

AEROSPACE MATERIAL SPECIFICATION

AMS 2251F

Superseding AMS 2251E

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TOLERANCES Low-Alloy Steel Bars

1. **SCOPE:** This specification covers established inch/pound manufacturing tolerances applicable to low-alloy 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, so no definitions of these products are included.
2. **DIAMETER OR THICKNESS:**
 - 2.1 **Cold Finished:**
 - 2.1.1 **Cold Drawn:** This table includes tolerances for bars that 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 are spheroidize annealed, normalized, normalized and tempered, or quenched and tempered after cold finishing.
 - 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 2.000 in. wide and 1.000 in. thick, the width tolerance is 0.006 in. and the thickness tolerance is the same, namely, 0.006 in.

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TABLE I

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

Specified Diameter or Thickness Inches				
	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 1.000, incl, in coils	0.002	0.003	0.004	0.005
Up to 1.500, incl	0.003	0.004	0.005	0.006
Over 1.500 to 2.500, incl	0.004	0.005	0.006	0.007
Over 2.500 to 4.000, incl	0.005	0.006	0.007	0.008
HEXAGONS				
Up to 0.750, incl	0.003	0.004	0.005	0.007
Over 0.750 to 1.500, incl	0.004	0.005	0.006	0.008
Over 1.500 to 2.500, incl	0.005	0.006	0.007	0.009
Over 2.500 to 3.125, incl	0.006	0.007	0.008	0.010
Over 3.125 to 4.000, incl	0.006	--	--	--
SQUARES				
Up to 0.750, incl	0.003	0.005	0.006	0.008
Over 0.750 to 1.500, incl	0.004	0.006	0.007	0.009
Over 1.500 to 2.500, incl	0.005	0.007	0.008	0.010
Over 2.500 to 4.000, incl	0.007	0.009	0.010	0.012
Over 4.000 to 5.000, incl	0.011	--	--	--
FLATS				
Specified Width, Inches				
Up to 0.750, incl	0.004	0.005	0.007	0.009
Over 0.750 to 1.500, incl	0.005	0.006	0.009	0.011
Over 1.500 to 3.000, incl	0.006	0.007	0.011	0.013
Over 3.000 to 4.000, incl	0.007	0.009	0.012	0.017
Over 4.000 to 6.000, incl	0.009	0.011	0.013	0.021
Over 6.000	0.014	--	--	--

2.1.1.2 When rough turned round bars are permitted, the tolerances in Table I shall be doubled.

2.1.1.3 The tolerances for flats applies to both width and thickness.

2.1.1.4 Tolerances in the column headed "Over 0.28 to 0.55, incl" also apply to all carbons up to 0.55 max, annealed or normalized before cold finishing.

2.1.2 Ground and Polished Rounds:

TABLE II

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

2.2 Hot Finished:

2.2.1 Rounds and Squares:

2.2.1.1 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 between opposite faces.

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TABLE III

Specified Diameter or Thickness Inches	Tolerance, Inch		Out-of-Round or Out-of-Square Inch
	Plus	Minus	
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 Hexagons and Octagons:

TABLE IV

Specified Distance Between Parallel Sides, Inches	Tolerance, Inch		Maximum Difference, Inch, 3 Measurements, For Hexagons Only
	Plus	Minus	
Up to 0.500, incl	0.007	0.007	0.011
Over 0.500 to 1.000, incl	0.010	0.010	0.015
Over 1.000 to 1.500, incl	0.021	0.013	0.025
Over 1.500 to 2.000, incl	0.031	0.016	0.031
Over 2.000 to 2.500, incl	0.047	0.016	0.047
Over 2.500 to 3.500, incl	0.063	0.016	0.063

2.2.3 Square-Edged and Round-Edged Flats:

2.2.3.1 Flats over 6.000 to 8.000 in., incl, in specified width, are not available as hot rolled alloy steel bars in thicknesses under 0.230 inch.

2.2.3.2 Tolerances shall be negotiated for flats over 6.000 to 8.000 in., incl, in specified width and over 3.000 in. in specified thickness.

TABLE V

Thickness Tolerance, Inch, Plus and Minus		Thickness Ranges, Inch				Width Tolerance, Inch	
		Over		Over		Plus Minus	
Specified Width Inches		to		to			
		excl	incl	excl	incl	excl	incl
Up to 1.000, incl	0.203	0.230	0.250	0.500	1.000	2.000	
	to	to	to	to	to	to	
	0.230, excl	0.250, excl	0.500, incl	1.000, incl	2.000, incl	3.000, incl	3.00
	Over 1.000, incl	0.007	0.008	0.010	--	--	0.016 0.016
	Over 1.000 to 2.000, incl	0.007	0.012	0.015	0.031	--	0.031 0.031
Over 2.000 to 4.000, incl	0.008	0.008	0.015	0.020	0.031	0.047	0.047 0.031
	Over 4.000 to 6.000, incl	0.009	0.015	0.020	0.031	0.047	0.047 0.063
Over 6.000 to 8.000, incl	--	0.015	0.016	0.025	0.031	--	0.094 0.063
							0.125 0.094

