



Standard Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) and Nickel-Chromium-Molybdenum-Silicon Alloy (UNS N06219)* Plate, Sheet, and Strip¹

This standard is issued under the fixed designation B 443; 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 Department of Defense.

^{e1} NOTE—Sections 1.1.2 and 4.1.3.1 were editorially altered in January 2001.

1. Scope

1.1 This specification² covers rolled nickel-chromium-molybdenum-columbium alloy (UNS N06625) and nickel-chromium-molybdenum-silicon alloy (UNS N06219)* plate, sheet, and strip.

1.1.1 Alloy UNS N06625 products are furnished in two grades of different heat-treated conditions:

1.1.1.1 *Grade 1 (Annealed)*—Material is normally employed in service temperatures up to 1100°F (593°C).

1.1.1.2 *Grade 2 (Solution Annealed)*—Material is normally employed in service temperatures above 1100°F (593°C) when resistance to creep and rupture is required.

NOTE 1—Hot-working or reannealing may change properties significantly, depending on working history and temperatures.

1.1.2 Alloy UNS N06219 is supplied in solution annealed condition only.

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

2. Referenced Documents

2.1 ASTM Standards:

B 446 Specification for Nickel-Chromium-Molybdenum-Columbium Alloy (UNS N06625) Rod and Bar³

B 880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys⁴

E 8 Test Methods for Tension Testing of Metallic Materials⁵

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁶

E 354 Test Methods for Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys⁷

E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys⁷

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*—The terms given in Table 1 shall apply.

4. Ordering Information

4.1 It is the responsibility of the purchaser to specify all requirements that are necessary for the safe and satisfactory performance of material ordered under this specification. Examples of such requirements include, but are not limited to, the following:

4.1.1 ASTM designation,

4.1.2 Alloy name or UNS number,

4.1.3 *Condition*—See 1.1.1, 1.1.2 and Appendix X1,

4.1.3.1 If neither grade of N06625 is specified, Grade 1 will be supplied,

4.1.4 *Finish*—Appendix X1,

4.1.5 *Dimensions*—Thickness, width, and length,

4.1.6 *Quantity*,

4.1.7 *Optional Requirements:*

4.1.7.1 *Sheet and Strip*—Whether to be furnished in coil, in cut straight lengths, or in random straight lengths,

4.1.7.2 *Plate*—How plate is to be cut (see 7.2.1 and 7.3.2),

4.1.8 *Certification*—State if certification is required (Section 15),

¹ This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.07 on Refined Nickel and Cobalt and Their Alloys.

Current edition approved August 10, 2000. Published September 2000. Originally published as B 443 – 66. Last previous edition B 443 – 99.

² For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-443 in Section II of that Code.

* New designation established in accordance with Practice E 527 and SAE J1086, Practice for Numbering Metals and Alloys (UNS).

³ *Annual Book of ASTM Standards*, Vol 02.04.

⁴ *Annual Book of ASTM Standards*, Vol 02.04.

⁵ *Annual Book of ASTM Standards*, Vol 03.01.

⁶ *Annual Book of ASTM Standards*, Vol 14.02.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

TABLE 1 Product Description

| Product | Thickness, in. (mm) | Width, in. (mm) |
|--------------------------------|--|------------------------|
| Hot-rolled plate ^A | 3/16 (4.8) and over (Table 4 and Table 5) | (Table 7) ^A |
| Cold-rolled plate ^B | 3/16 to 3/8 (4.8 to 9.5), incl (Table 4) | (Table 7) |
| Hot-rolled sheet ^B | 0.018 to 0.250 (0.46 to 6.4), incl (Table 6) | (Table 9) |
| Cold-rolled sheet ^C | 0.018 to 0.250 (0.46 to 6.4), incl (Table 6) | (Table 9) |
| Cold-rolled strip ^C | 0.005 to 0.250 (0.13 to 6.4), incl (Table 6) | (Table 9) |

^AHot-rolled plate, in widths 10 in. (254 mm) and under, may be furnished as hot-finished rectangles with sheared or cut edges in accordance with Specification B 446 provided the mechanical property requirements of this specification are met.

^BMaterial 3/16 to 3/8 in. (4.8 to 9.5 mm), incl, in thickness may be furnished as sheet or plate provided the material meets the specification requirements for the condition ordered.

^CMaterial under 48 in. (1219 mm) in width may be furnished as sheet or strip provided the material meets the specification requirements for the condition ordered.

4.1.9 *Samples for Product (Check) Analysis*—Whether samples for product (check) analysis should be furnished (see 5.2), and

4.1.10 *Purchaser Inspection*—If the purchaser wishes to witness tests or inspection of material at place of manufacture, the purchase order must so state, indicating which tests or inspections are to be witnessed (Section 13).

5. Chemical Composition

5.1 The material shall conform to the composition limits specified in Table 2.

5.2 If a product (check) analysis is performed by the purchaser, the material shall conform to the product (check) analysis variations as prescribed by B 880.

