

**AEROSPACE
MATERIAL
SPECIFICATION****AMS 2232F**
Superseding AMS 2232EIssued 7-1-45
Revised 1-1-83**TOLERANCES**
Carbon Steel Sheet, Strip, and Plate

1. **SCOPE:** This specification covers established inch/pound manufacturing tolerances applicable to carbon steel sheet, strip, and plate ordered to inch/pound dimensions. These tolerances apply to all conditions unless otherwise noted. The term "excl" is used to apply only to the higher figure of the specified range. Tolerances for product sizes not listed herein shall be as agreed upon by purchaser and vendor.
 2. **THICKNESS:** Tolerances apply to measurements made at any point on widths less than 1 in., at any point not less than 3/8 in. from a cut edge, or not less than 3/4 in. from a mill edge on widths 1 in. and over, and at a point 3/8 - 3/4 in. from the longitudinal edge of rectangular sheared plates. Regardless of whether thickness tolerances for sheet and strip are specified equally or unequally, plus and minus, the total tolerance shall be equal to the arithmetic sum of the tabular plus and minus tolerances (twice the tabular tolerances when specified equally plus and minus).
- 2.1 Cold Rolled Sheet, Coils and Cut Lengths (See 2.1.1):

TABLE I

Specified Thickness Inch	Tolerance, Inch, Plus and Minus For Width Ranges, Inches		
	2	Over 15	
	to 15, incl	to 72, incl	Over 72
0.0142 to 0.0194, incl	0.002	0.002	--
Over 0.0194 to 0.0388, incl	0.003	0.003	0.003
Over 0.0388 to 0.0567, incl	0.004	0.004	0.004
Over 0.0567 to 0.0709, incl	0.005	0.005	0.005
Over 0.0709 to 0.0971, incl	0.005	0.005	0.006
Over 0.0971 to 0.1419, incl	0.005	0.006	0.007

- 2.1.1 Tolerances in Table I for nominal widths of 2 - 12 in., incl, in nominal thicknesses of 0.0142 to 0.0821 in., incl, apply to product slit from wider sheet.

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2.2 Hot Rolled Sheet:

2.2.1 Coils and Cut Lengths, Specified Thicknesses 0.0449 to 0.2299 In., Inclusive:

TABLE II

Specified Thickness Inch	Tolerance, Inch, Plus and Minus For Width Ranges, Inches							
	Over 12 to 20, incl	Over 20 to 40, incl	Over 40 to 48, incl	Over 48 to 60, incl	Over 60 to 72, incl	Over 72 to 72		
	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
0.0449 to 0.0508, incl	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Over 0.0508 to 0.0567, incl	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005
Over 0.0567 to 0.0709, incl	0.006	0.006	0.006	0.006	0.006	0.006	0.006	0.006
Over 0.0709 to 0.0971, incl	0.006	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Over 0.0971 to 0.1799, incl	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Over 0.1799 to 0.2299, incl	0.007	0.008	0.008	0.008	0.008	0.008	0.008	0.008

2.2.2 Coils Only, Specified Thicknesses Over 0.1800 to 0.5000 In., Inclusive:

TABLE III

Specified Thickness Inch	Tolerance, Inch, Plus and Minus For Width Ranges, Inches							
	Over 12 to 20, incl	Over 20 to 40, incl	Over 40 to 48, incl	Over 48 to 60, incl	Over 60 to 72, incl	Over 72 to 72		
	0.010	0.011	0.012	0.012	0.012	0.012	0.012	0.012
Over 0.1800 to 0.2299, incl	0.010	0.011	0.012	0.012	0.012	0.012	0.012	0.012
Over 0.2299 to 0.3130, incl	0.012	0.012	0.013	0.014	0.015	0.016	0.016	0.016
Over 0.3130 to 0.3750, incl	0.014	0.014	0.014	0.015	0.016	0.016	0.016	0.016
Over 0.3750 to 0.5000, incl	0.014	0.014	0.014	0.015	0.016	0.016	0.016	0.016

