

**AEROSPACE  
MATERIAL  
SPECIFICATION**

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Superseding MAM 2231A

Tolerances, Metric  
Carbon Steel Bars

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AMS 2231 covers the same requirements.

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## 1. SCOPE:

This specification covers established metric manufacturing tolerances applicable to carbon steel bars 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 No clear cut demarcation is available to differentiate between bar and wire products, therefore definitions of these products are not included.
- 1.2 AMS 2231 is the inch/pound version of this MAM.

## 2. DIAMETER OR THICKNESS:

### 2.1 Cold Finished:

- 2.1.1 Cold Drawn: Table 1 includes tolerances for bars that, before cold finishing, have been annealed, spheroidize annealed, normalized, normalized and tempered, or quenched and tempered before cold finishing. This table does not include tolerances for bars that, after cold finishing, are spheroidize annealed, normalized, normalized and tempered, or quenched and tempered.
  - 2.1.1.1 Width governs the tolerances for both width and thickness of flats. For example, when the maximum carbon range is up to 0.28%, inclusive, for a flat 50.00 mm wide and 25.00 mm thick, the width tolerance is 0.12 mm and the thickness tolerance is the same, namely, 0.12 mm.

TABLE 1 - Diameter, Thickness, or Width Tolerances, Millimeter, Minus Only  
for Maximum of Carbon Range, %

TABLE 1A - Rounds

Specified Diameter Millimeters	Up to 0.28 Carbon, incl	Over 0.28 to 0.55 Carbon, incl	Up to 0.55 Carbon, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55 Carbon, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
Up to 37.50, incl	0.05	0.08	0.10	0.12
Over 37.50 to 62.50, incl	0.08	0.10	0.12	0.15
Over 62.50 to 100.00, incl	0.10	0.12	0.15	0.18

TABLE 1B - Hexagons

Specified Thickness Millimeters	Up to 0.28 Carbon, incl	Over 0.28 to 0.55 Carbon, incl	Up to 0.55 Carbon, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55 Carbon, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
Up to 18.75, incl	0.05	0.08	0.10	0.15
Over 18.75 to 37.50, incl	0.08	0.10	0.12	0.18
Over 37.50 to 62.50, incl	0.10	0.12	0.15	0.20
Over 62.50 to 80.00, incl	0.12	0.15	0.18	0.22

TABLE 1C - Squares

Specified Thickness Millimeters	Up to 0.28 Carbon, incl	Over 0.28 to 0.55 Carbon, incl	Up to 0.55 Carbon, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55 Carbon, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
Up to 18.75, incl	0.05	0.10	0.12	0.18
Over 18.75 to 37.50, incl	0.08	0.12	0.15	0.20
Over 37.50 to 62.50, incl	0.10	0.15	0.18	0.22
Over 62.50 to 100.00, incl	0.15	0.20	0.22	0.28

TABLE 1D - Flats

Specified Width Millimeters	Up to 0.28 Carbon, incl	Over 0.28 to 0.55 Carbon, incl	Up to 0.55 Carbon, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55 Carbon, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
Up to 18.75, incl	0.08	0.10	0.15	0.20
Over 18.75 to 37.50, incl	0.10	0.12	0.20	0.25
Over 37.50 to 75.00, incl	0.12	0.15	0.25	0.30
Over 75.00 to 100.00, incl	0.15	0.20	0.28	0.40
Over 100.00 to 150.00, incl	0.20	0.25	0.30	0.50
Over 150.00	0.32	0.38	--	--

2.1.2 Turned and Polished Rounds: Table 2 includes tolerances for bars that, before cold finishing, have been annealed, spheroidize annealed, normalized, normalized and tempered, or quenched and tempered. This table does not include tolerances for bars that, after cold finishing, are spheroidize annealed, normalized, normalized and tempered, or quenched and tempered.

