



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N. Y. 10001

AMS 2251E
Superseding AMS 2251D

Issued 5-1-45
Revised 5-15-73

TOLERANCES Low-Alloy Steel Bars

1. **SCOPE:** This specification covers established manufacturing tolerances applicable to low-alloy steel bars. 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 \emptyset 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. (50.80 mm) wide and 1.000 in. (25.40 mm) thick, the width tolerance is 0.006 in. (0.15 mm) and the thickness tolerance is the same, namely, 0.006 in. (0.15 mm).

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TABLE I

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

Nominal Diameter or Thickness Inches	Up to 0.28, incl		Over 0.28 to 0.55, incl	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 0.28, incl	0.28 to 0.55, incl	Over 0.55, incl	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				
Nominal 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	--	--	--

TABLE I (SI)

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Nominal Diameter or Thickness Millimeters	Tolerance, Millimeter, Minus Only Maximum of Carbon Range, %			
	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 25.40, incl, in coils	0.05	0.08	0.10	0.13
Up to 38.10, incl	0.08	0.10	0.13	0.15
Over 38.10 to 63.50, incl	0.10	0.13	0.15	0.18
Over 63.50 to 101.60, incl	0.13	0.15	0.18	0.20
HEXAGONS				
Up to 19.05, incl	0.08	0.10	0.13	0.18
Over 19.05 to 38.10, incl	0.10	0.13	0.15	0.20
Over 38.10 to 63.50, incl	0.13	0.15	0.18	0.23
Over 63.50 to 79.38, incl	0.15	0.18	0.20	0.25
Over 79.38 to 101.60, incl	0.15	--	--	--
SQUARES				
Up to 19.05, incl	0.08	0.13	0.15	0.20
Over 19.05 to 38.10, incl	0.10	0.15	0.18	0.23
Over 38.10 to 63.50, incl	0.13	0.18	0.20	0.25
Over 63.50 to 101.60, incl	0.18	0.23	0.25	0.30
Over 101.60 to 127.00, incl	0.28	--	--	--
FLATS				
Nominal Width, Millimeters				
Up to 19.05, incl	0.10	0.13	0.18	0.23
Over 19.05 to 38.10, incl	0.13	0.15	0.23	0.28
Over 38.10 to 76.20, incl	0.15	0.18	0.28	0.33
Over 76.20 to 101.60, incl	0.18	0.23	0.30	0.43
Over 101.60 to 152.40, incl	0.23	0.28	0.33	0.53
Over 152.40	0.36	--	--	--

- 2.1.1.2 When rough turned round bars are permitted, the above tolerances 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

TABLE II (SI)

Nominal Diameter Inches	Tolerance Inch Minus Only	∅ Nominal Diameter Millimeters	Tolerance Millimeters Minus Only
Up to 1.500, incl	0.001	Up to 38.10, incl	0.03
Over 1.500 to 2.500, excl	0.0015	Over 38.10 to 63.50, excl	0.038
2.500 to 3.000, incl	0.002	63.50 to 76.20, incl	0.05
Over 3.000 to 4.000, incl	0.003	Over 76.20 to 101.60, incl	0.08

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

TABLE III

∅ Nominal 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

TABLE III (SI)

Ø	Nominal Diameter or Thickness Millimeters	Tolerance, Millimeters		Out-of-Round or Out-of-Square, Millimeters
		Plus	Minus	
	Up to 7.938, incl	0.13	0.13	0.20
	Over 7.938 to 11.113, incl	0.15	0.15	0.23
	Over 11.113 to 15.88, incl	0.18	0.18	0.25
	Over 15.88 to 22.22, incl	0.20	0.20	0.30
	Over 22.22 to 25.40, incl	0.23	0.23	0.33
	Over 25.40 to 28.58, incl	0.25	0.25	0.38
	Over 28.58 to 31.75, incl	0.28	0.28	0.41
	Over 31.75 to 34.92, incl	0.30	0.30	0.46
	Over 34.92 to 38.10, incl	0.36	0.36	0.53
	Over 38.10 to 50.80, incl	0.41	0.41	0.58
	Over 50.80 to 63.50, incl	0.79	0	0.58
	Over 63.50 to 88.90, incl	1.19	0	0.89
	Over 88.90 to 114.30, incl	1.60	0	1.17
	Over 114.30 to 139.70, incl	1.98	0	1.47
	Over 139.70 to 165.10, incl	3.18	0	1.78
	Over 165.10 to 209.55, incl	3.96	0	2.16
	Over 209.55 to 241.30, incl	4.78	0	2.54
	Over 241.30 to 254.00, incl	6.35	0	3.05

2.2.2 Hexagons and Octagons:

TABLE IV

Nominal Distance Between Parallel Sides, Inches	Size 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

TABLE IV (SI)

Nominal Distance Between Parallel Sides, Millimeters	Size Tolerance, Millimeters		Maximum Difference, Millimeters, 3 Measurements, For Hexagons Only
	Plus	Minus	
Up to 12.70, incl	0.18	0.18	0.28
Over 12.70 to 25.40, incl	0.25	0.25	0.38
Over 25.40 to 38.10, incl	0.53	0.33	0.64
Over 38.10 to 50.80, incl	0.79	0.41	0.79
Over 50.80 to 63.50, incl	1.19	0.41	1.19
Over 63.50 to 88.90, incl	1.60	0.41	1.60