2.2.3 Tolerances in Table II and Table III do not apply to the uncropped ends of mill edge coils.

2.3 Cold Rolled Strip, Coils and Cut Lengths:

TABLE IV

Tolerance, Inch, Plus and Minus For Width Ranges, Inches		Tolerance, Inch, Plus and Minus For Width Ranges, Inches							
		Over	Over	Over	Over	Over	Over	Over	Over
Specified Thickness Inch		0.500 to 1, excl	1 to 3, excl	3 to 6, incl	6 to 9, incl	9 to 12, incl	12 to 16, incl	16 to 20, incl	Over 20 to 23-15/16, incl
Up to 0.007, excl		0.0005	0.0005	0.0005	--	--	--	--	--
0.007 to 0.009, excl		0.00075	0.00075	0.00075	--	--	--	--	--
0.009 to 0.013, excl		0.00075	0.00075	0.00075	0.001	0.001	0.001	0.001	0.001
0.013 to 0.020, excl		0.00075	0.00075	0.00075	0.001	0.001	0.0015	0.0015	0.0015
0.020 to 0.023, excl		0.001	0.001	0.001	0.0015	0.0015	0.0015	0.0015	0.0015
0.023 to 0.026, excl		0.001	0.001	0.001	0.0015	0.0015	0.002	0.002	0.002
0.026 to 0.029, excl		0.001	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002
0.029 to 0.032, excl		0.0015	0.0015	0.0015	0.002	0.002	0.002	0.002	0.002
0.032 to 0.035, excl		0.0015	0.0015	0.002	0.002	0.002	0.002	0.002	0.002
0.035 to 0.040, excl		0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002
0.040 to 0.050, excl		0.002	0.002	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025
0.050 to 0.069, excl		0.002	0.002	0.0025	0.0025	0.0025	0.003	0.003	0.003
0.069 to 0.100, excl		0.002	0.002	0.0025	0.003	0.003	0.0035	0.0035	0.0035
0.100 to 0.161, excl		0.002	0.002	0.003	0.003	0.003	0.0035	0.0045	0.005
0.161 to 0.200, excl		0.0025	0.0035	0.004	0.004	0.0045	0.0045	0.005	0.005
0.200 to 0.250, excl		0.003	0.004	0.0045	0.0045	0.005	0.0055	0.0055	0.0055

2.4 Hot Rolled Strip, Coils and Cut Lengths (See 2.4.1):

TABLE V

Specified Thickness Inch	Tolerance, Inch, Plus and Minus For Width Ranges, Inches			
	Up to 3 1/2, incl	Over 3-1/2 to 6, incl	Over 6 to 8, incl	Over 8 to 12, incl
0.0255 to 0.0343, incl	0.003	--	--	--
Over 0.0343 to 0.0448, incl	0.003	0.003	--	--
Over 0.0448 to 0.0567, incl	0.003	0.003	0.004	0.004
Over 0.0567 to 0.1179, incl	0.004	0.005	0.005	0.005
Over 0.1179 to 0.1874, incl	0.005	0.005	0.005	0.005
Over 0.1874 to 0.2030, incl	0.006	0.006	0.006	0.006
Over 0.2030 to 0.2299, incl	--	--	0.006	0.006
Over 0.2299 to 0.3124, incl	--	--	--	0.008
Over 0.3124 to 0.3750, incl	--	--	--	0.009
Over 0.3750 to 0.5000, incl	--	--	--	0.010

2.4.1 Tolerances in Table V do not include crown; the tolerances shown in Table VI are in addition to those shown in Table V.

2.5 Crown (See 2.4.1): Strip may be thicker at the center than at a point 3/8 in. from the edge by the amounts shown in Table VI.

TABLE VI

Specified Thickness Inch	Crown, Inch For Width Ranges, Inches		
	Over 1 to 3 1/2, incl	Over 3-1/2 to 6, incl	Over 6 to 12 incl
0.0255 to 0.0343, incl	0.002	--	--
Over 0.0343 to 0.0448, incl	0.002	0.003	--
Over 0.0448 to 0.1179, incl	0.002	0.003	0.004
Over 0.1179 to 0.1874, incl	0.002	0.002	0.003
Over 0.1874 to 0.2030, incl	0.001	0.002	0.003
Over 0.2030 to 0.2299, incl	--	--	0.002

2.6 Rectangular Sheared Plates: Minus tolerance for all sizes shall be 0.010 in., plus tolerances shall be as specified in Table VII.

