

Issued 1983-01-01
Revised 1989-04-01
Superseding MAM-2241

Submitted for recognition as an American National Standard

**TOLERANCES, METRIC
Corrosion and Heat Resistant Steel, Iron Alloy,
Titanium, and Titanium Alloy Bars and Wire**

THIS REVISION CONTAINS ONLY EDITORIAL CHANGES.

1. **SCOPE:** This specification covers established metric manufacturing tolerances applicable to corrosion and heat resistant steel, iron alloy, titanium, and titanium alloy bars and wire 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.

1.1 AMS-2241, specified in Inch/pound units, is the equivalent of this MAM.

2. **DIAMETER AND THICKNESS:**

2.1 **Cold Finished Bars:**

2.1.1 **Rounds, Squares, Hexagons, and Octagons (See 2.1.3):**

TABLE I

Specified Diameter or Thickness Millimetres	Tolerance, Millimetre	
	Rounds plus and minus (See 2.1.1.1)	Squares, Hexagons, and Octagons minus only (See 2.1.1.2)
Over 12.50 to 25.00, excl	0.05	0.10
25.00	0.062	0.10
Over 25.00 to 37.50, excl	0.026	0.15
37.50 to 50.00, incl	0.08	0.15
Over 50.00 to 75.00, incl	0.08	0.20
Over 75.00 to 100.00, incl	0.08	0.25

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2.1.1.1 Size tolerances for round bars are plus and minus as shown in Table I. When required, however, they may be specified all plus and nothing minus, or all minus and nothing plus, or any combination of plus and minus, if the total spread in size tolerance for a specified size is not less than the total spread shown in the table.

2.1.1.2 For titanium and titanium alloys, the difference among the three measurements of the distance between opposite faces of hexagons shall be not greater than one-half the size tolerance. The difference among the measurements of the distance between opposite faces of octagons shall be not greater than the size tolerance.

2.1.2 Flats (See 2.1.3):

TABLE II

Specified Thickness Millimetres	Tolerance, Millimetre plus and minus
3.00 to 25.00, incl	0.05
Over 25.00 to 50.00, incl	0.08
Over 50.00 to 75.00, incl	0.10
Over 75.00 to 115.00, incl	0.12

2.1.3 If cold finished bars are ordered heat treated or heat treated and pickled after cold finishing, tolerances shall be double those of Tables I and II.

2.2 Cold Finished Wire:

2.2.1 Rounds, Squares, Hexagons, and Octagons (See 2.2.1.1):

TABLE III

Specified Diameter or Thickness Millimetres	Tolerance, Millimetre	
	Rounds and Squares plus and minus	Hexagons and Octagons minus only
0.08 to 0.12, excl	0.002	--
0.12 to 0.20, excl	0.005	--
0.20 to 0.30, excl	0.008	--
0.30 to 0.60, excl	0.010 (See 2.2.1.2)	--
0.60 to 0.85, excl	0.012 (See 2.2.1.2)	--
0.85 to 1.10, excl	0.020	--
1.10 to 3.15, excl	0.02	--
3.15 to 7.80, excl	0.02	0.05
7.80 to 12.50, excl	0.038	0.08
12.50	0.05	0.10

2.2.1.1 If cold finished wire is ordered heat treated or heat treated and pickled after cold finishing, tolerances shall be double those of Table III for nominal sizes 0.60 mm and over.

2.2.1.2 For titanium and titanium alloys, tolerances for these sizes are ± 0.019 millimetre.

2.2.1.3 For titanium and titanium alloys, the difference among the three measurements of the distance between opposite faces of hexagons shall be not greater than one-half the size tolerance. The difference among the four measurements of the distance between opposite faces of octagons shall be not greater than one-half the size tolerance.

2.2.2 Out-of-Round: Round wire shall not be out-of-round by more than one-half of the total tolerance shown in Table III.

2.2.3 Flats:

TABLE IV

Specified Thickness Millimetres	Tolerance, Millimetre plus and minus
Up to 0.70, excl	0.02
0.70 to 0.90, excl	0.038
0.90 to 4.75, excl	0.04

2.3 Hot Finished Bars:

2.3.1 Hot Rolled:

2.3.1.1 Rounds and Squares: Out-of-round is the difference between the maximum and minimum diameters of the bar measured at the same cross section. Out-of-square is the difference in the two dimensions at the same cross section of a square bar, each dimension being the distance between opposite faces.

TABLE V

Specified Diameter or Thickness Millimetres	Tolerance <u>Millimetres</u> plus minus		Out-of-Round or Out-of-Square Millimetres
	plus	minus	
6.25 to 7.80, incl	0.12	0.12	0.20
Over 7.80 to 11.00, incl	0.15	0.15	0.22
Over 11.00 to 15.75, incl	0.18	0.18	0.25
Over 15.75 to 22.00, incl	0.20	0.20	0.30
Over 22.00 to 25.00, incl	0.22	0.22	0.32
Over 25.00 to 28.00, incl	0.25	0.25	0.38
Over 28.00 to 31.00, incl	0.28	0.28	0.40
Over 31.00 to 34.00, incl	0.30	0.30	0.45
Over 34.00 to 37.50, incl	0.35	0.35	0.52
Over 37.50 to 50.00, incl	0.40	0.40	0.58
Over 50.00 to 62.50, incl	0.80	0	0.58
Over 62.50 to 87.50, incl	1.20	0	0.88
Over 87.50 to 115.00, incl	1.60	0	1.15
Over 115.00 to 138.00, incl	2.00	0	1.45
Over 138.00 to 165.00, incl	3.15	0	1.75
Over 165.00 to 200.00, incl	3.90	0	2.12

