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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 2231H

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Superseding AMS 2231G

Submitted for recognition as an American National Standard

TOLERANCES
Carbon Steel Bars

1. SCOPE:

This specification covers established inch/pound manufacturing tolerances applicable to carbon steel bars 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.

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 MAM 2231 is the metric version of this AMS.

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 2.000 inch wide and 1.000 inch thick, the width tolerance is 0.005 inch and the thickness tolerance is the same, namely, 0.005 inch.

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

TABLE 1A - Rounds

Specified Diameter Inches	Upto 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 1.500, incl	0.002	0.003	0.004	0.005
Over 1.500 to 2.500, incl	0.003	0.004	0.005	0.006
Over 2.500 to 4.000, incl	0.004	0.005	0.006	0.007

TABLE 1B - Hexagons

Specified Thickness Inches	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 0.750, incl	0.002	0.003	0.004	0.006
Over 0.750 to 1.500, incl	0.003	0.004	0.005	0.007
Over 1.500 to 2.500, incl	0.004	0.005	0.006	0.008
Over 2.500 to 3.125, incl	0.005	0.006	0.007	0.009

TABLE 1C - Squares

Specified Thickness Inches	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 0.750, incl	0.002	0.004	0.005	0.007
Over 0.750 to 1.500, incl	0.003	0.005	0.006	0.008
Over 1.500 to 2.500, incl	0.004	0.006	0.007	0.009
Over 2.500 to 4.000, incl	0.006	0.008	0.009	0.011

TABLE 1D - Flats

Specified Width Inches	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 0.750, incl	0.003	0.004	0.006	0.008
Over 0.750 to 1.500, incl	0.004	0.005	0.008	0.010
Over 1.500 to 3.000, incl	0.005	0.006	0.010	0.012
Over 3.000 to 4.000, incl	0.006	0.008	0.011	0.016
Over 4.000 to 6.000, incl	0.008	0.010	0.012	0.020
Over 6.000	0.013	0.015	--	--

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, Inch, Minus Only
for Maximum of Carbon Range, %

Specified Diameter Inches	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 1.500, incl	0.002	0.003	0.004	0.005
Over 1.500 to 2.500, incl	0.003	0.004	0.005	0.006
Over 2.500 to 4.000, incl	0.004	0.005	0.006	0.007
Over 4.000 to 6.000, incl	0.005	0.006	0.007	0.008
Over 6.000 to 8.000, incl	0.006	0.007	0.008	0.009
Over 8.000 to 9.000, incl	0.007	0.008	0.009	0.010
Over 9.000	0.008	0.009	0.010	0.011

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

TABLE 3 - Diameter Tolerances

Specified Diameter Inches	Tolerance, Inch Minus Only
Up to 1.500, incl	0.001
Over 1.500 to 2.500, excl	0.0015
2.500 to 3.000, incl	0.002
Over 3.000 to 4.000, incl	0.003

2.1.4 Turned, Ground, and Polished Rounds: See Table 4.
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TABLE 4 - Diameter Tolerances

Specified Diameter Inches	Tolerance, Inch Minus Only
Up to 1.500, incl	0.001
Over 1.500 to 2.500, excl	0.0015
2.500 to 3.000, incl	0.002
Over 3.000 to 4.000, incl	0.003
Over 4.000 to 6.000, incl	0.004 (See 2.1.4.1)
Over 6.000	0.005 (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 4.000 inches in specified diameter are increased by 0.001 inch.

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 Inches	Tolerance, Inch Plus	Tolerance, Inch Minus	Out-of-Round or Out-of-Square Inch
Up to 0.3125, incl	0.005	0.005	0.008
Over 0.3125 to 0.4375, incl	0.006	0.006	0.009
Over 0.4375 to 0.625, incl	0.007	0.007	0.010
Over 0.625 to 0.875, incl	0.008	0.008	0.012
Over 0.875 to 1.000, incl	0.009	0.009	0.013
Over 1 .000 to 1.125, incl	0.010	0.010	0.015
Over 1.125 to 1.250, incl	0.011	0.011	0.016
Over 1.250 to 1.375, incl	0.012	0.012	0.018
Over 1.375 to 1.500, incl	0.014	0.014	0.021
Over 1.500 to 2.000, incl	0.016	0.016	0.023
Over 2.000 to 2.500, incl	0.031	0	0.023
Over 2.500 to 3.500, incl	0.047	0	0.035
Over 3.500 to 4.500, incl	0.063	0	0.046
Over 4.500 to 5.500, incl	0.078	0	0.058
Over 5.500 to 6.500, incl	0.125	0	0.070
Over 6.500 to 8.250, incl	0.156	0	0.085
Over 8.250 to 9.500, incl	0.188	0	0.100
Over 9.500 to 10.000, incl	0.250	0	0.120

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

TABLE 6 - Thickness Tolerance, Inch, Plus and Minus for Thickness Ranges, Inch

Specified Width Inches	0.203 to 0.230, excl	0.230 to 0.250, excl	0.250 to 0.500, incl	Over 0.500 to 1.000, incl	Over 1.000 to 2.000, incl	Over 2.000 to 3.000, incl	Over 3.000
Up to 1.000. incl	0.007	0.007	0.008	0.010	--	--	--
Over 1 .000 to 2. 000 , incl	0.007	0.007	0.012	0.015	0.031	--	--
Over 2.000 to 4.000, incl.	0.008	0.008	0.015	0.020	0.031	0.047	0.047
Over 4.000 to 6.000, incl	0.009	0.009	0.015	0.020	0.031	0.047	0.047
Over 6.000 to 8.000, incl	--	0.015	0.016	0.025	0.031	0.047	--