TABLE 2 - Diameter Tolerances, Millimeter, Minus Only  
for Maximum of Carbon Range, %

Specified Diameter Millimeters	Up to 0.28 Carbon, incl	Over 0.28 to 0.55 Carbon, incl	Up to 0.55 Carbon, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55 Carbon, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
Up to 37.50, incl	0.05	0.08	0.10	0.12
Over 37.50 to 62.50, incl	0.08	0.10	0.12	0.15
Over 62.50 to 100.00, incl	0.10	0.12	0.15	0.18
Over 100.00 to 150.00, incl	0.12	0.15	0.18	0.20
Over 150.00 to 200.00, incl	0.15	0.18	0.20	0.22
Over 200.00 to 225.00, incl	0.18	0.20	0.22	0.25
Over 225.00	0.20	0.22	0.25	0.28

2.1.3 Cold Drawn, Ground, and Polished Rounds: See Table 3.

TABLE 3 - Diameter Tolerances

Specified Diameter Millimeters	Tolerance, Millimeter Minus Only
Up to 37.50, incl	0.02
Over 37.50 to 62.50, excl	0.038
62.50 to 75.00, incl	0.05
Over 75.00 to 100.00, incl	0.08

2.1.4 Turned, Ground, and Polished Rounds: See Table 4.  
(R)

TABLE 4 - Diameter Tolerances

Specified Diameter Millimeters	Tolerance, Millimeter Minus Only
Up to 37.50, incl	0.02
Over 37.50 to 62.50, excl	0.038
62.50 to 75.00, incl	0.05
Over 75.00 to 100.00, incl	0.08
Over 100.00 to 150.00, incl	0.10 (See 2.1.4.1)
Over 150.00	0.12 (See 2.1.4.1)

2.1.4.1 For nonresulfurized steels (steels specified to maximum sulfur limits under 0.08%) or for steels thermally treated, the tolerances for sizes over 100.00 mm in specified diameter are increased by 0.02 mm.

2.2 Hot Finished:

2.2.1 Rounds and Squares: See Table 5. Out-of-round is the difference between maximum and minimum diameters of the bar, measured at the same cross section. Out-of-square section is the difference in the two dimensions at the same cross section of a square bar between opposite faces.

TABLE 5 - Diameter or Thickness Tolerances

Specified Diameter or Thickness Millimeters	Tolerance, Millimeter		Out-of-Round or Out-of-Square Millimeters
	Plus	Minus	
Up to 8.00, incl	0.12	0.12	0.20
Over 8.00 to 11.00 incl	0.15	0.15	0.22
Over 11.00 to 16.00 incl	0.18	0.18	0.25
Over 16.00 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 32.00, incl	0.28	0.28	0.40
Over 32.00 to 35.00, incl	0.30	0.30	0.45
Over 35.00 to 38.00, incl	0.35	0.35	0.52
Over 38.00 to 50.00, incl	0.40	0.40	0.58
Over 50.00 to 65.00, incl	0.78	0	0.58
Over 65.00 to 90.00, incl	1.18	0	0.88
Over 90.00 to 115.00, incl	1.58	0	1.15
Over 115.00 to 140.00, incl	1.95	0	1.45
Over 140.00 to 165.00, incl	3.12	0	1.75
Over 165.00 to 200.00, incl	3.90	0	2.12
Over 200.00 to 240.00, incl	4.70	0	2.50
Over 240.00 to 255.00, incl	6.25	0	3.00

2.2.2 Square-Edge and Round-Edge Flats: See Table 6 and Table 7.

TABLE 6 - Thickness Tolerance, Millimeter, Plus and Minus for Thickness Ranges, Millimeters

Specified Width Millimeters	5.00 to 5.75, excl		5.75 to 6.25, excl		6.25 to 12.50, incl		12.50 to 25.00, incl		25.00 to 50.00, incl		50.00 to 75.00, incl		75.00 to Over 75.00	
	5.00	5.75	5.75	6.25	6.25	12.50	12.50	25.00	25.00	50.00	50.00	75.00	75.00	Over 75.00
Up to 25.00, incl	0.18	0.18	0.18	0.18	0.20	0.25	--	--	--	--	--	--	--	--
Over 25.00 to 50.00, incl	0.18	0.18	0.18	0.18	0.30	0.38	0.78	--	--	--	--	--	--	--
Over 50.00 to 100.00, incl	0.20	0.20	0.20	0.20	0.38	0.50	0.78	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Over 100.00 to 150.00, incl	0.22	0.22	0.22	0.22	0.38	0.50	0.78	1.18	1.18	1.18	1.18	1.18	1.18	1.18
Over 150.00 to 200.00, incl	--	--	0.38	0.38	0.40	0.62	0.78	1.18	1.18	1.18	1.18	1.18	1.18	--