Tensile<br>Strength, min |      | Yield<br>Strength, min |      | Elonga-<br>tion in 2<br>in. or<br>50 mm,<br>min,<br>% <sup>A</sup> | Reduc-<br>tion of<br>Area,<br>min,<br>% <sup>A</sup> | Hardness, min            |                         | Impact<br>Charpy V,<br>min <sup>B</sup> |     |
|------------------|---------------------------------------------------------------|-----------------------------------|--------------------------|------|------------------------|------|--------------------------------------------------------------------|------------------------------------------------------|--------------------------|-------------------------|-----------------------------------------|-----|
|                  |                                                               |                                   | ksi                      | MPa  | ksi                    | MPa  |                                                                    |                                                      | Rockwell,<br>min/<br>max | Brinell,<br>min/<br>max | ft-lbf                                  | J   |
| 630 and<br>XM-12 | 900 (482)                                                     | Under 0.1875 (4.762)              | 190                      | 1310 | 170                    | 1170 | 5                                                                  | ...                                                  | C40/<br>C48              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 190                      | 1310 | 170                    | 1170 | 8                                                                  | 25                                                   | C40/<br>C48              | 388/<br>477             | ...                                     | ... |
|                  |                                                               | 0.626 to 4.0 (15.90 to 102)       | 190                      | 1310 | 170                    | 1170 | 10                                                                 | 30                                                   | C40/<br>C48              | 388/<br>477             | ...                                     | ... |
|                  | 925 (496)                                                     | Under 0.1875 (4.762)              | 170                      | 1170 | 155                    | 1070 | 5                                                                  | ...                                                  | C38/<br>C46              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 170                      | 1170 | 155                    | 1070 | 8                                                                  | 25                                                   | C38/<br>C47              | 375/<br>477             | ...                                     | ... |
|                  |                                                               | 0.626 to 4.0 (15.90 to 102)       | 170                      | 1170 | 155                    | 1070 | 10                                                                 | 30                                                   | C38/<br>C47              | 375/<br>477             | ...                                     | ... |
|                  | 1025 (552)                                                    | Under 0.1875 (4.762)              | 155                      | 1070 | 145                    | 1000 | 5                                                                  | ...                                                  | C35/<br>C43              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 155                      | 1070 | 145                    | 1000 | 8                                                                  | 30                                                   | C33/<br>C42              | 321/<br>415             | 10                                      | 14  |
|                  |                                                               | 0.626 to 4.0 (15.90 to 102)       | 155                      | 1070 | 145                    | 1000 | 12                                                                 | 35                                                   | C33/<br>C42              | 321/<br>415             | 15                                      | 20  |
|                  | 1075 (579)                                                    | Under 0.1875 (4.762)              | 145                      | 1000 | 125                    | 860  | 5                                                                  | ...                                                  | C31/<br>C40              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 145                      | 1000 | 125                    | 860  | 9                                                                  | 30                                                   | C29/<br>C38              | 293/<br>375             | 15                                      | 20  |
|                  |                                                               | 0.626 to 4.0 (15.88 to 102)       | 145                      | 1000 | 125                    | 860  | 13                                                                 | 35                                                   | C29/<br>C38              | 293/<br>375             | 20                                      | 27  |
|                  | 1100 (593)                                                    | Under 0.1875 (4.762)              | 140                      | 965  | 115                    | 790  | 5                                                                  | ...                                                  | C31/<br>C40              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 140                      | 965  | 115                    | 790  | 10                                                                 | 30                                                   | C29/<br>C38              | 293/<br>375             | 15                                      | 20  |
|                  |                                                               | 0.626 to 4.0 (15.88 to 102)       | 140                      | 965  | 115                    | 790  | 14                                                                 | 35                                                   | C29/<br>C38              | 293/<br>375             | 20                                      | 27  |
|                  | 1150 (621)                                                    | Under 0.1875 (4.762)              | 135                      | 930  | 105                    | 725  | 8                                                                  | ...                                                  | C28/<br>C38              | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 135                      | 930  | 105                    | 725  | 10                                                                 | 35                                                   | C26/<br>C36              | 269/<br>352             | 25                                      | 34  |
|                  |                                                               | 0.626 to 4.0 (15.88 to 102)       | 135                      | 930  | 105                    | 725  | 16                                                                 | 40                                                   | C26/<br>C36              | 269/<br>352             | 30                                      | 41  |
|                  | 1400 + 1150<br>(760 + 621)                                    | Under 0.1875 (4.762)              | 115                      | 790  | 75                     | 515  | 9                                                                  | ...                                                  | C26/<br>C36              | 255/<br>331             | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 115                      | 790  | 75                     | 515  | 11                                                                 | 40                                                   | C24/<br>C34              | 248/<br>321             | 55                                      | 75  |
|                  |                                                               | 0.626 to 4.0 (15.88 to 102)       | 115                      | 790  | 75                     | 515  | 18                                                                 | 45                                                   | C24/<br>C34              | 248/<br>321             | 55                                      | 75  |
| 631              | 1400 (760) +<br>plus 55 (15) +<br>1050 (566)                  | 0.0015 to 0.0049 (0.038 to 0.124) | 180                      | 1240 | 150                    | 1035 | 3                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.0050 to 0.0099 (0.127 to 0.251) | 180                      | 1240 | 150                    | 1035 | 4                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.010 to 0.0199 (0.25 to 0.505)   | 180                      | 1240 | 150                    | 1035 | 5                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.020 to 0.1874 (0.51 to 4.760)   | 180                      | 1240 | 150                    | 1035 | 6                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 170                      | 1170 | 140                    | 965  | 7                                                                  | 20                                                   | C38                      | 352                     | ...                                     | ... |
|                  | 1750 (954) +<br>minus 100 (73)<br>+ 950 (510)                 | 0.0015 to 0.0049 (0.038 to 0.124) | 210                      | 1450 | 190                    | 1310 | 1                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.0050 to 0.0099 (0.127 to 0.251) | 210                      | 1450 | 190                    | 1310 | 2                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.010 to 0.0199 (0.25 to 0.505)   | 210                      | 1450 | 190                    | 1310 | 3                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                  |                                                               | 0.020 to 0.1874 (0.51 to 4.760)   | 210                      | 1450 | 190                    | 1310 | 4                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                  |                                                               |                                   |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |



TABLE 5 Continued

| Grade | Hardening or<br>Precipitation<br>Treatment or<br>both, °F(°C) | Thickness, in. (mm)               | Tensile<br>Strength, min |      | Yield<br>Strength, min |      | Elonga-<br>tion in 2<br>in. or<br>50 mm,<br>min,<br>% <sup>A</sup> | Reduc-<br>tion of<br>Area,<br>min,<br>% <sup>A</sup> | Hardness, min            |                         | Impact<br>Charpy V,<br>min <sup>B</sup> |     |
|-------|---------------------------------------------------------------|-----------------------------------|--------------------------|------|------------------------|------|--------------------------------------------------------------------|------------------------------------------------------|--------------------------|-------------------------|-----------------------------------------|-----|
|       |                                                               |                                   | ksi                      | MPa  | ksi                    | MPa  |                                                                    |                                                      | Rockwell,<br>min/<br>max | Brinell,<br>min/<br>max | ft-lbf                                  | J   |
| 632   |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 200                      | 1380 | 180                    | 1240 | 6                                                                  | 20                                                   | C43                      | 401                     | ...                                     | ... |
|       | Cold rolled at mill                                           | 0.0015 to 0.050 (0.038 to 1.27)   | 200                      | 1380 | 175                    | 1205 | 1                                                                  | ...                                                  | C41                      | ...                     | ...                                     | ... |
|       | Cold rolled at mill<br>+ 900 (482)                            | 0.0015 to 0.050 (0.038 to 1.27)   | 240                      | 1655 | 230                    | 1580 | 1                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       | 1400 (760) +                                                  | 0.0015 to 0.0049 (0.038 to 0.124) | 190                      | 1310 | 170                    | 1170 | 2                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|       | plus 55 (15) +                                                | 0.0050 to 0.0099 (0.127 to 0.251) | 190                      | 1310 | 170                    | 1170 | 3                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|       | 1050 (566)                                                    | 0.010 to 0.0199 (0.25 to 0.505)   | 190                      | 1310 | 170                    | 1170 | 4                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|       |                                                               | 0.020 to 0.1874 (0.51 to 4.760)   | 190                      | 1310 | 170                    | 1170 | 5                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|       |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 190                      | 1310 | 170                    | 1170 | 4                                                                  | 20                                                   | C40                      | 375                     | ...                                     | ... |
|       | 1750 (954) +                                                  | 0.0015 to 0.0049 (0.038 to 0.124) | 225                      | 1550 | 200                    | 1380 | 1                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       | minus 100 (73)                                                | 0.0050 to 0.0099 (0.127 to 0.251) | 225                      | 1550 | 200                    | 1380 | 2                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       | + 950 (510)                                                   | 0.010 to 0.0199 (0.25 to 0.505)   | 225                      | 1550 | 200                    | 1380 | 3                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       |                                                               | 0.020 to 0.1874 (0.51 to 4.760)   | 225                      | 1550 | 200                    | 1380 | 4                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       |                                                               | 0.1875 to 0.625 (4.762 to 15.88)  | 225                      | 1550 | 200                    | 1380 | 4                                                                  | 20                                                   | C45                      | 429                     | ...                                     | ... |
|       | Cold rolled at mill                                           | 0.0015 to 0.050 (0.038 to 0.13)   | 200                      | 1380 | 175                    | 1205 | 1                                                                  | ...                                                  | C41                      | ...                     | ...                                     | ... |
