



# Standard Specification for UNS N08020, UNS N08026, and UNS N08024 Alloy Plate, Sheet, and Strip<sup>1</sup>

This standard is issued under the fixed designation B 463; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

## 1. Scope

1.1 This specification<sup>2</sup> covers UNS N08020, UNS N08026,\* and UNS N08024 alloy plate, sheet, and strip.

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:

A 262 Practices for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels<sup>3</sup>

B 880 Specification for General Requirements for Chemical Check Analysis Limits for Nickel, Nickel Alloys and Cobalt Alloys<sup>4</sup>

E 8 Test Methods for Tension Testing of Metallic Materials<sup>5</sup>

E 10 Test Method for Brinell Hardness of Metallic Materials<sup>5</sup>

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials<sup>5</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>6</sup>

E 140 Hardness Conversion Tables for Metals<sup>5</sup>

E 1473 Test Methods for Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys<sup>7</sup>

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 The terms plate, sheet, and strip as used in this specification are defined as follows:

3.1.2 *cold rolled plate*—material  $\frac{3}{16}$  to  $\frac{3}{8}$  in. (4.76 to 9.52 mm), inclusive in thickness and over 10 in. (254.0 mm) in width.

3.1.3 *hot rolled plate*—material  $\frac{3}{16}$  in. (4.76 mm) and over in thickness and over 10 in. (254.0 mm) in width.

3.1.4 *plate*—material  $\frac{3}{16}$  in. (4.75 mm) and over in thickness and over 10 in. (254.0 mm) in width.

3.1.5 *sheet*—material under  $\frac{3}{16}$  in. (4.75 mm) in thickness and 24 in. (609.6 mm) and over in width. Material under  $\frac{3}{16}$  in. (4.75 mm) in thickness and in all widths with No. 4 finish.

3.1.6 *strip*—material under  $\frac{3}{16}$  in. (4.75 mm) in thickness and under 24 in. (609.6 mm) in width.

## 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 Quantity (weight or number of pieces),

4.1.2 Name of material or UNS number,

4.1.3 Form (plate, sheet or strip),

4.1.4 Dimensions,

4.1.5 Type edge required (for strip only) (8.4.1),

4.1.6 Finish (Section 9). For sheet with No. 4 Finish, specify whether one or both sides are to be polished,

4.1.7 Certification (Section 16). State if certification or a report of test results is required,

4.1.8 ASTM designation, and

4.1.9 Supplementary requirements.

NOTE 1—A typical ordering description is as follows: 200 sheets (UNS number) 0.060 by 48 by 120 in. (1.5 mm by 1.2 m by 3 m) No. 2D Finish in accordance with Specification B 463.

## 5. Material and Manufacture

5.1 *Heat Treatment*— UNS N08020 Alloy shall be furnished in the stabilize-annealed condition. UNS N08026 Alloy shall be furnished in the solution-annealed condition. UNS N08024 Alloy shall be furnished in the annealed condition.

NOTE 2—The recommended annealing temperatures are 1800 to 1850°F (982 to 1010°C) for UNS N08020, 2050 to 2200°F (1121 to

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SB – 463 in Section II of that Code.

\* New designation established in accordance with ASTM E527 and SAE J1086, Recommended Practice for Numbering Metals and Alloys (UNS).

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 01.03.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 02.04.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.06.

1204°C) for UNS N08026, and 1925 to 1975°F (1052 to 1079°C) for UNS N08024.

## 6. Chemical Composition

6.1 The material shall conform to the composition limits specified in Table 1.

6.2 If a product analysis is performed by the purchaser, the material shall conform to the composition limits specified in Table 1 subject to the product analysis tolerances per B 880.

## 7. Mechanical Properties

7.1 *Mechanical Properties*—The material shall conform to the mechanical property requirements specified in Table 2.

## 8. Dimensions and Permissible Variations

8.1 *Sheet*—The material referred to as sheet shall conform to the variations in dimensions specified in Tables 3-11, inclusive.

8.2 *Cold-Rolled Strip*—The material referred to as cold-rolled strip shall conform to the permissible variations in dimensions specified in Tables 12-16, inclusive.

8.3 *Plate*—The material referred to as plate shall conform to the permissible variations in dimensions specified in Tables 17-23, inclusive.

8.4 *Edges for Cold-Rolled Strip*—The various types of edges procurable shall be as follows:

8.4.1 *No. 1 Edge*—Rolled-edge, either round or square as specified.

8.4.2 *No. 3 Edge*—An edge produced by slitting.

8.4.3 *No. 5 Edge*—Approximately square edge produced by rolling or filing, or both, after slitting.

## 9. Workmanship, Finish, and Appearance

9.1 The material shall correspond to the designated finishes as described by the following:

9.1.1 *Sheet*—The various types of finish on sheet products shall be as follows:

9.1.1.1 *No. 1 Finish*— Hot-rolled, annealed, and descaled.

9.1.1.2 *No. 2D Finish*— Dull, cold-rolled finish.

9.1.1.3 *No. 2B Finish*— Bright, cold-rolled finish.