6. Mechanical Properties and Other Requirements

6.1 *Mechanical Properties*—The material shall conform to the heat treatment and room temperature tensile properties prescribed in Table 3.

TABLE 2 Chemical Requirements

| Element | Composition Limits, % | |
|------------------------|-----------------------|-----------|
| | N06625 | N06219 |
| Carbon | 0.10 max | 0.05 max |
| Manganese | 0.50 max | 0.50 max |
| Silicon | 0.50 max | 0.70-1.10 |
| Phosphorus | 0.015 max | 0.020 max |
| Sulfur | 0.015 max | 0.010 max |
| Chromium | 20.0 min 23.0 max | 18.0-22.0 |
| Columbium + tantalum | 3.15 min 4.15 max | ... |
| Cobalt (if determined) | 1.0 max | 1.0 max |
| Molybdenum | 8.0 min 10.0 max | 7.0-9.0 |
| Iron | 5.0 max | 2.0-4.0 |
| Aluminum | 0.40 max | 0.50 max |
| Titanium | 0.40 max | 0.50 max |
| Copper | ... | 0.50 max |
| Nickel ^A | 58.0 min | Bal. |

^AElement shall be determined arithmetically by difference.

7. Dimensions and Permissible Variations

7.1 Thickness and Weight:

7.1.1 *Plate*—For plate up to 2 in. (50.8 mm), inclusive, in thickness, the permissible variations under the specified thickness and permissible excess in overweight shall not exceed the amounts prescribed in Table 4.

7.1.1.1 For use with Table 4, plate shall be assumed to weigh 0.305 lb/in.³ (8.442 g/cm³).

7.1.2 *Plate*—For plate over 2 in. (50.8 mm) in thickness, the permissible variations over the specified thickness shall not exceed the amounts prescribed in Table 5.

7.1.3 *Sheet and Strip*—The permissible variations in thickness of sheet and strip shall be as prescribed in Table 6. The thickness of strip and sheet shall be measured with the micrometer spindle 3/8 in. (9.5 mm) or more from either edge for material 1 in. (25.4 mm) or over in width and at any place on the strip under 1 in. (25.4 mm) in width.

7.2 Width or Diameter:

7.2.1 *Plate*—The permissible variations in width of rectangular plates and diameter of circular plates shall be as prescribed in Table 7 and Table 8.

7.2.2 *Sheet and Strip*—The permissible variations in width for sheet and strip shall be as prescribed in Table 9.

7.3 Length:

7.3.1 Sheet and strip of all sizes may be ordered to cut lengths, in which case a variation of 1/8 in. (3.2 mm) over the specified length shall be permitted.

7.3.2 Permissible variations in length of rectangular plate shall be as prescribed in Table 10.

7.4 Straightness:

7.4.1 The edgewise curvature (depth of chord) of flat sheet, strip, and plate shall not exceed 0.05 in. (1.27 mm) multiplied by the length in feet (0.04 mm multiplied by the length in centimetres).

7.4.2 Straightness for coiled material is subject to agreement between the manufacturer and the purchaser.

7.5 Edges:

7.5.1 Sheet and strip shall have sheared or slit edges.

7.5.2 Plate shall have sheared or cut (machined, abrasive cut, powder cut, or inert arc cut) edges, as specified.

7.6 *Squareness (Sheet)*—For sheets of all thicknesses, the angle between adjacent sides shall be 90 ± 0.15° (1/16 in. in 24 in.) (1.6 mm in 610 mm).

7.7 *Flatness*—Standard flatness tolerances for plate shall conform to the requirements of Table 11.

8. Workmanship, Finish, and Appearance

8.1 The material shall be uniform in quality and temper, smooth, commercially straight or flat, and free of injurious imperfections.

9. Sampling

9.1 Lot—Definition:

9.1.1 A lot for chemical analysis shall consist of one heat.

9.1.2 A lot for mechanical testing shall consist of all material from the same heat, nominal thickness, and condition.

9.1.2.1 Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material in the

TABLE 3 Room Temperature Tensile Properties and Heat Treatment
(All Thicknesses and Sizes Unless Otherwise Indicated)

| Product | Tensile Strength, min, ksi (MPa) | Yield Strength ^A (0.2 % Offset), min, ksi (MPa) | Elongation in 2 in. or 50 mm (or 4D), min, % ^B |
|--|----------------------------------|--|---|
| Grade 1 UNS N06625 (Annealed) ^C | | | |
| Cold-rolled sheet and strip | 120 (827) | 60 (414) | 30 |
| Hot-rolled sheet and hot-rolled plate up to 2.75 in. (70 mm), incl | 110 (758) | 55 (379) | 30 |
| Cold-rolled plate up to 0.375 in. (9.5 mm), incl | 110 (758) | 55 (379) | 30 |
| Grade 2 UNS N06625 (Solution Annealed) ^D | | | |
| Cold-rolled sheet and strip, hot-rolled sheet, cold-rolled plate, and hot-rolled plate | 100 (690) | 40 (276) | 30 |
| All UNS N06219 (Solution Annealed) | | | |
| All plate, sheet, and strip | 96 (660) | 39 (270) | 50 |

^AYield strength requirements do not apply to material under 0.020 in. (0.508 mm) in thickness.