| 633   | Cold rolled at mill<br>+ 900 (482)                            | 0.0015 to 0.050 (0.038 to 0.13)   | 240                      | 1655 | 230                    | 1585 | 1                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|       | 850 (455)                                                     | 0.0005 to 0.0015 (0.022 to 0.038) | 185                      | 1275 | 150                    | 1035 | 2                                                                  | ...                                                  | C42                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0015 to 0.0020 (0.038 to 0.041) | 185                      | 1275 | 150                    | 1035 | 4                                                                  | ...                                                  | C42                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0020 to 0.0100 (0.041 to 0.254) | 185                      | 1275 | 150                    | 1035 | 6                                                                  | ...                                                  | C42                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0100 to 0.1875 (0.254 to 4.762) | 185                      | 1275 | 150                    | 1035 | 8                                                                  | ...                                                  | C42                      | ...                     | ...                                     | ... |
|       | 1000 (540)                                                    | 0.0005 to 0.0015 (0.022 to 0.038) | 165                      | 1140 | 145                    | 1000 | 2                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0015 to 0.0020 (0.038 to 0.041) | 165                      | 1140 | 145                    | 1000 | 4                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0020 to 0.0100 (0.041 to 0.254) | 165                      | 1140 | 145                    | 1000 | 6                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|       |                                                               | 0.0100 to 0.1875 (0.254 to 4.762) | 165                      | 1140 | 145                    | 1000 | 8                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|       | 850 (455)                                                     |                                   | 190                      | 1310 | 165                    | 1140 | 10                                                                 | ...                                                  | ...                      | ...                     | ...                                     | ... |
| 634   | 1000 (540)                                                    |                                   | 170                      | 1170 | 150                    | 1035 | 12                                                                 | ...                                                  | C37                      | ...                     | ...                                     | ... |
|       | 950 (510)                                                     | 0.030 (0.76) and under            | 190                      | 1310 | 170                    | 1170 | 3                                                                  | ...                                                  | C39                      | ...                     | ...                                     | ... |
| 635   |                                                               | 0.030 to 0.060 (0.76 to 1.52)     | 190                      | 1310 | 170                    | 1170 | 4                                                                  | ...                                                  | C39                      | ...                     | ...                                     | ... |
|       |                                                               | Over 0.060 (1.52)                 | 190                      | 1310 | 170                    | 1170 | 5                                                                  | ...                                                  | C39                      | ...                     | ...                                     | ... |
|       |                                                               | Plate                             | 190                      | 1310 | 170                    | 1170 | 8                                                                  | 25                                                   | C39                      | 363                     | ...                                     | ... |
|       | 1000 (540)                                                    | 0.030 (0.76) and under            | 180                      | 1240 | 160                    | 1105 | 3                                                                  | ...                                                  | C37                      | ...                     | ...                                     | ... |
|       |                                                               | 0.030 to 0.060 (0.76 to 1.52)     | 180                      | 1240 | 160                    | 1105 | 4                                                                  | ...                                                  | C37                      | ...                     | ...                                     | ... |
|       |                                                               | Over 0.060 (1.52)                 | 180                      | 1240 | 160                    | 1105 | 5                                                                  | ...                                                  | C37                      | ...                     | ...                                     | ... |
|       |                                                               | Plate                             | 180                      | 1240 | 160                    | 1105 | 8                                                                  | 30                                                   | C38                      | 352                     | ...                                     | ... |
|       |                                                               |                                   |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |
|       |                                                               |                                   |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |
|       |                                                               |                                   |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |



TABLE 5 Continued

| Grade          | Hardening or<br>Precipitation<br>Treatment or<br>both, °F(°C) | Thickness, in. (mm)                | Tensile<br>Strength, min |      | Yield<br>Strength, min |      | Elonga-<br>tion in 2<br>in. or<br>50 mm,<br>min,<br>% <sup>A</sup> | Reduc-<br>tion of<br>Area,<br>min,<br>% <sup>A</sup> | Hardness, min            |                         | Impact<br>Charpy V,<br>min <sup>B</sup> |     |
|----------------|---------------------------------------------------------------|------------------------------------|--------------------------|------|------------------------|------|--------------------------------------------------------------------|------------------------------------------------------|--------------------------|-------------------------|-----------------------------------------|-----|
|                |                                                               |                                    | ksi                      | MPa  | ksi                    | MPa  |                                                                    |                                                      | Rockwell,<br>min/<br>max | Brinell,<br>min/<br>max | ft-lbf                                  | J   |
| XM-13          | 1050 (565)                                                    | 0.030 (0.76) and under             | 170                      | 1170 | 150                    | 1035 | 3                                                                  | ...                                                  | C35                      | ...                     | ...                                     | ... |
|                |                                                               | 0.030 to 0.060 (0.76 to 1.52)      | 170                      | 1170 | 150                    | 1035 | 4                                                                  | ...                                                  | C35                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.060 (1.52)                  | 170                      | 1170 | 150                    | 1035 | 5                                                                  | ...                                                  | C35                      | ...                     | ...                                     | ... |
|                |                                                               | Plate                              | 170                      | 1170 | 150                    | 1035 | 8                                                                  | 30                                                   | C36                      | 331                     | ...                                     | ... |
|                | 950 (510)                                                     | Under 0.020 (0.51)                 | 220                      | 1515 | 205                    | 1410 | 6                                                                  | ...                                                  | C45                      | ...                     | ...                                     | ... |
|                |                                                               | 0.020 to 0.1874 (0.51 to 4.760)    | 220                      | 1515 | 205                    | 1410 | 8                                                                  | ...                                                  | C45                      | ...                     | ...                                     | ... |
|                |                                                               | 0.1875 to 0.625 (4.760 to 15.88)   | 220                      | 1515 | 205                    | 1410 | 10                                                                 | ...                                                  | C45                      | ...                     | ...                                     | ... |
|                |                                                               | 0.626 to 4.0 (15.90 to 102)        | 220                      | 1515 | 205                    | 1410 | 10                                                                 | ...                                                  | C45                      | 429                     | ...                                     | ... |
|                | 1000 (538)                                                    | Under 0.020 (0.51)                 | 200                      | 1380 | 190                    | 1310 | 6                                                                  | ...                                                  | C43                      | ...                     | ...                                     | ... |
|                |                                                               | 0.020 to 0.1874 (0.51 to 4.760)    | 200                      | 1380 | 190                    | 1310 | 8                                                                  | ...                                                  | C43                      | ...                     | ...                                     | ... |
|                |                                                               | 0.1875 to 0.625 (4.760 to 15.88)   | 200                      | 1380 | 190                    | 1310 | 10                                                                 | ...                                                  | C43                      | ...                     | ...                                     | ... |
|                |                                                               | 0.626 to 4.0 (15.90 to 102)        | 200                      | 1380 | 190                    | 1310 | 10                                                                 | ...                                                  | C43                      | 401                     | ...                                     | ... |
| XM-16          | 950 (510)                                                     | Up to 0.020 (0.51)                 | 222                      | 1525 | 205                    | 1410 | ...                                                                | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.020 to 0.062 (0.51 to 1.57) | 222                      | 1525 | 205                    | 1410 | 3                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.062 (1.57)                  | 222                      | 1525 | 205                    | 1410 | 4                                                                  | ...                                                  | C44                      | ...                     | ...                                     | ... |
| XM-25          | 900 (482)                                                     | Up to 0.020 (0.51)                 | 180                      | 1240 | 170                    | 1170 | 3                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.020 to 0.062 (0.51 to 1.57) | 180                      | 1240 | 170                    | 1170 | 4                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.062 (1.57)                  | 180                      | 1240 | 170                    | 1170 | 5                                                                  | ...                                                  | C40                      | ...                     | ...                                     | ... |
|                |                                                               |                                    |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |
|                | 1000 (538)                                                    | Up to 0.020 (0.51)                 | 160                      | 1105 | 150                    | 1035 | 5                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.020 to 0.062 (0.51 to 1.57) | 160                      | 1105 | 150                    | 1035 | 6                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.062 (1.57)                  | 160                      | 1105 | 150                    | 1035 | 7                                                                  | ...                                                  | C36                      | ...                     | ...                                     | ... |
|                |                                                               |                                    |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |
|                | 1150 (621)                                                    | Up to 0.020 (0.51)                 | 125                      | 860  | 75                     | 515  | 8                                                                  | ...                                                  | C26                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.020 to 0.062 (0.51 to 1.57) | 125                      | 860  | 75                     | 515  | 9                                                                  | ...                                                  | C26                      | ...                     | ...                                     | ... |
|                |                                                               | Over 0.062 (1.57)                  | 125                      | 860  | 75                     | 515  | 10                                                                 | ...                                                  | C26                      | ...                     | ...                                     | ... |
|                |                                                               |                                    |                          |      |                        |      |                                                                    |                                                      |                          |                         |                                         |     |
| XM-9<br>S46500 | 900 (482)                                                     | Over 0.010 (0.25)                  | 180                      | 1240 | 160                    | 1105 | 3                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                | 900 (482)                                                     | 0.140 (3.56) and under             | 245                      | 1690 | 235                    | 1620 | 2                                                                  | ...                                                  | C48                      | ...                     | ...                                     | ... |
|                | 950 (510)                                                     | 0.140 (3.56) and under             | 235                      | 1620 | 225                    | 1550 | 3                                                                  | ...                                                  | C47                      | ...                     | ...                                     | ... |
|                | 1000 (538)                                                    | 0.140 (3.56) and under             | 220                      | 1515 | 210                    | 1445 | 4                                                                  | ...                                                  | C45                      | ...                     | ...                                     | ... |
|                | 1050 (566)                                                    | 0.140 (3.56) and under             | 200                      | 1380 | 185                    | 1275 | 5                                                                  | ...                                                  | C43                      | ...                     | ...                                     | ... |
|                | 1100 (593)                                                    | 0.140 (3.56) and under             | 180                      | 1240 | 145                    | 1000 | 6                                                                  | ...                                                  | C39                      | ...                     | ...                                     | ... |
| S46910         | Cold rolled at mill                                           | 0.00079 to 0.15 (0.020 to 3.8)     | 135                      | 950  | 65                     | 475  | 5                                                                  | ...                                                  | C29                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill +890 (475)                                | 0.00079 to 0.15 (0.020 to 3.8)     | 180                      | 1250 | 135                    | 950  | 1                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill                                           | 0.00059 to 0.091 (0.015 to 2.3)    | 160                      | 1100 | 95                     | 650  | 3                                                                  | ...                                                  | C33                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill +890 (475)                                | 0.00059 to 0.091 (0.015 to 2.3)    | 240                      | 1650 | 210                    | 1450 | 1                                                                  | ...                                                  | C46                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill                                           | 0.00059 to 0.047 (0.015 to 1.2)    | 185                      | 1300 | 160                    | 1100 | 1                                                                  | ...                                                  | C38                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill +890 (475)                                | 0.00059 to 0.047 (0.015 to 1.2)    | 280                      | 1950 | 265                    | 1850 | ...                                                                | ...                                                  | C50                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill                                           | 0.00059 to 0.028 (0.015 to 0.70)   | 215                      | 1500 | 195                    | 1350 | ...                                                                | ...                                                  | C42                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill +890 (475)                                | 0.00059 to 0.028 (0.015 to 0.70)   | 325                      | 2250 | 310                    | 2150 | ...                                                                | ...                                                  | C54                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill                                           | 0.00059 to 0.0059 (0.015 to 0.15)  | 245                      | 1700 | 220                    | 1525 | ...                                                                | ...                                                  | C45                      | ...                     | ...                                     | ... |
|                | Cold rolled at mill +890 (475)                                | 0.00059 to 0.0059 (0.015 to 0.15)  | 340                      | 2350 | 325                    | 2250 | ...                                                                | ...                                                  | C55                      | ...                     | ...                                     | ... |