9.1.1.4 *No. 4 Finish*— General-purpose, polished finish. Following initial grinding with coarser abrasives, sheets are generally finished last with abrasives approximately 120 to 150 mesh. Sheets can be produced with one or two sides polished. When polished on one side only, the other side may be rough ground in order to obtain the necessary flatness.

9.1.1.5 *Bright-Annealed*— Bright finish produced by cold-rolling and annealing in a protective atmosphere.

9.1.2 *Strip*—The type of finish procurable on cold-rolled strip shall be as follows:

9.1.2.1 *No. 1 Finish*— Cold-rolled, annealed, and descaled.

9.1.2.2 *Bright-Annealed*— Bright finish produced by cold-rolling and annealing in a protective atmosphere.

9.1.3 *Plate*—The types of finish procurable on plates shall be as follows:

9.1.3.1 *No. 1 Finish*— Hot-rolled, annealed, and descaled.

9.1.3.2 *No. 1 Finish*— Cold-rolled, annealed, and descaled.

9.2 Sheet with No. 1, No. 2B, No. 2D or bright-annealed surface, strip with No. 1 or bright-annealed surface, and any

plate may be ground to remove surface imperfections providing such grinding does not reduce the thickness or width at any point beyond the permissible variations in dimensions.

## 10. Sampling

10.1 *Lots for Chemical Analysis and Mechanical Testing:*

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

10.1.2 *Plate*—A lot of plate for mechanical testing shall consist of the product resulting from the rolling of one heat of material to the same nominal thickness, but in no case more than 25 000 lb (11 340 kg).

10.1.3 *Sheet and Strip*— A lot of sheet and strip for mechanical testing shall consist of material from one heat in the same condition, finish and nominal thickness, but in no case more than 25 000 lb (11 340 kg).

NOTE 3—Where material cannot be identified by heat, a lot shall consist of not more than 500 lb (227 kg) of material in the same thickness and condition, except that for plates weighing over 500 lb, only one specimen shall be taken.

10.2 *Sampling for Chemical Analysis:*

10.2.1 A representative sample shall be taken from each heat during pouring or subsequent processing.

10.2.2 Product analysis, if performed, shall be wholly the responsibility of the purchaser.

10.3 *Sampling for Mechanical Tests:*

10.3.1 A sample of the material to provide test specimens for mechanical tests shall be taken from such a location in each lot as to be representative of that lot.

10.3.2 When samples are to be taken after delivery, the purchaser of material ordered to cut lengths may request on the purchase order additional material of adequate size to provide sample coupons for inspection purposes.

## 11. Number of Tests

11.1 *Chemical Analysis*—One test per lot.

11.2 *Mechanical Properties*—In the case of sheet or strip supplied in coil form, one tension test and one hardness test shall be made on specimens taken from each end of a coil representing the lot. When material is supplied in flat sheet, flat strip or plate, one tension and one hardness test shall be made on each 100 or less sheets, strips or plates of the same lot.

11.2.1 If any specimens selected to represent any heat fail to meet any of the test requirements, the material represented by such specimens may be reworked and resubmitted for test.

## 12. Specimen Preparation

12.1 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.

## 13. Test Methods

13.1 Determine the chemical composition and mechanical properties of the material enumerated in this specification, in case of disagreement, in accordance with the following methods:

Test	ASTM Designations
Chemical analysis	E 38, E 1473
Tension	E 8
Brinell hardness	E 10

Rockwell hardness	E 18
Hardness conversion	E 140
Rounding procedure	E 29

13.2 For purposes of determining compliance with the limits in this specification, round an observed value or a calculated value as indicated in accordance with the rounding method of Practice E 29 as follows:

Test	Rounded Unit for Observed or Calculated Value
Chemical composition hardness and tolerances (when expressed in decimals)	nearest unit in the last right-hand place of figures of the specified limit
Tensile strength and yield strength	nearest 1 000 psi (7 MPa)
Elongation	nearest 1 %

**14. Inspection**

14.1 Inspection of the material shall be agreed upon between the purchaser and the supplier as part of the purchase contract.

**15. Rejection and Rehearing**

15.1 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.

**16. Certification**

16.1 When specified in the purchase order or contract, a manufacturer’s certification shall be furnished to the purchaser stating that material has been manufactured, tested, and inspected in accordance with this specification and that the 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.

**17. Product Marking**

17.1 Each plate, sheet, or strip shall be marked on one face with the alloy designation or UNS number, specification number, heat number, manufacturer’s identification, and size. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

17.2 Each bundle or shipping container shall be marked with the name of the material, specification number, the size, gross, tare, and net weight, consignor and consignee address, contract or order number, and such other information as may be required by the contract or order.

**18. Keywords**

18.1 N08020; N08024; N08026; plate; sheet; strip

**SUPPLEMENTARY REQUIREMENTS**

The following supplementary requirements shall be applied only when specified by the purchaser in the inquiry, contract, or order.

**S1. Corrosion Tests**

S1.1 One intergranular corrosion test per lot shall be performed by the manufacturer on a sensitized specimen and tested in accordance with Practices A 262. When this supplementary requirement is specified, the specific practice (Practice B or Practice E) shall also be specified. If Practice B is specified, the specimen must pass with a rate of less than 0.002 inches per month. A lot for intergranular corrosion testing shall be the same as for mechanical testing.