2.2.3 Square Edged and Round Edged Flats:

- 2.2.3.1 Flats over 6.000 to 8.000 in. (152.40 to 203.20 mm), incl, in width, are not available as hot rolled alloy steel bars in thickness under 0.230 in. (5.84 mm).
- 2.2.3.2 Tolerances shall be negotiated for flats over 6.000 to 8.000 in. (152.40 to 203.20 mm), incl, in width and over 3.000 in. (76.20 mm) in thickness.

TABLE V

Nominal Width Inches	<u>Thickness Tolerance, Inch, Plus and Minus</u>							<u>Width Tolerance Inch</u>	
	<u>Thickness Ranges, Inch</u>								
	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, incl	Over 3.000	Plus
Up to 1.000, incl	0.007	0.007	0.008	0.010	--	--	--	0.016	0.016
Over 1.000 to 2.000, incl	0.007	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	0.063	0.031
Over 4.000 to 6.000, incl	0.009	0.009	0.015	0.020	0.031	0.047	0.047	0.094	0.063
Over 6.000 to 8.000, incl	--	0.015	0.016	0.025	0.031	0.047	--	0.125	0.094

TABLE V (SI)

Nominal Width Millimeters	<u>Thickness Tolerance, Millimeters, Plus and Minus</u>							<u>Width Tolerance Millimeters</u>	
	<u>Thickness Ranges, Millimeters</u>								
	5.16 to 5.84, excl	5.84 to 6.35, excl	6.35 to 12.70, incl	Over 12.70 to 25.40, incl	Over 25.40 to 50.80, incl	Over 50.80 to 76.20 incl	Over 76.20	Over 76.20	Plus
Up to 25.40, incl	0.18	0.18	0.20	0.25	--	--	--	0.41	0.41
Over 25.40 to 50.80, incl	0.18	0.18	0.30	0.38	0.79	--	--	0.79	0.79
Over 50.80 to 101.60, incl	0.20	0.20	0.38	0.51	0.79	1.19	1.19	1.60	0.79
Over 101.60 to 152.40, incl	0.23	0.23	0.38	0.51	0.79	1.19	1.19	2.39	1.60
Over 152.40 to 203.20, incl	--	0.38	0.41	0.64	0.79	1.19	--	3.18	2.39

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, Octagons:

TABLE VI

Nominal 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	2.250
Over 1.000 to 2.000, incl	0.625	1.000	1.500	2.000	2.500
Over 2.000 to 5.000, incl	1.000	1.500	1.750	2.250	2.750
Over 5.000 to 9.500, incl	2.000	2.500	2.750	3.000	3.250

TABLE VI (SI)

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tolerance, Millimeters, Plus Only				
	Length Ranges, Meters				
	1.52 to 3.05, excl	3.05 to 6.10, excl	6.096 to 9.144, excl	9.144 to 12.192, excl	12.192 to 18.288, incl
Up to 25.40, incl	12.70	19.05	31.75	44.45	57.15
Over 25.40 to 50.80, incl	15.88	25.40	38.10	50.80	63.50
Over 50.80 to 127.00, incl	25.40	38.10	44.45	57.15	69.85
Over 127.00 to 241.30, incl	50.80	63.50	69.85	76.20	82.55

4.2.1.2 Round Edged and Square Edged Flats:

TABLE VII

Nominal Dimensions		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 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

TABLE VII (SI)

Nominal Dimensions Millimeters		Tolerance, Millimeters, Plus Only				
		Length Ranges, Meters				
Width	Thickness	1.52 to 3.05, excl	3.05 to 6.10, excl	6.10 to 9.14, excl	9.14 to 12.19, excl	12.19 to 18.29, incl
Up to 76.20,	Up to 25.40, incl	12.70	19.05	31.75	44.45	57.15
	Over 25.40	15.88	25.40	38.10	50.80	63.50
Over 76.20 to 152.40 incl	Up to 25.40, incl	15.88	25.40	38.10	50.80	57.15
	Over 25.40	25.40	38.10	44.45	57.15	69.85
Over 152.40 to 203.20, incl	Up to 25.40, incl	19.05	31.75	44.45	88.90	101.60
	Over 25.40 to 76.20, incl	31.75	44.45	50.80	88.90	101.60

4.2.2 Hot Sawn:

4.2.2.1 Rounds, Squares, Hexagons, Octagons:

TABLE VIII

Nominal 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

TABLE VIII (SI)

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tolerance, Millimeters, Plus Only			
	Length Ranges, Meters			
	3.05 to 6.10, excl	6.10 to 9.14, excl	9.14 to 12.19, excl	12.19 to 18.29, incl
50.80 to 127.00, incl	38.10	44.45	57.15	69.85
Over 127.00 to 240.50, incl	63.50	69.85	76.20	82.55