TABLE VII

Specified Thickness Inches	Tolerance, Inch, Plus For Width Ranges, Inches						
	Up to 48, incl	Over 48 to 60, excl	60 to 72, excl	72 to 84, excl	84 to 96, excl	96 to 108, excl	108 to 120, incl
Up to 0.250, excl	0.016	0.016	0.020	0.020	0.024	0.028	0.032
0.250 to 0.312, excl	0.016	0.020	0.020	0.024	0.028	0.032	0.036
0.312 to 0.375, excl	0.020	0.020	0.024	0.024	0.028	0.032	0.036
0.375 to 0.437, excl	0.020	0.024	0.024	0.028	0.032	0.036	0.040
0.437 to 0.500, excl	0.024	0.024	0.028	0.028	0.032	0.036	0.040
0.500 to 0.625, excl	0.024	0.028	0.028	0.032	0.036	0.040	0.040
0.625 to 0.750, excl	0.028	0.028	0.032	0.032	0.036	0.040	0.044
0.750 to 1.000, excl	0.032	0.032	0.036	0.036	0.040	0.044	0.048
1.000 to 1.250, excl	0.040	0.044	0.048	0.048	0.048	0.052	0.056
1.250 to 1.500, excl	0.052	0.052	0.056	0.056	0.056	0.064	0.068
1.500 to 1.750, excl	0.060	0.060	0.064	0.064	0.064	0.072	0.080
1.750 to 2.000, incl	0.068	0.068	0.072	0.076	0.076	0.086	0.094

2.6.1 For thickness measured at any location other than that specified in Section 2, the permissible maximum plus tolerance shall be increased by 75%.

3. WIDTH:

- 3.1 Cold Rolled Sheet Over 12 In. in Width and Hot Rolled, Cut Edge Sheet, Not Resquared, Coils and Cut Lengths:

TABLE VIII

Specified Width Inches	Tolerance, Inch, Plus Only
Over 12 to 30, incl	1/8
Over 30 to 48, incl	3/16
Over 48 to 60, incl	1/4
Over 60 to 80, incl	5/16
Over 80	3/8

- 3.1.1 For hot rolled sheet, tolerances apply only to thicknesses 0.2299 in. and under.

- 3.2 Cold Rolled Sheet 2 to 12 In. in Width, Produced by Slitting Wider Sheet, Not Resquared, Coils and Cut Lengths:

TABLE IX

Specified Width Inches	<u>Tolerance, Inch, Plus and Minus</u> <u>For Thickness Ranges, Inch</u>	
	0.0142 to 0.0680, incl	Over 0.0680 to 0.0821, incl
2 to 6, incl	0.008	0.012
Over 6 to 9, incl	0.016	0.016
Over 9 to 12, incl	0.032	0.032

- 3.3 Cold Rolled Strip, Coils and Cut Lengths:

3.3.1 Mill Edge:

TABLE X

	Specified Width Inches	Tolerance, Inch, Plus and Minus
Ø	Over 1/2 to 2, incl	1/32
	Over 2 to 5, incl	3/64
	Over 5 to 10, incl	5/64
	Over 10 to 15, incl	3/32
	Over 15 to 20, incl	1/8
	Over 20 to 24, excl	5/32

3.3.2 Slit Edge:

TABLE XI

	Specified Width Inches	Tolerance, Inch, Plus and Minus For Thickness Ranges, Inch			
		Up to	Over	Over	Over
		0.068, incl	0.068 to 0.099, incl	0.099 to 0.160, incl	0.160 to 0.2490, incl
Ø	Over 1/2 to 6, incl	0.005	0.008	0.010	0.016
	Over 6 to 9, incl	0.005	0.010	0.016	0.020
	Over 9 to 12, incl	0.010	0.010	0.016	0.020
	Over 12 to 20, incl	0.016	0.016	0.020	0.031
	Over 20 to 24, excl	0.020	0.020	0.020	0.031

3.4 Hot Rolled Strip, Coils and Cut Lengths (See 3.4.1):

TABLE XII

	Specified Width Inches	Tolerance, Inch, Plus and Minus For Thickness Ranges, Inch	
		Mill Edge or Square Edge	Slit or Cut Edge
		Up to 0.2299, incl	Over Up to 0.109, incl
Ø	Up to 2, incl	1/32	0.008
	Over 2 to 5, incl	3/64	0.008
	Over 5 to 10, incl	1/16	0.010
	Over 10 to 12, incl	3/32	0.016

3.4.1 Tolerances for strip over 0.2299 to 0.5000 in. in specified thickness with mill edge or square edge apply only to coiled strip.

3.5 Hot Rolled Plate:

3.5.1 Sheared Plate: Minus tolerance shall be 1/4 in. for all sizes; plus tolerances shall be as specified in Table XIII.