S1.1.1 In addition to the anneal recommended in Note 2, the specimen shall be sensitized for 1 h at 1250°F (677°C) before being subjected to corrosion testing.

S1.1.2 If any corrosion test specimen fails the test, the

material represented by such specimens may be reheat-treated and resubmitted for test.

**TABLE 1 Chemical Requirements**

Element	Composition, %		
	UNS N08026	UNS N08020	UNS N08024
Carbon, max	0.03	0.07	0.03
Manganese, max	1.00	2.00	1.00
Phosphorus, max	0.03	0.045	0.035
Sulfur, max	0.03	0.035	0.035
Silicon, max	0.50	1.00	0.50
Nickel	33.00–37.20	32.00–38.00	35.00–40.00
Chromium	22.00–26.00	19.00–21.00	22.50–25.00
Molybdenum	5.00–6.70	2.00–3.00	3.50–5.00
Copper	2.00–4.00	3.00–4.00	0.50–1.50
Columbium (Nb) + tantalum	...	8 × carbon–1.00	0.15–0.35
Nitrogen	0.10–0.16	...	...
Iron	remainder <sup>A</sup>	remainder <sup>A</sup>	remainder

<sup>A</sup>By difference.

**TABLE 2 Mechanical Property Requirements**

Tensile Strength, min		Yield Strength, <sup>A</sup> min		Elongation <sup>B</sup> in 2 in. (50.8 mm), min, %
ksi	MPa	ksi	MPa	
80	551	35	241	30.0
Hardness Number, max <sup>C</sup>				
Brinell		Rockwell B		
217		95		

<sup>A</sup>Yield strength shall be determined by the offset method at 0.2 % limiting permanent set in accordance with Test Methods E 8. An alternative method of determining yield strength may be based on a total extension under load of 0.5 %.

<sup>B</sup>Elongation for thickness, less than 0.015 in. (0.38 mm) shall be 20 % minimum, in 1 in. (25.4 mm).

<sup>C</sup>Either Brinell or Rockwell B hardness is permissible.

**TABLE 3 Permissible Variations in Thickness for Hot-Rolled Sheets in Cut Lengths, Cold-Rolled Sheets in Cut Lengths and Coils**

Specified Thickness, <sup>A</sup> in. (mm)	Permissible Variations, Over and Under <sup>B</sup>	
	in.	mm
Over 0.145 (3.68) to less than 3/16 (4.76)	0.014	0.36
Over 0.130 (3.30) to 0.145 (3.68), incl	0.012	0.30
Over 0.114 (2.90) to 0.130 (3.30), incl	0.010	0.25
Over 0.098 (2.49) to 0.114 (2.90), incl	0.009	0.23
Over 0.083 (2.11) to 0.098 (2.49), incl	0.008	0.20
Over 0.072 (1.83) to 0.083 (2.11), incl	0.007	0.18
Over 0.058 (1.47) to 0.072 (1.83), incl	0.006	0.15
Over 0.040 (1.02) to 0.058 (1.47), incl	0.005	0.13
Over 0.026 (0.66) to 0.040 (1.02), incl	0.004	0.10
Over 0.016 (0.41) to 0.026 (0.66), incl	0.003	0.08
Over 0.007 (0.18) to 0.016 (0.41), incl	0.002	0.05
Over 0.005 (0.13) to 0.007 (0.18), incl	0.0015	0.04
0.005 (0.13)	0.001	0.03

<sup>A</sup>Thickness measurements are taken at least 3/16 in. (9.52 mm) from the edge of the sheet.

<sup>B</sup>Cold-rolled sheets in cut lengths and coils are produced in some type numbers and some widths and thicknesses to tolerances less than those shown in the table.

**TABLE 4 Permissible Variations in Width and Length for Hot-Rolled Resquared Sheets (Stretcher Leveled Standard of Flatness)**

NOTE 1—Polished sheets with Finishes No. 4 and higher are produced to tolerances given in this table.

Specified Dimensions, in. (mm)	Tolerances		
	Over		Under
	in.	mm	
For thicknesses under 0.131 (3.33):			
Widths up to 48 (1219), excl	1/16	1.59	0
Widths 48 (1219) and over	1/8	3.18	0
Lengths up to 120 (3048), excl	1/16	1.59	0
Lengths 120 (3048) and over	1/8	3.18	0
For thicknesses 0.131 (3.33) and over:			
All widths and lengths	1/4	6.35	0

**TABLE 5 Permissible Variations in Weight for Hot-Rolled and Cold-Rolled Sheets**

Any item of five sheets or less, or any item estimated to weigh 200 lb (90.72 kg) or less, may actually weigh as much as 10 % over the theoretical weight	weight 200 lb (90.72 kg) or less
Any item of more than five sheets and estimated to weigh more than 200 lb (90.72 kg), may actually weigh as much as 7½ % over the theoretical weight	weigh more than 200 lb (90.72 kg)
Chromium-manganese-nickel	40.7 lb/ft <sup>2</sup> -in. thickness (7.82 kg/m <sup>2</sup> -mm thickness)
Chromium-nickel	42.0 lb/ft <sup>2</sup> -in. thickness (8.07 kg/m <sup>2</sup> -mm thickness)
Chromium	41.2 lb/ft <sup>2</sup> -in. thickness (7.92 kg/m <sup>2</sup> -mm thickness)