<sup>A</sup> Applicable to tests in the long transverse direction. Transverse to the direction of rolling and parallel to the product surface.<sup>B</sup> Impact test is not required unless specified on the purchase order.



TABLE 6 Bend Test Requirements in Solution-Treated Condition

| Type   | Size, in. (mm)                      | Cold Bend Degrees | Bend Test Mandrel |
|--------|-------------------------------------|-------------------|-------------------|
| 630    |                                     | none required     |                   |
| 631    | 0.187 (4.76) and under              | 180               | 1 T <sup>A</sup>  |
|        | Over 0.187 to 0.275 (4.76 to 6.98)  | 180               | 3 T               |
| 632    | 0.187 (4.76) and under              | 180               | 1 T               |
|        | Over 0.187 to 0.275 (4.76 to 6.98)  | 180               | 3 T               |
| 633    | Under 0.1875 (4.762)                | 180               | 2 T               |
| 634    | 0.187 to 0.249 (4.76 to 6.32)       | 130               | 3 T               |
|        | Over 0.249 to 0.750 (6.32 to 19.08) | 90                | 3 T               |
| 635    |                                     | none required     |                   |
| XM-9   | 0.109 (2.77) and under              | 180               | 9 T               |
| XM-12  |                                     | none required     |                   |
| XM-13  |                                     | none required     |                   |
| XM-16  | Under 0.1875 (4.762)                | 180               | 6 T               |
| XM-25  | Under 0.1875 (4.762)                | 180               | 6 T               |
| S46500 | 0.140 (3.56) and under              | 180               | 6 T               |

<sup>A</sup>T = thickness of sheet being tested.

### SUMMARY OF CHANGES

Committee A01 has identified the location of selected changes to this standard since the last issue (A693 – 13) that may impact the use of this standard. (Approved Sept. 1, 2016.)

- (1) Revised footnotes B, C, D, F, and H in Table 1.  
 (2) Changed “Columbium” to “Niobium” in Table 1.

- (3) Changed “Columbium plus tantalum” to “Niobium” in Table 1.

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