^BElongation requirements do not apply to material under 0.010 in. (0.254 mm) in thickness.

^CAnnealed at 1600°F (871°C) minimum.

^DSolution annealed at 2000°F (1093°C) minimum, with or without subsequent stabilization anneal at 1800°F (982°C) minimum to increase resistance to sensitization.

TABLE 4 Permissible Variations in Thickness and Overweight of Rectangular Plates

NOTE 1—All plates shall be ordered to thickness and not to weight per square foot. No plates shall vary more than 0.01 in. (0.3 mm) under the thickness ordered, and the overweight of each lot^A in each shipment shall not exceed the amount given in the table. Spot grinding is permitted to remove surface imperfections, such spots not to exceed 0.01 in. (0.3 mm) under the specified thickness.

| Specified Thickness, in. (mm) | Permissible Excess in Average Weight, ^{B,C} per Square Foot of Plates for Widths Given in Inches (Millimetres) Expressed in Percent of Nominal Weights | | | | | | | | | |
|----------------------------------|--|-------------------------------|-------------------------------|-------------------------------|-------------------------------|--------------------------------|---------------------------------|---------------------------------|---------------------------------|---------------------------------|
| | Under 48 (1220) | 48 to 60 (1220 to 1520), excl | 60 to 72 (1520 to 1830), excl | 72 to 84 (1830 to 2130), excl | 84 to 96 (2130 to 2440), excl | 96 to 108 (2440 to 2740), excl | 108 to 120 (2740 to 3050), excl | 120 to 132 (3050 to 3350), excl | 132 to 144 (3350 to 3660), excl | 144 to 160 (3660 to 4070), excl |
| 3/16 to 5/16 (4.8 to 7.9), excl | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 | ... | ... | ... |
| 5/16 to 3/8 (7.9 to 9.5), excl | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 | ... | ... |
| 3/8 to 7/16 (9.5 to 11.1), excl | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 | 19.5 |
| 7/16 to 1/2 (11.1 to 12.7), excl | 6.0 | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 | 18.0 |
| 1/2 to 5/8 (12.7 to 15.9), excl | 5.0 | 6.0 | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 | 16.5 |
| 5/8 to 3/4 (15.9 to 19.1), excl | 4.5 | 5.5 | 6.0 | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 | 15.0 |
| 3/4 to 1 (19.1 to 25.4), excl | 4.0 | 4.5 | 5.5 | 6.0 | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 | 13.5 |
| 1 to 2 (25.4 to 50.8), incl | 4.0 | 4.0 | 4.5 | 5.5 | 6.0 | 7.0 | 7.5 | 9.0 | 10.5 | 12.0 |

^AThe term "lot" applied to this table means all of the plates of each group width and each group thickness.

^BThe permissible overweight for lots of circular and sketch plates shall be 25 % greater than the amounts given in this table.

^CThe weight of individual plates shall not exceed the nominal weight by more than 1 1/4 times the amount given in the table and Footnote B.

TABLE 5 Permissible Variations in Thickness for Rectangular Plates Over 2 in. (51 mm) in Thickness

NOTE 1—Permissible variation under specified thickness, 0.01 in. (0.3 mm).

| Specified Thickness, in. (mm) | Permissible Variations, in. (mm), over Specified Thickness for Widths Given, in. (mm) | | | | | |
|------------------------------------|---|------------------------------|-------------------------------|--------------------------------|---------------------------------|---------------------|
| | To 36 (915), excl | 36 to 60 (915 to 1520), excl | 60 to 84 (1520 to 2130), excl | 84 to 120 (2130 to 3050), excl | 120 to 132 (3050 to 3350), excl | 132 (3350 and over) |
| Over 2 to 2 3/4 (51 to 69.8), incl | 1/16 (1.6) | 3/32 (2.4) | 7/64 (2.8) | 1/8 (3.2) | 1/8 (3.2) | 3/64 (3.6) |

same thickness and condition, except for plates weighing over 500 lb (227 kg), in which case only one specimen shall be taken.

9.2 Test Material Selection:

9.2.1 *Chemical Analysis*—Representative samples from each lot shall be taken during pouring or subsequent processing.

9.2.1.1 Product (check) analysis shall be wholly the responsibility of the purchaser.

9.2.2 *Mechanical Properties*—Samples of the material to provide test specimens for mechanical properties shall be taken from such locations in each lot as to be representative of that lot.

10. Number of Tests

10.1 *Chemical Analysis*—One test per lot.

10.2 *Mechanical Properties*—One test per lot.