**TABLE 6 Permissible Variations in Width for Hot-Rolled and Cold-Rolled Sheets Not Resquared and Cold-Rolled Coils**

Specified Thickness, in. (mm)	Tolerances for Specified Width, in. (mm)	
	24 (610) to 48 (1219), excl	48 (1219) and Over
Less than 3/16 (4.76)	1/16 (1.59) over, 0 under	1/8 (3.18) over, 0 under

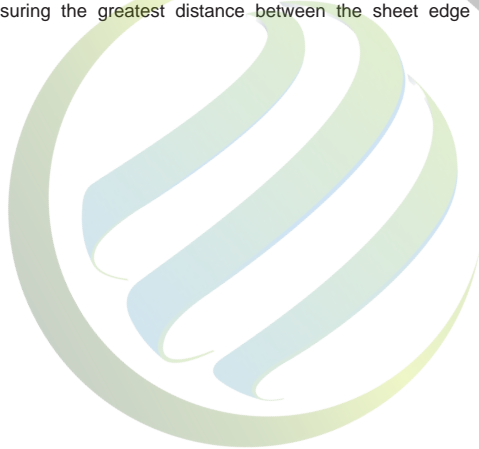
**TABLE 7 Permissible Variations in Length for Hot-Rolled and Cold-Rolled Sheets Not Resquared**

Length, ft (mm)	Tolerances, in. (mm)
Up to 10 (3048), incl	1/4 (6.35) over, 0 under
Over 10 (3048) to 20 (6096), incl	1/2 (12.70) over, 0 under

**TABLE 8 Permissible Variations in Camber for Hot-Rolled and Cold-Rolled Sheets Not Resquared and Cold-Rolled Coils<sup>A</sup>**

Specified Width, in. (mm)	Tolerances per Unit Length of Any 8 ft (2438 mm), in. (mm)
24 (610) to 36 (914), incl	1/8 (3.18)
Over 36 (914)	3/32 (2.38)

<sup>A</sup>Camber is the greatest deviation of a side edge from a straight line and measurement is taken by placing an 8-ft (2438-mm) straightedge on the concave side and measuring the greatest distance between the sheet edge and the straightedge.



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**TABLE 9 Permissible Variations in Flatness for Hot-Rolled and Cold-Rolled Sheets Specified to Stretcher-Level Standard of Flatness**

Specified Thickness, in. (mm)	Width, in. (mm)	Length, in. (mm)	Flatness Tolerance, <sup>A</sup> in. (mm)
Under 3/16 (4.76)	to 48 (1219), incl	to 96 (2438), incl	1/8(3.18)
Under 3/16 (4.76)	to 48 (1219), incl	over 96 (2438)	1/4(6.35)
Under 3/16 (4.76)	over 48 (1219)	to 96 (2438), incl	1/4 (6.35)
Under 3/16 (4.76)	over 48 (1219)	over 96 (2438)	1/4 (6.35)

<sup>A</sup>Maximum deviation from a horizontal flat surface.

**TABLE 10 Permissible Variations in Flatness for Hot-Rolled and Cold-Rolled Sheets Not Specified on Stretcher-Level Standard of Flatness Not Including Dead-Soft and Deep-Drawing Sheets**

Specified Thickness, in. (mm)	Width, in. (mm)	Flatness Tolerance, <sup>A</sup> in. (mm)
0.062 (1.57) and over	to 60 (1524), incl over 60 (1524) to 72 (1829), incl over 72 (1829)	1/2 (12.70) 3/4 (19.05) 1 (25.40)
Under 0.062 (1.57)	to 36 (914), incl over 36 (914) to 60 (1524), incl over 60 (1524)	1/2 (12.70) 3/4 (19.05) 1 (25.40)

<sup>A</sup>Maximum deviation from a horizontal flat surface.

**TABLE 11 Permissible Variations in Diameter for Hot-Rolled and Cold-Rolled Sheets, Sheared Circles**

Specified Thickness, in. (mm)	Tolerance Over Specified Diameter (No Tolerance Under), in. (mm)		
	Diameters Under 30 in. (762)	Diameters 30 (762) to 48 in. (1219)	Diameters Over 48 in. (1219)
0.0972 (2.46) and thicker	1/8 (3.18)	3/16 (4.76)	1/4 (6.35)
0.0971 (2.46) to 0.0568 (1.44), incl	3/32 (2.38)	5/32 (3.97)	7/32 (5.56)
0.0567 (1.44) and thinner	1/16 (1.59)	1/8 (3.18)	3/16 (4.76)

**TABLE 12 Permissible Variations in Thickness for Cold-Rolled Strip in Coils and Cut Lengths**

NOTE 1—Thickness measurements are taken at least 3/8 in. (9.52 mm) in from the edge of the strip except that on widths less than 1 in. (25.4 mm), the tolerances are applicable for measurements at all locations. The tolerances in this table include crown tolerances.