2.3.1.2 Hexagons and Octagons:

TABLE VI

Specified Thickness Millimetres	Tolerance Millimetres plus and minus	Maximum Difference 3 Measurements Hexagons Only Millimetres
6.25 to 12.50, incl	0.18	0.28
Over 12.50 to 25.00, incl	0.25	0.38
Over 25.00 to 37.50, incl	0.52	0.62
Over 37.50 to 50.00, incl	0.78	0.78
Over 50.00 to 62.50, incl	1.18	1.18
Over 62.50 to 87.50, incl	1.56	1.56

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2.3.1.3 Flats:

TABLE VII

Specified Width Millimetres	Tolerance, Millimetres For Thickness Ranges, Millimetres							
	3.10 to 12.50, incl plus minus	Over 12.50 to 25.00, incl plus minus	Over 25.00 to 50.00, incl plus minus	Over 50.00 to 100.00, incl plus minus	Over 100.00 to 150.00, incl plus minus	Over 150.00 to 200.00, incl plus minus	Over 200.00 to 250.00, incl plus minus	Over 250.00 to 300.00, incl plus minus
Up to 25.00, incl	0.20	0.20	0.25	0.25	0.25	0.25	0.25	0.25
Over 25.00 to 50.00, incl	0.30	0.30	0.38	0.38	0.38	0.38	0.38	0.38
Over 50.00 to 100.00, incl	0.38	0.38	0.50	0.50	0.50	0.50	0.50	0.50
Over 100.00 to 150.00, incl	0.38	0.38	0.50	0.50	0.50	0.50	0.50	0.50
Over 150.00 to 200.00, incl	0.40	0.40	0.52	0.52	0.52	0.52	0.52	0.52
Over 200.00 to 250.00, incl	0.52	0.52	0.78	0.78	0.78	0.78	0.78	0.78

2.3.2 Forged: Tolerances shall be as agreed upon by purchaser and vendor.

3. WIDTH:

3.1 Cold Finished Bars:

3.1.1 Flats (See 3.1.1.1.1):

TABLE VIII

Specified Width Millimetres	Tolerance, Millimetre, Plus and Minus For Thickness Ranges, Millimetres	
	Up to 6.00, incl	Over 6.00
9.00 to 25.00, incl	0.10	0.05
Over 25.00 to 50.00, incl	0.15	0.08
Over 50.00 to 75.00, incl	0.20	0.10
Over 75.00 to 115.00, incl	0.25	0.12

3.1.1.1 If cold finished bars are ordered heat treated or heat treated and pickled after cold finishing, tolerances shall be double those of Table VIII.

3.2 Cold Finished Wire: Width tolerances shall be ± 0.12 mm for specified widths 1.56 - 9.38 mm, exclusive.

3.3 Hot Finished Bars:

3.3.1 Hot Rolled:

3.3.1.1 Flats:

TABLE IX

Specified Width Millimetres	Tolerance, Millimetres	
	plus	minus
Up to 25.00, incl	0.38	0.38
Over 25.00 to 50.00, incl	0.78	0.78
Over 50.00 to 100.00, incl	1.55	0.78
Over 100.00 to 150.00, incl	2.32	1.55
Over 150.00 to 200.00, incl	3.12	3.90
Over 200.00 to 250.00, incl	3.90	4.68

3.3.2 Forged: Tolerances shall be as agreed upon by purchaser and vendor.

4. LENGTH: Tolerances in Tables X and XI shall apply only when definite lengths are ordered.

4.1 Hot or Cold Finished Bars:

TABLE X

Specified Diameter of Rounds Thickness of Squares, Hexagons, and Octagons Width of Flats Millimetres	Tolerance, Millimetres, Plus Only For Length Ranges, Millimetres	
	Up to 3600, incl	Over 3600 to 7500, incl
Up to 50.00, incl	12.5	19.0
Over 50.00 to 100.00, incl	19.0	25.0
Over 100.00 to 150.00, incl	25.0	31.0
Over 150.00 to 225.00, incl	31.0	37.5
Over 225.00 to 300.00, incl	37.5	50.0

4.2 Wire:

4.2.1 Round and Shape, Straightened and Cut, Exact Length Resheared:

TABLE XI

Specified Diameter of Rounds Thickness of Squares, Hexagons, and Octagons Millimetres	Tolerance, Millimetres, Plus Only For Length Ranges, Millimetres		
	Up to 900, excl	900 to 3600, incl	Over 3600 to 7500, incl
Up to 3.12, incl	1.6	1.6	3.1
Over 3.12 to 12.50, incl	0.8 (See 4.2.1.1)	1.6	3.1

4.2.1.1 For titanium and titanium alloys, tolerance for these sizes is +1.6 mm, -0.

5. STRAIGHTNESS:

5.1 Cold Finished: Bars shall be of such straightness that the maximum curvature (depth of arc) shall not exceed 1.56 mm in any 1500 mm of length, but may not exceed 1.04 mm x length in metres.

5.2 Hot Finished or Heat Treated: Unless otherwise ordered, bars shall be of such straightness that the maximum curvature (depth of arc) shall not exceed 3.13 mm in any 1500 mm of length, but may not exceed 2.08 mm x length in metres.