



AEROSPACE MATERIAL SPECIFICATION

AMS2251™**REV. K**

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Superseding AMS2251J

(R) Tolerances
Low-Alloy Steel Bars

RATIONALE

AMS2251K is the result of a Five-Year Review and update of the specification. The revision adds SI units throughout the document, updates terminology and aligns table titles to current SAE terminology (see 3.1.1, 3.1.2, 3.1.3, 3.1.4, 4.2.2, and associated tables), adds larger sizes to Table 2, and deletes items covered elsewhere in document (see 3.1.1.2, 3.1.1.3, 3.3.1.4, and Section 4).

1. SCOPE

This specification covers established manufacturing tolerances applicable to low-alloy steel bars ordered to inch/pound dimensions. These tolerances apply to all conditions, unless otherwise noted. The term “exclusive” 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. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AS7766 Terms Used in Aerospace Metals Specifications

2.2 Definitions

Terms used in AMS are defined in AS7766.

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3. DIAMETER OR THICKNESS

3.1 Cold Finished

3.1.1 Cold Drawn

Table 1 includes tolerances for bars that are cold finished.

3.1.1.1 Width governs the tolerances for both width and thickness of flats. For example, when the maximum of carbon range is up to 0.28, inclusive, for a flat 2.000 inches (50.80 mm) wide and 1.000 inch (25.40 mm) thick, the width tolerance is 0.006 inch (0.15 mm) and the thickness tolerance is the same; namely, 0.006 inch (0.15 mm).

Table 1A - Cold-finished tolerances, minus only; based on carbon range, % (inch/pound units)

Specified Diameter or Thickness Inches	Up to 0.28 Carbon Incl	Over 0.28 to 0.55 Carbon Incl and Carbon Above 0.55 Annealed and Normalized Before Cold Finishing	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 Carbon 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	--	--	--

Table 1B - Cold-finished tolerances, minus only; based on carbon range, % (SI units)

Specified Diameter or Thickness Millimeters	Up to 0.28 Carbon Incl	Over 0.28 to 0.55 Carbon Incl and Carbon Above 0.55 Annealed and Normalized Before Cold Finishing	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 Carbon 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				
Specified 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	--	--	--

3.1.2 Machined or Turned Bars

Tolerances for machined bars 0.375 inch (9.52 mm) and over in specified diameter or thickness are shown in Table 2. Bars up to 0.375 inch (9.52 mm), exclusive, in specified diameter or thickness are supplied centerless ground.

Table 2A - Tolerances, machined or turned bars (inch/pound units)

Specified Diameter or Thickness Inches	Tolerance Plus Only Inch	Out-of-Round Inch
0.375 to 2.000, incl	0.016	0.008
Over 2.000 to 4.000, incl	0.031	0.016
Over 4.000 to 4.500, incl	0.062	0.046
Over 4.500 to 5.500, incl	0.078	0.058
Over 5.500 to 6.500, incl	0.125	0.070
Over 6.500 to 8.000, incl	0.156	0.085
Over 8.000 to 12.000, incl	0.187	0.094
Over 12.000 to 15.000, incl	0.219	0.109
Over 15.000 to 25.000, incl	0.250	0.125

Table 2B - Tolerances, machined or turned bars (SI units)

Specified Diameter or Thickness Millimeters	Tolerance Plus Only Millimeters	Out-of-Round Millimeters
9.525 to 50.80, incl	0.406	0.203
Over 50.80 to 101.6, incl	0.787	0.406
Over 101.6 to 115.0, incl	1.600	1.200
Over 115.0 to 140.0, incl	2.000	1.500
Over 140.0 to 165.0, incl	3.000	1.800
Over 165.0 to 200.0, incl	4.000	2.200
Over 200.0 to 300.0, incl	4.800	2.400
Over 300.0 to 400.0, incl	5.500	2.800
Over 400.0 to 625.0, incl	6.500	3.200

3.1.3 Centerless Ground or Polished Round Bars

Tolerances for centerless ground bars 0.125 to 4.062 inches (3.18 to 103.17 mm), inclusive, in specified diameter are shown in Table 3. Bars over 4.062 inches (103.17 mm) in specified diameter are supplied machined.

Table 3A - Tolerances, centerless ground or polished bars (inch/pound units)

Specified Diameter Inches	Tolerance Plus or Minus Inches	Out-of-Round Inches
0.125 to 0.3125, excl	0.001	0.001
0.3125 to 0.500, excl	0.0015	0.0015
0.500 to 1.000, excl	0.002	0.002
1.000 to 1.500, incl	0.0025	0.0025
Over 1.500 to 3.250, incl	0.003	0.003
Over 3.250 to 4.062	0.005	0.005

Table 3B - Tolerances, centerless ground or polished bars (SI units)

Specified Diameter Millimeters	Tolerance Plus or Minus Millimeters	Out-of-Round Millimeters
3.18 to 7.938, excl	0.02	0.02
7.938 to 12.70, excl	0.038	0.038
12.70 to 25.40, excl	0.05	0.05
25.40 to 38.10, incl	0.064	0.064
Over 38.10 to 82.55, incl	0.08	0.08
Over 82.55 to 103.17	0.13	0.13

3.1.4 Precision Ground and Polished Rounds

See Table 4.