Specified Thickness, in. (mm)	Thickness Tolerances for the Thickness and Widths Given Over and Under, in. (mm)		
	Width, in. (mm)		
	3/16 (4.76) to 6 (152), incl	Over 6 (152) to 12 (305), incl	Over 12 (305) to 24 (610), excl
	Thickness Tolerances <sup>A</sup>		
0.005 (0.13) to 0.010 (0.25), incl	10 %	10 %	10 %
Over 0.010 (0.25) to 0.011 (0.28), incl	0.0015 (0.04)	0.0015 (0.04)	0.0015 (0.04)
Over 0.011 (0.28) to 0.013 (0.33), incl	0.0015 (0.04)	0.0015 (0.04)	0.002 (0.05)
Over 0.013 (0.33) to 0.017 (0.43), incl	0.0015 (0.04)	0.002 (0.05)	0.002 (0.05)
Over 0.017 (0.43) to 0.020 (0.51), incl	0.0015 (0.04)	0.002 (0.05)	0.0025 (0.06)
Over 0.020 (0.51) to 0.029 (0.74), incl	0.002 (0.05)	0.0025 (0.06)	0.0025 (0.06)
Over 0.029 (0.74) to 0.035 (0.89), incl	0.002 (0.05)	0.003 (0.08)	0.003 (0.08)
Over 0.035 (0.89) to 0.050 (1.27), incl	0.0025 (0.06)	0.0035 (0.09)	0.0035 (0.09)
Over 0.050 (1.27) to 0.069 (1.75), incl	0.003 (0.08)	0.0035 (0.09)	0.0035 (0.09)
Over 0.069 (1.75) to 0.100 (2.54), incl	0.003 (0.08)	0.004 (0.10)	0.005 (0.13)
Over 0.100 (2.54) to 0.125 (2.98), incl	0.004 (0.10)	0.0045 (0.11)	0.005 (0.13)
Over 0.125 (2.98) to 0.161 (4.09), incl	0.0045 (0.11)	0.0045 (0.11)	0.005 (0.13)
Over 0.161 (4.09) to under 3/16 (4.76)	0.005 (0.13)	0.005 (0.13)	0.006 (0.15)

<sup>A</sup>Thickness tolerances given in inches (millimetres) unless otherwise indicated.

**TABLE 13 Permissible Variations in Width for Cold-Rolled Strip in Coils and Cut Lengths for Edge Nos. 1 and 5**

Specified Edge No.	Width, in. (mm)	Thickness, in. (mm)	Width Tolerance for Thickness and Width Given, in. (mm)	
			Over	Under
1 and 5	$\frac{3}{32}$ (7.14) and under	$\frac{1}{16}$ (1.59) and under	0.005 (0.13)	0.005 (0.13)
1 and 5	over $\frac{3}{32}$ (7.14) to $\frac{3}{4}$ (19.05), incl	$\frac{3}{32}$ (2.38) and under	0.005 (0.13)	0.005 (0.13)
1 and 5	over $\frac{3}{4}$ (19.05) to 5 (127), incl	$\frac{1}{8}$ (3.18) and under	0.005 (0.13)	0.005 (0.13)
5	over 5 (127.00) to 9 (228.60), incl	$\frac{1}{8}$ (3.18) to 0.008 (0.20), incl	0.010 (0.25)	0.010 (0.25)
5	over 9 (228.60) to 20 (508.00), incl	0.105 (2.67) to 0.015 (0.38)	0.010 (0.25)	0.010 (0.25)
5	over 20 (508.00)	0.080 (2.03) to 0.023 (0.58)	0.015 (0.38)	0.015 (0.38)

**TABLE 14 Permissible Variations in Width for Cold-Rolled Strip in Coils and Cut Lengths for Edge No. 3**

Specified Thickness, in. (mm)	Width Tolerance, Over and Under, for Thickness and Width Given, in. (mm)					
	under $\frac{1}{2}$ (12.70) to $\frac{3}{16}$ (4.76), incl	$\frac{1}{2}$ (12.70) to 6 (152.40), incl	Over 6 (152.40) to 9 (228.60), incl	Over 9 (228.60) to 12 (304.80), incl	Over 12 (304.80) to 20 (508.00), incl	Over 20 (508.00) to 24 (609.60), incl
Under $\frac{3}{16}$ (4.76) to 0.161 (4.09), incl	...	0.016 (0.41)	0.020 (0.51)	0.020 (0.51)	0.031 (0.79)	0.031 (0.79)
0.160 (4.06) to 0.100 (2.54), incl	0.010 (0.25)	0.010 (0.25)	0.016 (0.41)	0.016 (0.41)	0.020 (0.51)	0.020 (0.51)
0.099 (2.51) to 0.069 (1.75), incl	0.008 (0.20)	0.008 (0.20)	0.010 (0.25)	0.010 (0.25)	0.016 (0.41)	0.020 (0.51)
0.068 (1.73) and under	0.005 (0.13)	0.005 (0.13)	0.005 (0.13)	0.010 (0.25)	0.016 (0.41)	0.020 (0.51)

