

**AEROSPACE
MATERIAL
SPECIFICATION****MAM 2232**

Issued 1-1-83

Revised

**TOLERANCES, METRIC
Carbon Steel Sheet, Strip, and Plate**

1. **SCOPE:** This specification covers established metric manufacturing tolerances applicable to carbon steel sheet, strip, and plate ordered to metric 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 25 mm, at any point not less than 10 mm from a cut edge, or not less than 20 mm from a mill edge on widths 25 mm and over, and at a point 10 - 20 mm 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 Millimetres	Tolerance, Millimetre, Plus and Minus For Width Ranges, Millimetres			
	Over 50 to 300, incl	Over 300 to 1800, incl	Over 1800 to 2000, incl	Over 2000
Up to 0.4, incl	0.05	0.05	--	--
Over 0.4 to 1.0, incl	0.08	0.08	0.08	0.15
Over 1.0 to 1.2, incl	0.10	0.10	0.10	0.15
Over 1.2 to 2.5, incl	0.12	0.12	0.15	0.18
Over 2.5 to 4.0, incl	--	0.15	0.18	0.20

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

10/9/

2.2 Hot Rolled Sheets:

2.2.1 Coils and Cut Lengths, Specified Thicknesses Up to 6.0 mm, Inclusive:

TABLE II

Specified Thickness Millimetres	Tolerance, Millimetre, Plus and Minus For Width Ranges, Millimetres				
	Over 300 to 600, incl	Over 600 to 1200, incl	Over 1200 to 1500, incl	Over 1500 to 1800, incl	Over 1800
Up to 2.0, incl	0.15	0.15	0.18	0.18	0.18
Over 2.0 to 2.5, incl	0.15	0.18	0.18	0.20	0.20
Over 2.5 to 4.0, incl	0.18	0.20	0.20	0.20	0.20
Over 4.0 to 5.5, incl	0.20	0.22	0.25	0.28	0.30
Over 5.5 to 6.0, incl	0.28	0.30	0.30	0.32	0.38

2.2.2 Coils Only, Specified Thicknesses Over 6.0 to 12.5 mm, Inclusive:

TABLE III

Specified Thickness Millimetres	Tolerance, Millimetre, Plus and Minus For Width Ranges, Millimetres				
	Over 300 to 600, incl	Over 600 to 1200, incl	Over 1200 to 1500, incl	Over 1500 to 1800, incl	Over 1800
Over 6.0 to 8.0, incl	0.25	0.28	0.30	0.32	0.38
Over 8.0 to 9.5, incl	0.30	0.30	0.32	0.38	0.40
Over 9.5 to 12.5, incl	0.35	0.35	0.35	0.40	0.45

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

Specified Thickness Millimetres	Tolerance, Millimetre, Plus and Minus For Width Ranges, Millimetres				
	Up to 75, incl	Over 75 to 150, incl	Over 150 to 300, incl	Over 300 to 450, incl	Over 450 to 600, incl
Up to 0.2, incl	0.015	0.015	--	--	--
Over 0.2 to 0.3, incl	0.02	0.02	--	--	--
Over 0.3 to 0.5, incl	0.02	0.02	0.03	0.04	0.04
Over 0.5 to 0.6, incl	0.03	0.03	0.04	0.04	0.04
Over 0.6 to 0.9, incl	0.04	0.04	0.05	0.05	0.05
Over 0.9 to 1.0, incl	0.05	0.05	0.05	0.05	0.05
Over 1.0 to 1.5, incl	0.05	0.07	0.07	0.08	0.08
Over 1.5 to 2.0, incl	0.05	0.07	0.07	0.09	0.09
Over 2.0 to 4.0, incl	0.05	0.08	0.08	0.12	0.13
Over 4.0 to 5.0, incl	0.09	0.10	0.10	0.13	0.13
Over 5.0 to 6.0, incl	0.10	0.12	0.12	0.14	0.14

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

TABLE V

Specified Thickness Millimetres	Tolerance, Millimetre, Plus and Minus For Width Ranges, Millimetres		
	Up to 100, incl	Over 100 to 200, incl	Over 200 to 300, incl
Up to 1.5, incl	0.08	0.08	0.10
Over 1.5 to 3.0, incl	0.10	0.13	0.13
Over 3.0 to 4.5, incl	0.13	0.13	0.13
Over 4.5 to 5.0, incl	0.15	0.15	0.15
Over 5.0 to 6.0, incl	--	--	0.15

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 10 mm from the edge by the amounts shown in Table VI.

