

# AEROSPACE

## MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

AMS 4165A

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### ALUMINUM ALLOY EXTRUSIONS 4.4Cu - 1.5Mg - 0.6Mn (2024-T3511) Stress-Relief Stretched and Straightened

1. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

2. FORM: Bars, rods, shapes, and round tubing.

3. APPLICATION: Primarily for parts subject to excessive warpage during machining due to residual stresses, and for parts requiring good strength and whose fabrication does not involve welding.

4. COMPOSITION:

|                         |            |
|-------------------------|------------|
| Copper                  | 3.8 - 4.9  |
| Magnesium               | 1.2 - 1.8  |
| Manganese               | 0.30 - 0.9 |
| Iron                    | 0.50 max   |
| Silicon                 | 0.50 max   |
| Zinc                    | 0.25 max   |
| Chromium                | 0.10 max   |
| Other Impurities, each  | 0.05 max   |
| Other Impurities, total | 0.15 max   |
| Aluminum                | remainder  |

5. CONDITION: Solution heat treated and stress-relieved by stretching.

5.1 Unless otherwise specified, extrusions shall be supplied with an as-extruded surface finish; light polishing to remove minor surface imperfections is permissible provided such imperfections can be removed within the dimensional tolerances.

5.2 Material shall be stretched in the solution heat treated condition to produce a nominal permanent set of 1.5%, but not less than 1% nor more than 3%.

5.3 Material may receive minor straightening after stretching of an amount necessary to meet the requirements of Section 8.

6. TECHNICAL REQUIREMENTS:

6.1 Tensile Properties:

6.1.1 Bars, Rods, and Shapes:

| Nominal Diameter or<br>Thickness, and Area<br>Inches | Tensile<br>Strength<br>psi, min | Yield Strength at 0.2% Offset<br>or at Extension Indicated<br>(E = 10,500,000) |                                      | Elongation<br>% in 2 in.<br>or 4D<br>min |
|--|---------------------------------|--|--------------------------------------|--|
|  |                                 | psi, min   | Extension Under Load<br>in. in 2 in. |  |
| 0.050 to 0.249, incl, all areas                      | 57,000                          | 42,000   | 0.0120                               | 12                                       |
| Over 0.249 to 0.749, incl, all areas                 | 60,000                          | 44,000   | 0.0124                               | 12                                       |
| Over 0.749 to 1.499, incl, all areas                 | 65,000                          | 46,000   | 0.0128                               | 10                                       |
| Over 1.499   |                                 |  |                                      |  |
| Area 25 sq in. and under                             | 70,000                          | 52,000   | 0.0139                               | 10                                       |
| Area over 25 to 32 sq in., incl                      | 68,000                          | 48,000   | 0.0131                               | 8  |

For material of such thickness that a standard specimen cannot be taken, or for material thinner than 0.062 in., the test for elongation is not required.

The tensile property requirements shall be based on the thickness of the position of the extrusion from which the tensile test specimens are taken.

Ø Specimens from sections over 1.5 in. in diameter or thickness shall be taken midway between center and surface.

6.1.2 Round Tubing:

| Nominal Wall Thickness and Area<br>Inches | Tensile<br>Strength<br>psi, min | Yield Strength at 0.2% Offset<br>or at Extension Indicated<br>(E = 10,500,000) |                                      | Elongation<br>% in 2 in.<br>or 4D(a)<br>min |
|---|---------------------------------|--|--------------------------------------|---|
|   |                                 | psi, min   | Extension Under Load<br>in. in 2 in. |   |
| 0.499 and under, all areas                | 60,000                          | 40,000   | 0.0116                               | 10  |
| Over 0.499 to 1.499, incl, all areas      | 65,000                          | 46,000   | 0.0128                               | 10  |
| Over 1.499                                |                                 |  |                                      |   |
| Area 25 sq in. and under                  | 70,000                          | 48,000   | 0.0131                               | 10  |
| Area over 25 to 32 sq in., incl           | 68,000                          | 46,000   | 0.0128                               | 6   |

(a) Elongation of full section and cut-out sheet type specimens; for cut-out round specimens D represents diameter of specimen.

6.1.3 When a dispute occurs between purchaser and vendor over the yield strength value, yield strength determined by the offset method shall apply.

6.1.4 If sizes other than those shown are ordered, tensile property requirements shall be as agreed upon by purchaser and vendor.

6.2 Hardness: Material should have hardness not lower than Brinell 100 using 500 kg load and 10 mm ball or 1000 kg load and 9/16 in. ball or not lower than Brinell 106 using 1000 kg load and 10 mm ball, but shall not be rejected on the basis of hardness if the tensile property requirements are met.

7. QUALITY: Material shall be uniform in quality and condition, clean, sound, smooth, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.