TABLE XIII

Specified Width Inches	Specified Length Inches	Tolerance, Inches, Plus For Thickness Ranges, Inches			
		Up to 3/8, excl	3/8 to 5/8, excl	5/8 to 1, excl	1 to 1-1/2, incl
Up to 60, excl	Up	3/8	7/16	1/2	5/8
60 to 84, excl	to	7/16	1/2	5/8	3/4
84 to 108, excl	120,	1/2	5/8	3/4	1
108 and over	excl	5/8	3/4	7/8	1-1/8
Up to 60, excl	120	3/8	1/2	5/8	3/4
60 to 84, excl	to	1/2	5/8	3/4	7/8
84 to 108, excl	240,	9/16	11/16	13/16	1
108 and over	excl	5/8	3/4	7/8	1-1/8
Up to 60, excl	240	3/8	1/2	5/8	3/4
60 to 84, excl	to	1/2	5/8	3/4	7/8
84 to 108, excl	360,	9/16	11/16	7/8	1
108 and over	excl	11/16	7/8	1	1-1/4
Up to 60, excl	360	7/16	1/2	5/8	3/4
60 to 84, excl	to	1/2	5/8	3/4	7/8
84 to 108, excl	480,	9/16	3/4	7/8	1
108 and over	excl	3/4	7/8	1	1-1/4
Up to 60, excl	480	7/16	1/2	5/8	3/4
60 to 84, excl	to	1/2	5/8	3/4	7/8
84 to 108, excl	600,	5/8	3/4	7/8	1
108 and over	excl	3/4	7/8	1	1-1/4
Up to 60, excl	600	1/2	5/8	3/4	7/8
60 to 84, excl	to	5/8	3/4	7/8	1
84 to 108, excl	720,	5/8	3/4	7/8	1-1/8
108 and over	excl	7/8	1	1-1/8	1-1/4
Up to 60, excl	720	9/16	3/4	7/8	1
60 to 84, excl	and	3/4	7/8	1	1-1/8
84 to 108, excl	over	3/4	7/8	1	1-1/4
108 and over		1	1-1/8	1-1/4	1-3/8

3.5.2 Gas Cut Rectangular Plate:

TABLE XIV

Specified Width Inches	Tolerance, Inch, Plus and Minus For Thicknesses up to 2 in., excl
All	1/2

3.5.2.1 Tolerance may be taken all minus or divided unequally plus and minus, if so specified.

3.5.2.2 Plates with universal rolled edges are commonly cut to length only.

3.5.3 Universal Mill Plate: Minus tolerance shall be 1/8 inch. Plus tolerances shall be as specified in Table XV.

TABLE XV

Specified Width Inches	Tolerance, Inch, Plus For Thickness Ranges, Inches			
	Up to 3/8, excl	3/8 to 5/8, excl	5/8 to 1, excl	1 to 2, excl
Up to 20, excl	1/8	1/8	3/16	1/4
20 to 36, excl	3/16	1/4	5/16	3/8
36 and over	5/16	3/8	7/16	1/2

3.5.4 Mill Edge Plates in Coils and Cut Lengths for Plates Produced on Strip Mills:

TABLE XVI

Specified Width Inches	Tolerances, Inches, Plus and Minus
Up to 14, excl	7/16
14 to 17, excl	1/2
17 to 19, excl	9/16
19 to 21, excl	5/8
21 to 24, excl	11/16
24 to 26, excl	13/16
26 to 28, excl	15/16
28 to 35, excl	1-1/8
35 to 50, excl	1-1/4
50 to 60, excl	1-1/2
60 to 65, excl	1-5/8
65 to 70, excl	1-3/4
70 to 80, excl	1-7/8
80 and over	2

3.5.4.1 Tolerances in Table XVI do not apply to the uncropped ends of mill edge plate in coils.

4. LENGTH:

4.1 Cold Rolled Sheet, Cut Lengths, Not Resquared:

TABLE XVII

Specified Length Inches	Tolerance, Inches, Plus Only For Width Ranges, Inches	
	2 to 12, incl	Over 12
Over 12 to 24, incl	--	1/8
Over 24 to 30, incl	1/2	1/8
Over 30 to 60, incl	1/2	1/4
Over 60 to 96, incl	3/4	1/2
Over 96 to 120, incl	3/4	3/4
Over 120 to 156, incl	1	1
Over 156 to 192, incl	1	1-1/4
Over 192 to 240, incl	1	1-1/2
Over 240	--	1-3/4

4.1.1 Tolerances in Table XVII for widths 2 - 12 in., incl, apply to product produced by slitting from wider sheet.

4.2 Hot Rolled Sheet, Cut Lengths, Not Resquared:

TABLE XVIII

Specified Length Inches	Tolerance, Inches, Plus Only
Up to 15, incl	1/8
Over 15 to 30, incl	1/4
Over 30 to 60, incl	1/2
Over 60 to 120, incl	3/4
Over 120 to 156, incl	1
Over 156 to 192, incl	1-1/4
Over 192 to 240, incl	1-1/2
Over 240	1-3/4