TABLE VI

Specified Thickness Millimetres	Crown, Millimetre		
	For Width Ranges, Millimetres		
	Up to 100, incl	Over 100 to 200, incl	Over 200 to 300, incl
Up to 3.0, incl	0.05	0.10	0.10
Over 3.0 to 4.5, incl	0.05	0.08	0.08
Over 4.5 to 6.0, incl	0.03	0.05	0.08
Over 6.0 to 9.5, incl	--	--	0.05

2.6 Rectangular Sheared Plates: Minus tolerance for all sizes shall be 0.25 mm; plus tolerance shall be as specified in Table VII.

TABLE VII

		Tolerance, Millimetres, Plus For Width Ranges, Millimetres						
		Up to 1200, incl	Over 1200 to 1500, excl	1500 to 1800, excl	1800 to 2100, excl	2100 to 2400, excl	2400 to 2700, excl	2700 to 3000, incl
Specified Thickness Millimetres	Up to 6.5, excl	0.4	0.4	0.5	0.5	0.6	0.7	0.8
	6.5 to 8.0, excl	0.4	0.5	0.5	0.6	0.7	0.8	0.9
	8.0 to 9.5, excl	0.5	0.5	0.6	0.6	0.7	0.8	0.9
	9.5 to 11.0, excl	0.5	0.6	0.6	0.7	0.8	0.9	1.0
	11.0 to 12.5, excl	0.6	0.6	0.7	0.7	0.8	0.9	1.0
	12.5 to 16.0, excl	0.6	0.7	0.7	0.8	0.9	1.0	1.0
	16.0 to 19.0, excl	0.7	0.7	0.8	0.8	0.9	1.0	1.1
	19.0 to 25.0, excl	0.8	0.8	0.9	0.9	1.0	1.1	1.2
	25.0 to 31.0, excl	1.0	1.1	1.2	1.2	1.2	1.3	1.4
	31.0 to 37.5, excl	1.3	1.3	1.4	1.4	1.4	1.6	1.7
37.5 to 44.0, excl	1.5	1.5	1.6	1.6	1.6	1.8	2.0	
44.0 to 50.0, incl	1.7	1.7	1.8	1.9	1.9	2.2	2.4	

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 300 mm in Width and Hot Rolled, Cut Edge Sheet, Not Resquared, Coils and Cut Lengths:

TABLE VIII

Specified Width Millimetres	Tolerance, Millimetres Plus Only
Over 300 to 600, incl	3
Over 600 to 1200, incl	5
Over 1200 to 1500, incl	6
Over 1500 to 1800, incl	8
Over 1800	10

3.1.1 For hot rolled sheet, tolerances apply only to thicknesses 6 mm and under.

3.2 Cold Rolled Sheet 50 to 300 mm in Width, Produced by Slitting Wider Sheet, Not Resquared, Coils and Cut Lengths:

TABLE IX

Specified Width Millimetres	Tolerance, Millimetre Plus and Minus
Over 50 to 100, incl	0.3
Over 100 to 200, incl	0.4
Over 200 to 300, incl	0.8

3.3 Cold Rolled Strip, Coils and Cut Lengths:

3.3.1 Mill Edge:

TABLE X

Specified Width Millimetres	Tolerance, Millimetres Plus and Minus
Up to 50, incl	0.8
Over 50 to 100, incl	1.2
Over 100 to 200, incl	1.6
Over 200 to 400, incl	2.5
Over 400 to 500, incl	3.0
Over 500 to 600, incl	4.0

3.3.2 Slit Edge:

TABLE XI

Specified Width Millimetres	Tolerance, Millimetre, Plus and Minus For Thickness Ranges, Millimetres			
	Up to 1.5, incl	Over 1.5 to 2.5, incl	Over 2.5 to 4.5, incl	Over 4.5 to 6.0, incl
Up to 100, incl	0.13	0.20	0.25	0.40
Over 100 to 200, incl	0.13	0.25	0.40	0.50
Over 200 to 300, incl	0.25	0.25	0.40	0.50
Over 300 to 450, incl	0.40	0.40	0.50	0.80
Over 450 to 600, incl	0.50	0.50	0.50	0.80

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

Specified Width Millimetres	<u>Tolerance, Millimetres, Plus and Minus</u> <u>For Thickness Ranges, Millimetres</u>		
	Mill Edge or Square Edge	<u>Slit or Cut Edge</u>	
		Up to 2.5, incl	Over 2.5
Up to 50, incl	0.8	0.2	0.4
Over 50 to 100, incl	1.2	0.2	0.4
Over 100 to 200, incl	1.6	0.3	0.4
Over 200 to 300, incl	2.4	0.4	0.4

3.4.1 Tolerances for strip over 6 to 12.5 mm 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 6.5 mm for all sizes; plus tolerance shall be as specified in Table XIII.