Table 4A - Tolerances, precision ground and polished rounds (inch/pound units)

Specified Diameter Inches	Tolerance Inches 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

Table 4B - Tolerances, precision ground and polished rounds (SI units)

Specified Diameter Millimeters	Tolerance Millimeters Minus Only
Up to 38.10, incl	0.02
Over 38.10 to 63.50, excl	0.038
63.50 to 76.20, incl	0.05
Over 76.20 to 101.60, incl	0.08

3.2 Hot Finished

3.2.1 Rounds and Squares

See Table 5.

- 3.2.1.1 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.

Table 5A - Tolerances, hot-finished rounds and squares (inch/pound units)

Specified Diameter or Thickness Inches	Tolerance		Out-of-Round or Out-of-Square Inches
	Inches Plus	Inches 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 5B - Tolerances, hot-finished rounds and squares (SI units)

Specified Diameter or Thickness Millimeters			Tolerance Millimeters Plus	Tolerance Millimeters Minus	Out-of-Round or Out-of-Square Millimeters
Up	to	7.938, incl	0.13	0.13	0.20
Over 7.938	to	11.112, incl	0.15	0.15	0.23
Over 11.112	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

3.2.2 Hexagons and Octagons

See Table 6.

Table 6A - Tolerances, hot-finished hexagons and octagons (inch/pound units)

Specified Distance Between Parallel Sides Inches		Tolerance Inches Plus	Tolerance Inches Minus	Maximum Difference Inches Three Measurements for Hexagons Only
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 6B - Tolerances, hot finished hexagons and octagons (SI units)

Specified Distance Between Parallel Sides Millimeters		Tolerance Millimeters Plus	Tolerance Millimeters Minus	Maximum Difference Millimeters Three Measurements for Hexagons Only
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

3.2.3 Square-Edged and Round-Edged Flats

See Table 7.

- 3.2.3.1 Flats over 6.000 to 8.000 inches (152.40 to 203.20 mm), inclusive, in specified width are not available as hot-rolled alloy steel bars in thicknesses under 0.230 inch.
- 3.2.3.2 Tolerances shall be negotiated for flats over 6.000 to 8.000 inches (152.40 to 203.20 mm), inclusive, in specified width and over 3.000 inches (76.20 mm) in specified thickness.

Table 7A - Thickness tolerances, inch, plus and minus; thickness ranges, inch (inch/pound units)

Specified Width Inches	0.203 to 0.230	0.230 to 0.250	0.250 to 0.500	Over 0.500 to 1.000	Over 1.000 to 2.000	Over 2.000 to 3.000	Over 3.000	Width Tolerance Inches Plus	Width Tolerance Inches Minus
	Excl	Excl	Incl	Incl	Incl	Incl			
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 7B - Thickness tolerances, millimeters, plus and minus; thickness ranges, millimeters (SI units)

Specified Width Millimeters	5.16 to 5.84	5.84 to 6.35	6.35 to 12.70	Over 12.70 to 25.40	Over 25.40 to 50.80	Over 50.80 to 76.20	Over 76.20	Width Tolerance Inches Plus	Width Tolerance Inches Minus
	Excl	Excl	Incl	Incl	Incl	Incl			
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	0.025	0.79	1.19	--	3.18	0.094

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

See Table 8.

Table 8A - Tolerances, inches, plus only; length ranges, feet (inch/pound units)

Specified Diameter or Distance Between Parallel Sides Inches	5 to 10 Excl	10 to 20 Excl	20 to 30 Excl	30 to 40 Excl	40 to 60 Excl
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 8B - Tolerances, millimeters, plus only; length ranges, meters (SI units)

Specified Diameter or Distance Between Parallel Sides Millimeters	1.5 to 3 Excl	3 to 6 Excl	6 to 9 Excl	9 to 12 Excl	12 to 18 Excl
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	76.20
Over 127.00 to 241.30, incl	50.80	63.50	76.20	88.90	101.60

4.2.1.2 Round-Edged and Square-Edged Flats

See Table 9.

Table 9A - Tolerances, inches, plus only; length ranges, feet (inch/pound units)

Specified Dimensions Inches Width	Specified Dimensions Inches Thickness	5 to 10 Excl	10 to 20 Excl	20 to 30 Excl	30 to 40 Excl	40 to 60 Excl
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	Up to 1.000, incl	0.625	1.000	1.500	2.000	2.500
to 6.000, incl	Over 1.000	1.000	1.500	1.750	2.250	2.750
Over 6.000	Up to 1.000, incl	0.750	1.250	1.750	3.500	4.000
to 8.000, incl	Over 1.000 to 3.000, incl	1.250	1.750	2.000	3.500	4.000

Table 9B - Tolerances, millimeters, plus only; length ranges, meters (SI units)

Specified Dimensions Millimeters Width	Specified Dimensions Millimeters Thickness	1.5 to 3 Excl	3 to 6 Excl	6 to 9 Excl	9 to 12 Excl	12 to 18 Excl
Up to 76.20, incl	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	Up to 25.40, incl	15.88	25.40	38.10	50.80	63.50
to 152.40, incl	Over 25.40	25.40	38.10	44.45	57.15	69.85
Over 152.40	Up to 25.40, incl	19.05	31.75	44.45	88.90	101.60
to 203.20, incl	Over 25.40 to 76.20, incl	31.75	44.45	50.80	88.90	101.60

4.2.2 Hot Cut

4.2.2.1 Rounds, Squares, Hexagons, and Octagons

See Table 10.