3. WIDTH: Included under Section 2.4. LENGTH:4.1 Cold Finished: No requirements specified.4.2 Hot Finished:4.2.1 Hot Sheared:4.2.1.1 Rounds, Squares, Hexagons, and Octagons:

TABLE VI

Specified Diameter or Distance Between Parallel Sides Inches		Tolerance, Inch, Plus Only			
		Length Ranges, Feet			
		5 to 10, excl	10 to 20, excl	20 to 30, excl	30 to 40, excl
					40 to 60, incl
Up to 1.000, incl	0.500		0.750	1.250	1.750
	Over 1.000 to 2.000, incl	0.625	1.000	1.500	2.000
	Over 2.000 to 5.000, incl	1.000	1.500	1.750	2.250
	Over 5.000 to 9.500, incl	2.000	2.500	2.750	3.000
Over 1.000 to 2.000, incl					2.250
					2.500
Over 2.000 to 5.000, incl					2.750
					3.250

4.2.1.2 Round-Edged and Square-Edged Flats:

TABLE VII

Specified Dimensions		Tolerance, Inch, Plus Only				
		Length Ranges, Feet				
Width	Thickness	5 to 10, excl	10 to 20, excl	20 to 30, excl	30 to 40, excl	40 to 60, incl
Up to 3.000, incl	Up to 1.000, incl	0.500	0.750	1.250	1.750	2.250
	Over 1.000	0.625	1.000	1.500	2.000	2.500
Over 3.000 to 6.000, incl	Up to 1.000, incl	0.625	1.000	1.500	2.000	2.500
	Over 1.000	1.000	1.500	1.750	2.250	2.750
Over 6.000 to 8.000, incl	Up to 1.000, incl	0.750	1.250	1.750	3.500	4.000
	Over 1.000 to 3.000, incl	1.250	1.750	2.000	3.500	4.000

4.2.2 Hot Sawn:

4.2.2.1 Rounds, Squares, Hexagons, and Octagons:

TABLE VIII

Specified Diameter or Distance Between Parallel Sides Inches	Tolerance, Inch, Plus Only			
	Length Ranges, Feet			
	10 to 20, excl	20 to 30, excl	30 to 40, excl	40 to 60, incl
2.000 to 5.000, incl	1.500	1.750	2.250	2.750
Over 5.000 to 9.500, incl	2.250	2.750	3.000	3.250

4.2.2.2 Round-Edged and Square-Edged Flats:

TABLE IX

Specified Dimensions Inches		Tolerance, Inch, Plus Only			
		Length Ranges, Feet			
Width	Thickness	10 to 20, excl	20 to 30, excl	30 to 40, excl	40 to 60, incl
3.000 and over	1.000 and over	1.500	1.750	2.250	2.750

4.2.3 Special Straightened and Machine Cut on Both Ends:

TABLE X

Specified Diameter of Rounds Thickness of Hexagons and Squares Width of Flats Inches	Tolerance, Inch			
	Length Ranges, Feet			
	Up to 12, incl		Over 12 to 25, incl	
	Plus	Minus	Plus	Minus
Up to 3.000, incl	0.188	0.062	0.250	0.062
Over 3.000 to 6.000, incl	0.250	0.062	0.375	0.062
Over 6.000 to 8.000, incl	0.375	0.062	0.500	0.062
Over 8.000 to 9.500, incl	0.500	0.062	0.625	0.062

4.2.3.1 If bars are ordered with tolerances all plus or all minus, the unilateral tolerance shall be the arithmetic sum of the plus and minus tolerances of Table X.

5. STRAIGHTNESS:

5.1 Cold Finished: No requirements specified.

5.2 Hot Finished: Shall be of such straightness that the maximum edgewise curvature (depth of arc) shall be not greater than 0.250 in. in any 5 ft of length or 0.050 in. x length in feet for shorter lengths.

5.2.1 When so ordered, bars shall be of such straightness that the maximum edgewise curvature (depth of arc) shall be not greater than 0.125 in. in any 5 ft of length or 0.025 in. x length in feet for shorter lengths.

6. FLATNESS: No requirements specified.

7. SPECIAL TOLERANCES:

7.1 Cold Drawn, Rounds: For maximum of carbon range over 0.28 and all carbons heat treated or stress relieved, the following tolerances apply when specified on the purchase order.

TABLE XI

Nominal Diameter Inches	Tolerance, Inch, Minus Only
Up to 1.500, incl	0.004
Over 1.500 to 2.000, incl	0.006

7.2 Across-Corners, Hexagons: The following requirements apply to cold finished hexagons only when specified on the purchase order.