TABLE XIII

Specified Width Millimetres	Specified Length Millimetres	Tolerance, Millimetres, Plus For Thickness Ranges, Millimetres			
		Up to 9.5, excl	9.5 to 16.0, excl	16.0 to 25.0, excl	25.0 to 37.5, incl
Up to 1500, excl	Up	9.5	11.0	12.5	16.0
1500 to 2100, excl	to	11.0	12.5	16.0	19.0
2100 to 2700, excl	3000,	12.5	16.0	19.0	25.0
2700 and over	excl	16.0	19.0	22.0	28.0
Up to 1500, excl	3000	9.5	12.5	16.0	19.0
1500 to 2100, excl	to	12.5	16.0	19.0	22.0
2100 to 2700, excl	6000,	14.0	18.0	20.0	25.0
2700 and over	excl	16.0	19.0	22.0	28.0
Up to 1500, excl	6000	9.5	12.5	16.0	19.0
1500 to 2100, excl	to	12.5	16.0	19.0	22.0
2100 to 2700, excl	9000,	14.0	18.0	22.0	25.0
2700 and over	excl	16.0	22.0	25.0	31.0
Up to 1500, excl	9000	11.0	12.5	16.0	19.0
1500 to 2100, excl	to	12.5	16.0	19.0	22.0
2100 to 2700, excl	12000,	14.0	19.0	22.0	25.0
2700 and over	excl	19.0	22.0	25.0	31.0
Up to 1500, excl	12000	11.0	12.5	16.0	19.0
1500 to 2100, excl	to	12.5	16.0	19.0	22.0
2100 to 2700, excl	15000,	16.0	19.0	22.0	25.0
2700 and over	excl	19.0	22.0	25.0	31.0
Up to 1500, excl	15000	12.5	16.0	19.0	22.0
1500 to 2100, excl	to	16.0	19.0	22.0	25.0
2100 to 2700, excl	18000,	16.0	19.0	22.0	28.0
2700 and over	excl	22.0	25.0	28.0	31.0
Up to 1500, excl	18000	14.0	19.0	22.0	25.0
1500 to 2100, excl	and	19.0	22.0	25.0	28.0
2100 to 2700, excl	over	19.0	22.0	25.0	31.0
2700 and over		25.0	28.0	31.0	35.0

3.5.2 Gas Cut Rectangular Plate:

TABLE XIV

Specified Width Millimetres	Tolerance, Millimetres, Plus and Minus For Thicknesses up to 50 mm, excl
All	12.5

3.5.2.1 Tolerances 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 3.5 millimetres. Plus tolerance shall be as specified in Table XV.

TABLE XV

Specified Width Millimetres	Tolerance, Millimetres, Plus For Thickness Ranges, Millimetres			
	Up to 10, excl	10 to 16, excl	16 to 25, excl	25 to 50, excl
Up to 500, excl	3.5	3.5	5.0	6.5
500 to 900, excl	5.0	6.5	8.0	9.5
900 and Over	8.0	9.5	11.0	12.5

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

TABLE XVI

Specified Width Millimetres	Tolerance, Millimetres Plus and Minus
Up to 350, excl	11.0
350 to 425, excl	12.5
425 to 475, excl	14.0
475 to 525, excl	16.0
525 to 600, excl	17.5
600 to 650, excl	20.5
650 to 700, excl	23.5
700 to 875, excl	28.5
875 to 1250, excl	31.5
1250 to 1500, excl	37.5

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 Millimetres	Tolerance, Millimetres Plus Only
Over 300 to 1500, incl	6
Over 1500 to 3000, incl	20
Over 3000 to 6000, incl	35
Over 6000	45

4.1.1 Tolerances in Table XVII for widths 50 - 300 mm, incl, apply to product produced by slitting from wider sheet.

4.2 Hot Rolled Sheet, Cut Lengths, Not Resquared:

TABLE XVIII

Specified Length Millimetres	Tolerance, Millimetres Plus Only
Over 300 to 600, incl	6
Over 600 to 900, incl	8
Over 900 to 1500, incl	12
Over 1500 to 3000, incl	20
Over 3000 to 4000, incl	25
Over 4000 to 5000, incl	35
Over 5000 to 6000, incl	40
Over 6000	45