**TABLE 15 Permissible Variations in Length for Cold-Rolled Strip in Cut Lengths**

Specified Length, ft (mm)	Tolerance Over Specified Length (No Tolerance Under), in. (mm)
To 5 (1524), incl	$\frac{3}{8}$ (9.52)
Over 5 (1524) to 10 (3048), incl	$\frac{1}{2}$ (12.70)
Over 10 (3048) to 20 (6096), incl	$\frac{3}{8}$ (15.88)

**TABLE 16 Permissible Variations in Camber for Cold-Rolled Strip in Coils and Cut Lengths<sup>A</sup>**

Specified Width, in. (mm)	Tolerance per Unit Length of Any 8 ft (2438 mm), in. (mm)
To 1 $\frac{1}{2}$ (38.10), incl	$\frac{1}{2}$ (12.70)
Over 1 $\frac{1}{2}$ (38.10) to 24 (609.60), excl	$\frac{1}{4}$ (6.35)

<sup>A</sup>Camber is the deviation of a side edge from a straight line and measurement is taken by placing an 8-ft (2438-mm) straightedge on the concave side and measuring the greatest distance between the strip edge and the straightedge.

TABLE 17 Permissible Variations in Thickness for Plates<sup>A</sup>

Specified Thickness <sup>B</sup> in. (mm)	Width, in. (mm)			
	To 84 (2134), incl	Over 84 (2134) to 120 (3048), incl	Over 120 (3048) to 144 (3658), incl	Over 144 (3658)
	Tolerance Over Specified Thickness <sup>C</sup> in. (mm)			
3/16 (4.76) to 3/8 (9.52), excl	0.045 (1.14)	0.050 (1.27)	...	...
3/8 (9.52) to (19.05), excl	0.055 (1.40)	0.060 (1.52)	0.075 (1.90)	0.090 (2.29)
3/4 (19.05) to 1 (25.40), excl	0.060 (1.52)	0.065 (1.65)	0.085 (2.16)	0.100 (2.54)
1 (25.40) to 2 (50.80), excl	0.070 (1.78)	0.075 (1.90)	0.095 (2.41)	0.115 (2.92)

<sup>A</sup>Thickness is measured along the longitudinal edges of the plate at least 3/8 in. (9.52 mm), but not more than 3 in. (76.20 mm), from the edge.

<sup>B</sup>Plates over 2 in. (50.80 mm) thick are produced. Thickness tolerances for such plates are not included.

<sup>C</sup>For circles, the over thickness tolerances in this table apply to the diameter of the circle corresponding to the width ranges shown. For plates of irregular shape, the over thickness tolerances apply to the greatest width corresponding to the width ranges shown. For plates up to 2 in. (50.80 mm), inclusive, in thickness, the tolerance under the specified thickness is 0.010 in. (0.25 mm).

TABLE 18 Permissible Variations in Width and Length for Rectangular Sheared Mill Plates and Universal Mill Plates