TABLE 6 Permissible Variations in Thickness of Sheet and Strip
(Permissible Variations, Plus and Minus, in Thickness, in. (mm), for Widths Given in in. (mm))

| Specified Thickness, in. (mm), incl | Sheet ^A | | | |
|-------------------------------------|---------------------|------------------------------------|---------------------|------------------------------------|
| | Hot-Rolled | | Cold-Rolled | |
| | 48 (1220) and Under | Over 48 to 60 (1220 to 1520), incl | 48 (1220) and Under | Over 48 to 60 (1220 to 1520), incl |
| 0.018 to 0.025 (0.5 to 0.6) | 0.003 (0.08) | 0.004 (0.10) | 0.002 (0.05) | 0.003 (0.08) |
| Over 0.025 to 0.034 (0.6 to 0.9) | 0.004 (0.10) | 0.005 (0.13) | 0.003 (0.08) | 0.004 (0.10) |
| Over 0.034 to 0.043 (0.9 to 1.1) | 0.005 (0.13) | 0.006 (0.15) | 0.004 (0.10) | 0.005 (0.13) |
| Over 0.043 to 0.056 (1.1 to 1.4) | 0.005 (0.13) | 0.006 (0.15) | 0.004 (0.10) | 0.005 (0.13) |
| Over 0.056 to 0.070 (1.4 to 1.8) | 0.006 (0.15) | 0.007 (0.18) | 0.005 (0.13) | 0.006 (0.15) |
| Over 0.070 to 0.078 (1.8 to 1.9) | 0.007 (0.18) | 0.008 (0.20) | 0.006 (0.15) | 0.007 (0.18) |
| Over 0.078 to 0.093 (1.9 to 2.4) | 0.008 (0.20) | 0.009 (0.23) | 0.007 (0.18) | 0.008 (0.20) |
| Over 0.093 to 0.109 (2.4 to 2.8) | 0.009 (0.23) | 0.010 (0.25) | 0.007 (0.18) | 0.009 (0.23) |
| Over 0.109 to 0.125 (2.8 to 3.2) | 0.010 (0.25) | 0.012 (0.31) | 0.008 (0.20) | 0.010 (0.25) |
| Over 0.125 to 0.140 (3.2 to 3.6) | 0.012 (0.31) | 0.014 (0.36) | 0.008 (0.20) | 0.010 (0.25) |
| Over 0.140 to 0.171 (3.6 to 4.3) | 0.014 (0.36) | 0.016 (0.41) | 0.009 (0.23) | 0.012 (0.31) |
| Over 0.171 to 0.187 (4.3 to 4.8) | 0.015 (0.38) | 0.017 (0.43) | 0.010 (0.25) | 0.013 (0.33) |
| Over 0.187 to 0.218 (4.8 to 5.5) | 0.017 (0.43) | 0.019 (0.48) | 0.011 (0.28) | 0.015 (0.38) |
| Over 0.218 to 0.234 (5.5 to 5.9) | 0.018 (0.46) | 0.020 (0.51) | 0.012 (0.31) | 0.016 (0.41) |
| Over 0.234 to 0.250 (5.9 to 6.4) | 0.020 (0.51) | 0.022 (0.56) | 0.013 (0.33) | 0.018 (0.46) |

| Specified Thickness, in. (mm), incl | Cold-Rolled ^{A,B} | |
|-------------------------------------|--|--|
| | Widths 12 in. (305 mm) and under, plus and minus | |
| Up to 0.050 (1.27), incl | 0.0015 (0.038) | |
| Over 0.050 to 0.093 (1.27 to 2.39) | 0.0025 (0.063) | |
| Over 0.093 to 0.125 (2.39 to 3.18) | 0.004 (0.11) | |

^A Measured $\frac{3}{16}$ in. (9.5 mm) or more from either edge except for strip under 1 in. (25.4 mm) in width which is measured at any place.

^B Standard sheet tolerances apply for thicknesses over 0.125 in. (3.2 mm) and for all thicknesses of strip over 12 in. (305 mm) wide.

11. Specimen Preparation

11.1 Tension test specimens shall be taken from material in the final condition (temper) and tested transverse to the direction of rolling when width will permit.

11.2 Tension test specimens shall be any of the standard or subsize specimens shown in Test Methods E 8.

11.3 In the event of disagreement, referee specimens shall be as follows:

11.3.1 Full thickness of the material, machined to the form and dimensions shown for the sheet-type specimen in Test Methods E 8 for material under $\frac{1}{2}$ in. (12.7 mm) in thickness.

