



# AEROSPACE MATERIAL

Society of Automotive Engineers, Inc.  
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## SPECIFICATION

### AMS 2231E

Superseding AMS 2231D

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### TOLERANCES Carbon Steel Bars

1. PURPOSE: To publish established manufacturing tolerances.
2. APPLICATION: Tolerances shown herein apply, unless otherwise agreed upon by purchaser and vendor. These tolerances apply to all conditions, unless otherwise noted.
3. DIAMETER OR THICKNESS:
  - 3.1 Cold Finished:
    - 3.1.1 Cold Drawn:

TABLE I (See Note 1)

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

| Nominal<br>Diameter or Thickness<br>Inches | Up to<br>0.28,<br>incl | Over 0.28<br>to 0.55,<br>incl | Up to 0.55,<br>incl, Stress<br>Relieved or<br>Annealed After<br>Cold Finishing | Over 0.55,<br>and All Carbons<br>Quenched and<br>Tempered or<br>Normalized<br>and Tempered<br>Before Cold<br>Finishing |
|--------------------------------------------|------------------------|-------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|
|                                            |                        |                               |                                                                                |                                                                                                                        |

#### ROUNDS

|                           |       |       |       |       |
|---------------------------|-------|-------|-------|-------|
| 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 |

#### HEXAGONS

|                           |       |       |       |       |
|---------------------------|-------|-------|-------|-------|
| 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 |

#### SQUARES

|                           |       |       |       |       |
|---------------------------|-------|-------|-------|-------|
| 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 I (See Note 1) - Continued

|                                            |                        | <u>Tolerance, Inch, Minus Only</u> |                                                                                |                                                                                                                        | <u>Maximum of Carbon Range, %</u> |
|--------------------------------------------|------------------------|------------------------------------|--------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
|                                            |                        |                                    |                                                                                |                                                                                                                        |                                   |
| Nominal<br>Diameter or Thickness<br>Inches | Up to<br>0.28,<br>incl | Over 0.28<br>to 0.55,<br>incl      | Up to 0.55,<br>incl, Stress<br>Relieved or<br>Annealed After<br>Cold Finishing | Over 0.55,<br>and All Carbons<br>Quenched and<br>Tempered or<br>Normalized<br>and Tempered<br>Before Cold<br>Finishing |                                   |
| Nominal Width, Inches (See Note 2)         |                        | FLATS                              |                                                                                |                                                                                                                        |                                   |
| 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                              | --                                                                             | --                                                                                                                     |                                   |

3.1.2 Turned and Polished Rounds:

TABLE II (See Note 1)

|                            |                        | <u>Tolerance, Inch, Minus Only</u> |                                                                                  |                                                                                                                        | <u>Maximum of Carbon Range, %</u> |
|----------------------------|------------------------|------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------|-----------------------------------|
|                            |                        |                                    |                                                                                  |                                                                                                                        |                                   |
| Nominal Diameter<br>Inches | Up to<br>0.28,<br>incl | Over 0.28<br>to 0.55,<br>incl      | Up to 0.55,<br>incl, Stresses<br>Relieved or<br>Annealed After<br>Cold Finishing | Over 0.55,<br>and All Carbons<br>Quenched and<br>Tempered or<br>Normalized<br>and Tempered<br>Before Cold<br>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                                                                                                                  |                                   |

3.1.3 Cold Drawn, Ground, and Polished Rounds:

TABLE III

| Nominal Diameter<br>Inches | Tolerance, Inch<br>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                         |

3.1.4 Turned, Ground, and Polished Rounds:

TABLE IV

| Nominal Diameter<br>Inches | Tolerance, Inch<br>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 Note 3)            |
| Over 6.000                 | 0.005 (See Note 3)            |

3.2 Hot Finished:

3.2.1 Rounds and Squares:

TABLE V

| Nominal<br>Diameter or Thickness<br>Inches | Tolerance, Inch |       | Out-of-Round<br>or Out-of-Square<br>Inch (See Note 4) |
|--------------------------------------------|-----------------|-------|-------------------------------------------------------|
|                                            | 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                                                 |