Width, in. (mm)	Length, in. (mm)	Tolerances Over Specified Width and Length for Given Width, Length, and Thickness <sup>A</sup> in. (mm)					
		Under 3/8 in. (9.52 mm) in Thickness		3/8 (9.52) to 1/2 (12.70 mm) in., incl, in Thickness		Over 1/2 (12.70 mm) to 1 in. (25.40 mm) in Thickness <sup>B</sup>	
		Width	Length	Width	Length	Width	Length
48 (1219) and under	144 (3658) and under	1/8 (3.18)	3/16 (4.76)	3/16 (4.76)	1/4 (6.35)	5/16 (7.94)	3/8 (9.52)
Over 48 (1219) to 60 (1524), incl	under	3/16 (4.76)	1/4 (6.35)	1/4 (6.35)	5/16 (7.94)	3/8 (9.52)	7/16 (11.11)
Over 60 (1524) to 84 (2134), incl		1/4 (6.35)	5/16 (7.94)	5/16 (7.94)	3/8 (9.52)	7/16 (11.11)	1/2 (12.70)
Over 84 (2134) to 108 (2743), incl		5/16 (7.94)	3/8 (9.52)	3/8 (9.52)	7/16 (11.11)	1/2 (12.70)	9/16 (14.29)
Over 108 (2743)		3/8 (9.52)	7/16 (11.11)	7/16 (11.11)	1/2 (12.70)	5/8 (15.88)	11/16 (17.46)
48 (1219) and under	over 144 (3658)	3/16 (4.76)	3/8 (9.52)	1/4 (6.35)	1/2 (12.70)	5/16 (7.94)	5/8 (15.88)
Over 48 (1219) to 60 (1524), incl	to 240 (6096)	1/4 (6.35)	7/16 (11.11)	5/16 (7.94)	5/8 (15.88)	3/8 (9.52)	3/4 (19.05)
Over 60 (1524) to 84 (2134), incl		3/8 (9.52)	1/2 (12.70)	7/16 (11.11)	11/16 (17.46)	1/2 (12.70)	3/4 (19.05)
Over 84 (2134) to 108 (2743), incl		7/16 (11.11)	9/16 (14.29)	1/2 (12.70)	3/4 (19.05)	5/8 (15.88)	7/8 (22.22)
Over 108 (2743)		1/2 (12.70)	5/8 (15.88)	5/8 (15.88)	7/8 (22.22)	11/16 (17.46)	1 (25.40)
48 (1219) and under	over 240 (6096)	1/4 (6.35)	1/2 (12.70)	5/16 (7.94)	5/8 (15.88)	3/8 (9.52)	3/4 (19.05)
Over 48 (1219) to 60 (1524), incl	to 360 (9144)	5/16 (7.94)	5/8 (15.88)	3/8 (9.52)	3/4 (19.05)	1/2 (12.70)	3/4 (19.05)
Over 60 (1524) to 84 (2134), incl		7/16 (11.11)	11/16 (17.46)	1/2 (12.70)	3/4 (19.05)	5/8 (15.88)	7/8 (22.22)
Over 84 (2134) to 108 (2743), incl		9/16 (14.29)	3/4 (19.05)	5/8 (15.88)	7/8 (22.22)	3/4 (19.05)	1 (25.40)
Over 108 (2743)		5/8 (15.88)	7/8 (22.22)	11/16 (17.46)	1 (25.40)	7/8 (22.22)	1 (25.40)
60 (1524) and under	over 360 (9144)	7/16 (11.11)	1 1/8 (28.58)	1/2 (12.70)	1 1/4 (31.75)	5/8 (15.88)	1 3/8 (34.92)
Over 60 (1524) to 84 (2134), incl	to 480 (12192)	1/2 (12.70)	1 1/4 (31.75)	5/8 (15.88)	1 3/8 (34.92)	3/4 (19.05)	1 1/2 (38.10)
Over 84 (2134) to 108 (2743), incl		9/16 (14.29)	1 1/4 (31.75)	3/4 (19.05)	1 3/8 (34.92)	7/8 (22.22)	1 1/2 (38.10)
Over 108 (2743)		3/4 (19.05)	1 3/8 (34.92)	7/8 (22.22)	1 1/2 (38.10)	1 (25.40)	1 5/8 (41.28)
60 (1524) and under	over 480 (12192)	7/16 (11.11)	1 1/4 (31.75)	1/2 (12.70)	1 1/2 (38.10)	5/8 (15.88)	1 5/8 (41.28)
Over 60 (1524) to 84 (2134), incl	to 600 (15240)	1/2 (12.70)	1 3/8 (34.92)	5/8 (15.88)	1 1/2 (38.10)	3/4 (19.05)	1 5/8 (41.28)
Over 84 (2134) to 108 (2743), incl		5/8 (15.88)	1 3/8 (34.92)	3/4 (19.05)	1 1/2 (38.10)	7/8 (22.22)	1 5/8 (41.28)
Over 108 (2743)		3/4 (19.05)	1 1/2 (38.10)	7/8 (22.22)	1 5/8 (41.28)	1 (25.40)	1 3/4 (44.45)
60 (1524) and under	over 600 (15240)	1/2 (12.70)	1 3/4 (44.45)	5/8 (15.88)	1 7/8 (47.62)	3/4 (19.05)	1 7/8 (47.62)
Over 60 (1524) to 84 (2134), incl		5/8 (15.88)	1 3/4 (44.45)	3/4 (19.05)	1 7/8 (47.62)	7/8 (22.22)	1 7/8 (47.62)
Over 84 (2134) to 108 (2743), incl		5/8 (15.88)	1 3/4 (44.45)	3/4 (19.05)	1 7/8 (47.62)	7/8 (22.22)	1 7/8 (47.62)
Over 108 (2743)		7/8 (22.22)	1 3/4 (44.45)	1 (25.40)	2 (50.80)	1 1/8 (28.58)	2 1/4 (57.15)

<sup>A</sup>The tolerance under specified width and length is 1/4 in. (6.35 mm).

<sup>B</sup>Rectangular plates over 1 in. (25.4 mm) in thickness are not commonly sheared and are machined or otherwise cut to length and width or produced in the size as rolled, uncropped.



TABLE 19 Permissible Variations in Annealed Plates

NOTE 1—Tolerance in this table apply to plates up to 15 ft (4572 mm) in length, or to any 15 ft of longer plates.

NOTE 2—If the longer dimension is under 36 in. (914 mm), the tolerance is not greater than 1/4 in. (6.35 mm).

NOTE 3—For plates with specified minimum yield strengths of 35 ksi (240 MPa) or more, the permissible variations are increased to 1 1/2 times the amounts shown below.