11.3.2 The largest possible round specimen shown in Test Methods E 8 for material $\frac{1}{2}$ in. (12.7 mm) and over.

12. Test Methods

12.1 The chemical composition and mechanical and other properties of the material as enumerated in this specification shall be determined, in case of disagreement, in accordance with the following ASTM standards:

| Test | ASTM Designation |
|--------------------|------------------|
| Chemical analysis | E 1473 |
| Tension | E 8 |
| Rounding procedure | E 29 |

12.2 For purposes of determining compliance with the specified limits for requirements of the properties listed in the following table, an observed or calculated value shall be rounded in accordance with the rounding method of Practice E 29.

| Test | Rounded unit for observed or calculated value |
|--|--|
| Chemical composition and tolerances (when expressed in decimals) | nearest unit in the last right-hand place of figures of the specified limit. If two choices are possible, as when the digits dropped are exactly a 5, or a 5 followed only by zeros, choose the one ending in an even digit, with zero defined as an even digit. |
| Tensile strength and yield strength Elongation | nearest 1000 psi (6.9 MPa) nearest 1 % |

13. Inspection

13.1 Inspection of the material shall be made as agreed upon between the manufacturer and the purchaser as part of the purchase contract.

14. Rejection and Rehearing

14.1 Material tested by the purchaser that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing.

15. Certification

15.1 When specified in the purchase order or contract, a manufacturer's certification shall be furnished to the purchaser stating that the material was manufactured, tested, and inspected in accordance with this specification, and that test results on representative samples meet specification requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

TABLE 7 Permissible Variations in Width^A of Sheared, Plasma Torch-Cut, and Abrasive-Cut Rectangular Plate^{B,C}

| Specified Thickness | Permissible Variations in Widths for Widths Given, in. (mm) | | | | | | | | | |
|--------------------------------|---|-------|---|-------|---|-------|--|-------|--|-------|
| | Up to 30 (760), incl | | Over 30 to 72 (760 to 1830), incl | | Over 72 to 108 (1830 to 2740), incl | | Over 108 to 144 (2740 to 3660), incl | | Over 144 to 160 (3660 to 4070), incl | |
| | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus |
| Inches | | | | | | | | | | |
| Sheared: ^D | | | | | | | | | | |
| 3/16 to 5/16, excl | 3/16 | 1/8 | 1/4 | 1/8 | 3/8 | 1/8 | 1/2 | 1/8 | ... | ... |
| 5/16 to 1/2, excl | 1/4 | 1/8 | 3/8 | 1/8 | 3/8 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 |
| 1/2 to 3/4, excl | 3/8 | 1/8 | 3/8 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 |
| 3/4 to 1, excl | 1/2 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 |
| 1 to 1 1/4, incl | 5/8 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 | 1 | 1/8 |
| Abrasive-cut: ^{E,F} | | | | | | | | | | |
| 3/16 to 1 1/4, incl | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 |
| Over 1 1/4 to 2 3/4, incl | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 |
| Plasma torch-cut: ^G | | | | | | | | | | |
| 3/16 to 2, excl | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 |
| 2 to 2 3/4, incl | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 |
| Millimetres | | | | | | | | | | |
| Sheared: ^D | | | | | | | | | | |
| 4.8 to 7.9, excl | 4.8 | 3.2 | 6.4 | 3.2 | 9.5 | 3.2 | 12.7 | 3.2 | ... | ... |
| 7.9 to 12.7, excl | 6.4 | 3.2 | 9.5 | 3.2 | 9.5 | 3.2 | 12.7 | 3.2 | 15.9 | 3.2 |
| 12.7 to 19.1, excl | 9.5 | 3.2 | 9.5 | 3.2 | 12.7 | 3.2 | 15.9 | 3.2 | 19.1 | 3.2 |
| 19.1 to 25.4, excl | 12.7 | 3.2 | 12.7 | 3.2 | 15.8 | 3.2 | 19.1 | 3.2 | 22.2 | 3.2 |
| 25.4 to 31.8, incl | 15.9 | 3.2 | 15.9 | 3.2 | 19.1 | 3.2 | 22.2 | 3.2 | 25.4 | 3.2 |
| Abrasive-cut: ^{E,F} | | | | | | | | | | |
| 4.8 to 31.8, incl | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 |
| Over 31.8 to 69.8, incl | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 |
| Plasma torch-cut: ^G | | | | | | | | | | |
| 4.8 to 50.8, excl | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 |
| 50.8 to 69.8, incl | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 |

^APermissible variations in width for powder- or inert arc-cut plate shall be as agreed upon between the manufacturer and the purchaser.

^BPermissible variations in machined, powder-, or inert arc-cut circular plate shall be as agreed upon between the manufacturer and the purchaser.

^CPermissible variations in plasma torch-cut sketch plates shall be as agreed upon between the manufacturer and the purchaser.

^DThe minimum sheared width is 24 in. (610 mm).

^EThe minimum abrasive-cut width is 2 in. (50.8 mm) and increases to 4 in. (101.6 mm) for thicker plates.

^FThese tolerances are applicable to lengths of 240 in. (6100 mm), max. For lengths over 240 in., an additional 1/16 in. (1.6 mm) is permitted, both plus and minus.

^GThe tolerance spread shown for plasma torch cutting may be obtained all on the minus side, or divided between the plus and minus side if so specified by the purchaser.

