

**AEROSPACE
MATERIAL
SPECIFICATION**

MAM 2231

Issued 1-1-83
Revised

**TOLERANCES, METRIC
Carbon Steel Bars**

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, so no definitions of these products are included.

2. **DIAMETER OR THICKNESS:**

2.1 **Cold Finished:**

2.1.1 **Cold Drawn:** Table I 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 of carbon range is up to 0.28, incl, 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 millimetres.

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."

TABLE I

Tolerance, Millimetre, Minus Only
Maximum of Carbon Range, %

Specified Diameter or Thickness Millimetres	Up to 0.28, incl	Over 0.28 to 0.55, incl	Up to 0.55, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55, With or Without Stress Relieving or Annealing After Cold Finishing, and All Carbons Quenched and Tempered or Normalized and Tempered Before Cold Finishing
ROUNDS				
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
HEXAGONS				
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
SQUARES				
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
Specified Width, Millimetres	FLATS			
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 II 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 II

Tolerance, Millimetre, Minus Only
Maximum of Carbon Range, %

Specified Diameter Millimetres	Up to 0.28, incl	Over 0.28 to 0.55, incl	Up to 0.55, incl, Stress Relieved or Annealed After Cold Finishing	Over 0.55, 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:

TABLE III

Specified Diameter Millimetres	Tolerance, Millimetre 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:

TABLE IV

Specified Diameter Millimetres	Tolerance, Millimetre Minus Only
Up to 37.50, incl	0.02
Over 37.50 to 62.50, excl	0.038
Over 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 millimetre.

2.2 Hot Finished:

2.2.1 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 section is the difference in the two dimensions at the same cross section of a square bar between opposite faces.

TABLE V

Specified Diameter or Thickness Millimetres	Tolerance, Millimetres		Out-of-Round or Out-of-Square Millimetres
	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:

2.2.2.1 Flats over 150.00 to 200.00 mm, incl, in specified width, are not available as hot rolled carbon steel bars in thicknesses under 6.00 millimetres.

2.2.2.2 On flats over 150.00 to 200.00 mm, incl, in specified width and over 75.00 mm in specified thickness, tolerances shall be as agreed upon by purchaser and vendor.