Specified Thickness, in. (mm)	Flatness Tolerance (Deviation from a Horizontal Flat Surface) for Thicknesses and Widths Given, in. (mm)								
	Width, in. (mm)								
	48 (1219) or Under	Over 48 (1219) to 60 (1524), excl	60 (1524) to 72 (1829), excl	72 (1829) to 84 (2134), excl	84 (2134) to 96 (2438), excl	96 (2438) to 108 (2743), excl	108 (2743) to 120 (3048), excl	120 (3048) to 144 (3658), excl	144 (3658) and Over
3/16 (4.76) to 1/4 (6.35), excl	3/4 (19.05)	1 1/16 (26.99)	1 1/4 (31.75)	1 3/8 (34.92)	1 5/8 (41.28)	1 7/8 (41.28)	1 7/8 (47.62)	2 (50.80)	...
1/4 (6.35) to 3/8 (9.52), excl	1 1/16 (17.46)	3/4 (19.05)	1 5/16 (23.81)	1 1/8 (28.58)	1 3/8 (34.92)	1 7/16 (36.51)	1 7/8 (47.62)	1 7/8 (47.62)	...
3/8 (9.52) to 1/2 (12.70) excl	1/2 (12.70)	9/16 (14.29)	1 1/16 (17.46)	3/4 (19.05)	1 5/16 (23.81)	1 1/8 (28.58)	1 1/4 (31.75)	1 1/16 (36.51)	1 3/4 (44.45)
1/2 (12.70) to 3/4 (19.05) excl	1/2 (12.70)	9/16 (14.29)	5/8 (15.88)	5/8 (15.88)	1 3/16 (20.64)	1 1/8 (28.58)	1 1/8 (28.58)	1 1/8 (28.58)	1 3/8 (34.92)
3/4 (19.05) to 1 (25.40), excl	1/2 (12.70)	9/16 (14.29)	5/8 (15.88)	5/8 (15.88)	3/4 (19.05)	1 3/16 (20.64)	1 5/16 (23.81)	1 (25.40)	1 1/8 (28.58)
1 (25.40) to 1 1/2 (38.10), excl	1/2 (12.70)	9/16 (14.29)	9/16 (14.29)	9/16 (14.29)	1 1/16 (17.46)	1 1/16 (17.46)	1 1/16 (17.46)	3/4 (19.05)	1 (25.40)
1 1/2 (38.10) to 4 (101.60), excl	3/16 (4.76)	5/16 (7.94)	3/8 (9.52)	7/16 (11.11)	1/2 (12.70)	9/16 (14.29)	5/8 (15.88)	3/4 (19.05)	7/8 (22.22)
4 (101.60) to 6 (152.40), excl	1/4 (6.35)	3/8 (9.52)	1/2 (12.70)	9/16 (14.29)	5/8 (15.88)	3/4 (19.05)	7/8 (22.22)	1 (25.40)	1 1/8 (28.58)

TABLE 20 Permissible Variations in Camber for Sheared Mill and Universal Mill Plates<sup>A</sup>

Maximum camber	= 1/8 in. in any 5 ft
	= 3.18 in any 1.524 m

<sup>A</sup>Camber is the deviation of a side edge from a straight line, and measurement is taken by placing a 5-ft straightedge on the concave side and measuring the greatest distance between the plate and the straightedge.

TABLE 21 Permissible Variations in Diameter for Circular Plates

Specified Diameter, in. (mm)	Tolerance Over Specified Diameter for Given Diameter and Thickness, <sup>A</sup> in. (mm)		
	To 3/8 (9.52), excl, in Thickness	3/8 (9.52) to 5/8 (15.88), excl in Thickness <sup>B</sup>	5/8 in. (15.88) and Over in Thickness <sup>B</sup>
To 60 (1524), excl	1/4 (6.35)	3/8 (9.52)	1/2 (12.70)
60 (1524) to 84 (2134), excl	5/16 (7.94)	7/16 (11.11)	9/16 (14.29)
84 (2134) to 108 (2743), excl	3/8 (9.52)	1/2 (12.70)	5/8 (15.88)
108 (2743) to 180 (4572), excl	7/16 (11.11)	9/16 (14.29)	1 1/16 (17.46)

<sup>A</sup>No tolerance under.

<sup>B</sup>Circular and sketch plates over 5/8 in. (15.88 mm) in thickness are not commonly sheared but are machined or flame cut.

TABLE 22 Recommended Flame Cutting Allowances to Clean Up in Machining Plates, Circles, Rings, and Sketches<sup>A</sup>

Specified Thickness, in. (mm)	Machining Allowance per Edge, in. (mm)
2 (50.80) and under	1/4 (6.35)
Over 2 (50.80) to 3 (76.20), incl	3/8 (9.52)
Over 3 (76.20) to 6 (152.40), incl	1/2 (12.70)

<sup>A</sup>Supplier assumes the appropriate clean-up allowances have been included in ordered dimension.

TABLE 23 Permissible Variations in Abrasive Cutting Width and Length for Plates

Specified Thickness, in. (mm)	Tolerance over Specified Width and Length, <sup>A</sup> in. (mm)	
	Width	Length
Up to 1 1/4 (31.75), incl	1/8 (3.18)	1/8 (3.18)
Over 1 1/4 (31.75) to 2 3/4 (69.85), incl <sup>B</sup>	3/16 (4.76)	3/16 (4.76)

<sup>A</sup>The tolerance under specified width and length is 1/4 in. (3.18 mm).

<sup>B</sup>Width and length tolerances for abrasive cut plates over 2 3/4 in. (69.85 mm) thick are not included in this table.

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