16. Product Marking

16.1 Each bundle or shipping container shall be marked with the name of the material or UNS number; condition (temper); this specification number; the size; gross, tare, and net weight; consignor and consignee address; contract or order number; or such other information as may be defined in the contract or order.

17. Keywords

17.1 UNS N06219; UNS N06625; plate; sheet; strip

TABLE 8 Permissible Variations in Diameter for Circular Plates

| Sheared Plate | | Permissible Variations Over Specified Diameter for Thickness Given, in. (mm) ^A | | | |
|---------------------------------|------------------------------|---|--|--|--|
| Specified Diameter, in. (mm) | To $\frac{3}{8}$ (9.5), incl | | | | |
| | 20 to 32 (508 to 813), excl | $\frac{1}{4}$ (6.4) | | | |
| 32 to 84 (813 to 2130), excl | $\frac{5}{16}$ (7.9) | | | | |
| 84 to 108 (2130 to 2740), excl | $\frac{3}{8}$ (9.5) | | | | |
| 108 to 140 (2740 to 3580), incl | $\frac{7}{16}$ (11.1) | | | | |

| Plasma Torch-Cut Plate ^B | | | | | |
|---|-------------------------|---|-------|---|-------|
| Permissible Variations in Specified Diameter for Thickness Given, in. (mm) ^C | | | | | |
| Specified Diameter, in. (mm) | Thickness max, in. (mm) | $\frac{3}{16}$ to 2 (4.8 to 50.8), excl | | 2 to 2 $\frac{3}{4}$ (50.8 to 69.8), incl | |
| | | Plus | Minus | Plus | Minus |
| 19 to 20 (483 to 508), excl | 2 $\frac{3}{4}$ (69.8) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |
| 20 to 22 (508 to 559), excl | 2 $\frac{3}{4}$ (69.8) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |
| 22 to 24 (559 to 610), excl | 2 $\frac{1}{2}$ (63.5) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |
| 24 to 28 (610 to 711), excl | 2 $\frac{1}{4}$ (57.3) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |
| 28 to 32 (711 to 812), excl | 2 (50.8) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |
| 32 to 34 (812 to 864), excl | 1 $\frac{3}{4}$ (44.5) | $\frac{1}{2}$ (12.7) | 0 | ... | ... |
| 34 to 38 (864 to 965), excl | 1 $\frac{1}{2}$ (38.1) | $\frac{1}{2}$ (12.7) | 0 | ... | ... |
| 38 to 40 (965 to 1020), excl | 1 $\frac{1}{4}$ (31.8) | $\frac{1}{2}$ (12.7) | 0 | ... | ... |
| 40 to 140 (1020 to 3560), incl | 2 $\frac{3}{4}$ (69.8) | $\frac{1}{2}$ (12.7) | 0 | $\frac{5}{8}$ (15.9) | 0 |

^ANo permissible variations under.

^BPermissible variations in plasma torch-cut sketch plates shall be as agreed upon between the manufacturer and the purchaser.

^CThe tolerance spread shown may also be obtained all on the minus side or divided between the plus and minus sides if so specified by the purchaser.

TABLE 9 Permissible Variations in Width of Sheet and Strip

| Specified Thickness, in. (mm) | Specified Width, in. (mm) | Permissible Variations in Specified Width, in. (mm) | |
|--|-----------------------------------|---|--------------|
| | | Plus | Minus |
| Sheet | | | |
| Up to 0.250 (6.35) | All | 0.125 (3.18) | 0 |
| Strip | | | |
| Under 0.075 (1.9) | Up to 12 (305), incl | 0.007 (0.18) | 0.007 (0.18) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0 |
| 0.075 to 0.100 (1.9 to 2.5), incl | Up to 12 (305), incl | 0.009 (0.23) | 0.009 (0.23) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0 |
| Over 0.100 to 0.125 (2.5 to 3.2), incl | Up to 12 (305), incl | 0.012 (0.30) | 0.012 (0.30) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0 |
| Over 0.125 to 0.160 (3.2 to 4.1), incl | Up to 12 (305), incl | 0.016 (0.41) | 0.016 (0.41) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0 |
| Over 0.160 to 0.187 (4.1 to 4.7), incl | Up to 12 (305), incl | 0.020 (0.51) | 0.020 (0.51) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0 |
| Over 0.187 to 0.250 (4.7 to 6.4), incl | Up to 12 (305), incl | 0.062 (1.6) | 0.062 (1.6) |
| | Over 12 to 48 (305 to 1219), incl | 0.062 (1.6) | 0.062 (1.6) |