4.3 Cold Rolled Strip:

TABLE XIX

Specified Length Millimetres	Tolerance, Millimetres, Plus Only For Width Ranges, Millimetres	
	Up to 300, incl	Over 300 to 600, incl
600 to 1500, incl	10	15
Over 1500 to 3000, incl	15	20
Over 3000	20	25

4.4 Hot Rolled Strip:

TABLE XX

Specified Length Millimetres	<u>Tolerance, Millimetres, Plus Only</u> <u>For Width Ranges, Millimetres</u>		
	Up to 100, incl	Over 100 to 200, incl	Over 200 to 300, incl
Up to 1500, incl	10	10	15
Over 1500 to 3000, incl	10	15	20
Over 3000 to 6000, incl	15	15	25
Over 6000 to 9000, incl	20	20	30
Over 9000 to 12000, incl	25	25	40
Over 12000	40	40	45

4.5 Hot Rolled Plate:

4.5.1 Sheared Plate, Universal Mill Plate, and Mill Edge Plate: Minus tolerance shall be 6.5 mm for all sizes. Plus tolerances shall be as specified in Table XXI except as specified in 4.5.1.1.

TABLE XXI

Specified Length Millimetres	Specified Width Millimetres	Tolerance, Millimetres, Plus Only For Thickness Ranges, Millimetres			
		Up to 9.5, excl	9.5 to 16.0, excl	16.0 to 25.0, excl	25.0 to 50.0, incl
Up to 3000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	12.5 16.0 19.0 22.0	16.0 17.0 22.0 25.0	19.0 22.0 25.0 28.0	25.0 25.0 28.0 32.0
3000 to 6000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	19.0 19.0 22.0 25.0	22.0 22.0 23.5 28.0	25.0 25.0 28.0 31.0	28.0 31.0 34.5 34.5
6000 to 9000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	25.0 25.0 25.0 28.0	28.0 28.0 28.0 31.0	31.0 31.0 34.5 34.5	37.5 37.5 37.5 44.0
9000 to 12000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	28.0 31.0 31.0 34.5	31.0 34.5 34.5 37.5	34.5 37.5 37.5 40.5	40.5 40.5 47.0 47.0
12000 to 15000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	31.0 34.5 34.5 37.5	37.5 37.5 37.5 40.5	40.5 40.5 40.5 44.0	47.0 47.0 47.0 47.0
15000 to 18000, excl	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	44.0 44.0 44.0 44.0	47.0 47.0 47.0 50.0	47.0 47.0 47.0 56.5	56.5 56.5 56.5 62.5
18000 and over	Up to 1500, excl 1500 to 2100, excl 2100 to 2700, excl 2700 and over	50.0 50.0 50.0 50.0	53.0 53.0 53.0 53.0	56.5 56.5 56.5 62.5	69.0 69.0 69.0 75.0

4.5.1.1 For sheared plate, the tolerances in Table XXI apply only to specified thicknesses 37.5 mm and under.

4.5.2 Gas Cut Rectangular Plates:TABLE XXII

Specified Length Millimetres	Tolerance, Millimetres, Plus Only For Thicknesses Up to 50 Millimetres, Excl
All	12.5

4.5.2.1 Tolerances 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 300 mm Wide and Hot Rolled Sheet, Not Resquared, Cut Lengths:TABLE XXIII

Specified Cut Length Millimetres	Tolerance, Millimetres
Up to 1200, incl	4
Over 1200 to 1800, incl	5
Over 1800 to 2400, incl	6
Over 2400 to 3000, incl	8
Over 3000 to 3700, incl	10
Over 3700 to 4300, incl	13
Over 4300 to 4900, incl	16
Over 4900 to 5500, incl	19
Over 5500 to 6000, incl	22
Over 6000 to 9000, incl	32
Over 9000 to 12200, incl	38

5.1.2 Cold Rolled Sheet Over 300 mm Wide and Hot Rolled Sheet in Coils: 25 mm in any 6000 millimetres.

5.1.3 Cold Rolled Sheet, 50 to 300 mm in Width, In Coils (Applies to Widths produced by slitting from wider sheet): 6.5 mm in any 2400 millimetres.

5.2 Strip: Camber (lateral bow) is the deviation of a side edge from a straight line. Such a deviation is determined by placing a 2400 mm straight edge on the concave side and measuring the greatest distance between the strip edge and the straight edge.