4.3 Cold Rolled Strip:

TABLE XIX

Specified Length Inches	Tolerance, Inch, Plus Only For Width Ranges, Inch	
	Over 1/2 to 12, incl	Over 12 to 24, excl
24 to 60, incl	1/4	1/2
Over 60 to 120, incl	1/2	3/4
Over 120 to 240, incl	3/4	1

4.4 Hot Rolled Strip:

TABLE XX

Specified Length Feet	Tolerance, Inches, Plus Only For Width Ranges, Inch		
	Up to 3, incl	Over 3 to 6, incl	Over 6 to 12, incl
Up to 5, incl	1/4	3/8	1/2
Over 5 to 10, incl	3/8	1/2	3/4
Over 10 to 20, incl	1/2	5/8	1
Over 20 to 30, incl	3/4	3/4	1-1/4
Over 30 to 40, incl	1	1	1-1/2
Over 40	1-1/2	1-1/2	1-3/4

4.5 Hot Rolled Plate:

- 4.5.1 Sheared Plate, Universal Mill Plate, and Mill Edge Plate: Minus tolerance shall be 1/4 in. for all sizes. Plus tolerances shall be as specified in Table XXI except as specified in 4.5.1.1.

TABLE XXI

Specified Length Inches	Specified Width Inches	Tolerance, Inches, Plus For Thickness Ranges, Inches			
		Up to 3/8, excl	3/8 to 5/8, excl	5/8 to 1, excl	1 to 2, incl
Up to 120, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	1/2 5/8 3/4 7/8	5/8 11/16 7/8 1	3/4 7/8 1 1-1/8	1 1 1-1/8 1-1/4
120 to 240, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	3/4 3/4 7/8 1	7/8 7/8 15/16 1-1/8	1 1 1-1/8 1-1/4	1-1/8 1-1/4 1-3/8 1-3/8
240 to 360, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	1 1 1 1-1/8	1-1/8 1-1/8 1-1/8 1-1/4	1-1/4 1-1/4 1-3/8 1-3/8	1-1/2 1-1/2 1-1/2 1-3/4
360 to 480, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	1-1/8 1-1/4 1-1/4 1-3/8	1-1/4 1-3/8 1-3/8 1-1/2	1-3/8 1-1/2 1-1/2 1-5/8	1-5/8 1-5/8 1-7/8 1-7/8
480 to 600, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	1-1/4 1-3/8 1-3/8 1-1/2	1-1/2 1-1/2 1-1/2 1-5/8	1-5/8 1-5/8 1-5/8 1-3/4	1-7/8 1-7/8 1-7/8 1-7/8
600 to 720, excl	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	1-3/4 1-3/4 1-3/4 1-3/4	1-7/8 1-7/8 1-7/8 2	1-7/8 1-7/8 1-7/8 2-1/4	2-1/4 2-1/4 2-1/4 2-1/2
720 and over	Up to 60, excl 60 to 84, excl 84 to 108, excl 108 and over	2 2 2 2	2-1/8 2-1/8 2-1/8 2-3/8	2-1/4 2-1/4 2-1/4 2-1/2	2-3/4 2-3/4 2-3/4 3

4.5.1.1 For sheared plate, the tolerances in Table XXI apply only to specified thicknesses 1-1/2 in. and under.

4.5.2 Gas Cut Rectangular Plates:TABLE XXII

Specified Length Inches	Tolerance, Inch, Plus Only For Thicknesses Up to 2 Inches, Excl
All	1/2

4.5.2.1 Tolerance may be taken all minus or divided plus and minus if so specified.

4.5.2.2 Plates with universal rolled edges are commonly cut to length only.

5. CAMBER (Lateral Bow):

5.1 Sheet: Camber (lateral bow) is the greatest deviation of a side edge from a straight line, the measurement being taken on the concave side with a straight edge.

5.1.1 Cold Rolled Sheet Over 12 In. Wide and Hot Rolled Sheet, Not Resquared, Cut Lengths:

TABLE XXIII

Specified Cut Length Feet	Tolerance, Inches
Up to 4, incl	1/8
Over 4 to 6, incl	3/16
Over 6 to 8, incl	1/4
Over 8 to 10, incl	5/16
Over 10 to 12, incl	3/8
Over 12 to 14, incl	1/2
Over 14 to 16, incl	5/8
Over 16 to 18, incl	3/4
Over 18 to 20, incl	7/8
Over 20 to 30, incl	1-1/4
Over 30 to 40, incl	1-1/2