TABLE 10 Permissible Variations in Length^A of Sheared, Plasma Torch-Cut,^B and Abrasive-Cut Rectangular Plate^C

| Specified Thickness | Permissible Variation in Length for Lengths Given, in. (mm) | | | | | | | | | | | | | | | |
|--------------------------------|---|-------|--|-------|---|-------|--|-------|--|-------|--|-------|---|-------|----------------------|-------|
| | Up to 60 (1520), incl | | Over 60 to 96 (1520 to 2440), incl | | Over 96 to 120 (2440 to 3050), incl | | Over 120 to 240 (3050 to 6096), incl | | Over 240 to 360 (6096 to 9144), incl | | Over 360 to 450 (9144 to 11 430), incl | | Over 450 to 540 (11 430 to 13 716), incl | | Over 540 (13 716) | |
| | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus | Plus | Minus |
| Inches | | | | | | | | | | | | | | | | |
| Sheared: ^D | | | | | | | | | | | | | | | | |
| 3/16 to 5/16, excl | 3/16 | 1/8 | 1/4 | 1/8 | 3/8 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 | ... | ... |
| 5/16 to 1/2, excl | 3/8 | 1/8 | 1/2 | 1/8 | 1/2 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 | 1 | 1/8 |
| 1/2 to 3/4, excl | 1/2 | 1/8 | 1/2 | 1/8 | 5/8 | 1/8 | 5/8 | 1/8 | 1/8 | 1/8 | 7/8 | 1/8 | 1 1/8 | 1/8 | 1 3/8 | 1/8 |
| 3/4 to 1, excl | 5/8 | 1/8 | 5/8 | 1/8 | 5/8 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 | 1 1/8 | 1/8 | 1 3/8 | 1/8 | 1 5/8 | 1/8 |
| 1 to 1 1/4, incl | 3/4 | 1/8 | 3/4 | 1/8 | 3/4 | 1/8 | 7/8 | 1/8 | 1 1/8 | 1/8 | 1 3/8 | 1/8 | 1 5/8 | 1/8 | ... | ... |
| Abrasive-cut: ^E | | | | | | | | | | | | | | | | |
| 3/16 to 1 1/4, incl | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | 1/8 | ... | ... | ... | ... |
| Over 1 1/4 to 2 3/4, incl | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | 3/16 | 1/8 | ... | ... | ... | ... |
| Plasma torch-cut: ^F | | | | | | | | | | | | | | | | |
| 3/16 to 2, excl | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 | 1/2 | 0 |
| 2 to 2 3/4 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 | 5/8 | 0 |
| Millimetres | | | | | | | | | | | | | | | | |
| Sheared: ^D | | | | | | | | | | | | | | | | |
| 4.8 to 7.94, excl | 4.8 | 3.2 | 6.4 | 3.2 | 9.5 | 3.2 | 12.7 | 3.2 | 15.9 | 3.2 | 19.0 | 3.2 | 22.2 | 3.2 | ... | ... |
| 7.94 to 12.7, excl | 9.5 | 3.2 | 12.7 | 3.2 | 12.7 | 3.2 | 12.7 | 3.2 | 15.9 | 3.2 | 19.0 | 3.2 | 22.2 | 3.2 | 25.4 | 3.2 |
| 12.7 to 19.0, excl | 12.7 | 3.2 | 12.7 | 3.2 | 15.9 | 3.2 | 15.9 | 3.2 | 19.0 | 3.2 | 22.2 | 3.2 | 28.6 | 3.2 | 34.9 | 3.2 |
| 19.0 to 25.4, excl | 15.9 | 3.2 | 15.9 | 3.2 | 15.9 | 3.2 | 19.0 | 3.2 | 22.2 | 3.2 | 28.6 | 3.2 | 34.9 | 3.2 | 41.2 | 3.2 |
| 25.4 to 31.8, incl | 19.0 | 3.2 | 19.0 | 3.2 | 19.0 | 3.2 | 22.2 | 3.2 | 28.6 | 3.2 | 34.9 | 3.2 | 41.2 | 3.2 | ... | ... |
| Abrasive-cut: ^E | | | | | | | | | | | | | | | | |
| 4.8 to 31.8, incl | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | 3.2 | ... | ... | ... | ... |
| Over 31.8 to 69.9, incl | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | 4.8 | 3.2 | ... | ... | ... | ... |
| Plasma torch-cut: ^F | | | | | | | | | | | | | | | | |
| 4.8 to 50.8, excl | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 | 12.7 | 0 |
| 50.8 to 69.8, incl | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 | 15.9 | 0 |

^APermissible variations in length for powder- or inert arc-cut plate shall be agreed upon between the manufacturer and the purchaser.

^BThe tolerance spread shown for plasma torch cutting may be obtained all on the minus side, or divided between the plus and minus sides if so specified by the purchaser.

^CPermissible variations in machined, powder- or inert arc-cut circular plate shall be as agreed upon between the manufacturer and the purchaser.

^DThe minimum sheared length is 24 in. (610 mm).

^EAbrasive cut applicable to a maximum length of 144 to 400 in. (3658 to 10 160 mm), depending on the thickness and width ordered.

^FThe tolerance spread shown for plasma torch-cut sketch plates shall be as agreed upon between the manufacturer and the purchaser.

TABLE 11 Permissible Variations From Flatness of Rectangular, Circular, and Sketch Plates

NOTE 1—Permissible variations apply to plates up to 12 ft (3.66 m) in length, or to any 12 ft (3.66 m) of longer plates.

NOTE 2—If the longer dimension is under 36 in. (914 mm), the permissible variation is not greater than 1/2 in. (12.7 mm).

NOTE 3—The shorter dimension specified is considered with width, and the permissible variation in flatness across the width does not exceed the tabular amount of that dimension.†

NOTE 4—The maximum deviation from a flat surface does not customarily exceed the tabular tolerance for the longer dimension specified.

| Specified Thickness | Permissible Variations from a Flat Surface for Thickness and Widths Given, in. (mm) | | | | | | | | | |
|---------------------|---|-------------------------------------|-------------------------------------|-------------------------------------|-------------------------------------|--------------------------------------|---------------------------------------|---------------------------------------|---------------------------|--|
| | To 48 (1220), excl | 48 to 60 (1220 to 1520), excl | 60 to 72 (1520 to 1830), excl | 72 to 84 (1830 to 2130), excl | 84 to 96 (2130 to 2400), excl | 96 to 108 (2440 to 2740), excl | 108 to 120 (2740 to 3050), excl | 120 to 144 (3050 to 3660), excl | 144 (3660) and over | |
| Inches | | | | | | | | | | |
| 3/16 to 1/4, excl | 1 1/2 | 2 1/8 | 2 1/2 | 2 3/4 | 3 1/4 | 3 1/4 | ... | ... | ... | |
| 1/4 to 3/8, excl | 1 3/8 | 1 1/2 | 1 7/8 | 2 1/4 | 2 3/4 | 2 7/8 | 3 1/8 | 3 3/4 | ... | |
| 3/8 to 1/2, excl | 1 | 1 1/8 | 1 3/8 | 1 1/2 | 1 7/8 | 2 1/4 | 2 1/2 | 2 7/8 | 3 1/2 | |
| 1/2 to 3/4, excl | 1 | 1 1/8 | 1 1/4 | 1 1/4 | 1 5/8 | 2 1/4 | 2 1/4 | 2 1/4 | 2 3/4 | |
| 3/4 to 1, excl | 1 | 1 1/8 | 1 1/4 | 1 1/4 | 1 1/2 | 1 5/8 | 1 7/8 | 2 | 2 1/4 | |
| 1 to 2, incl | 1 | 1 1/8 | 1 1/8 | 1 1/8 | 1 3/8 | 1 3/8 | 1 3/8 | 1 1/2 | 2 | |
| 2 to 2 3/4, incl | 1/2 | 5/8 | 3/4 | 7/8 | 1 | 1 1/8 | 1 1/4 | 1 1/2 | 1 3/4 | |
| Millimetres | | | | | | | | | | |
| 4.8 to 6.4, excl | 38.1 | 54.0 | 63.5 | 69.8 | 82.6 | 82.6 | ... | ... | ... | |
| 6.4 to 9.5, excl | 34.9 | 38.1 | 47.6 | 57.2 | 69.8 | 73.0 | 79.4 | 95.2 | ... | |
| 9.5 to 12.7, excl | 25.4 | 28.6 | 34.9 | 38.1 | 47.6 | 57.2 | 63.5 | 73.0 | 88.9 | |
| 12.7 to 19.0, excl | 25.4 | 28.6 | 31.8 | 31.8 | 41.3 | 57.2 | 57.2 | 57.2 | 69.8 | |
| 19.0 to 25.4, excl | 25.4 | 28.6 | 31.8 | 31.8 | 38.1 | 41.3 | 47.6 | 50.8 | 57.2 | |
| 25.4 to 50.8, excl | 25.4 | 28.6 | 28.6 | 28.6 | 34.9 | 34.9 | 34.9 | 38.1 | 50.8 | |
| 50.8 to 70.0, incl | 12.7 | 15.9 | 19.0 | 22.2 | 25.4 | 28.6 | 31.8 | 38.1 | 44.4 | |

† Editorially corrected.

APPENDIX

(Nonmandatory Information)

X1. CONDITIONS AND FINISHES NORMALLY SUPPLIED

X1.1 Scope

X1.1.1 This appendix lists the conditions and finishes in which plate, sheet, and strip are normally supplied. These are subject to change, and the manufacturer should be consulted for the latest information available.

X1.2 Plate

X1.2.1 Hot-rolled, annealed or solution annealed, and descaled.

X1.2.2 Cold-rolled, annealed or solution annealed, and descaled.

X1.3 Sheet

X1.3.1 Hot-rolled, annealed or solution annealed, and descaled.

X1.3.2 Cold-rolled, annealed or solution annealed, and descaled or bright annealed.

X1.4 Strip

X1.4.1 Cold-rolled, annealed or solution annealed, and descaled or bright annealed.

ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org).