

Aluminum Alloy Extrusions
8.9Zn - 2.2Cu - 2.2Mg - 0.15Zr (7136-T76511, -T76510)
Solution Heat Treated, Stress-Relieved, Straightened, and Overaged

RATIONALE

AMS4415 is a proposed draft of a new material specification which covers aluminum alloy 7136-T76511, -T76510 extrusions.

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of extruded bars, rods, wire, profiles (shapes) and tubing.

1.2 Application

These extrusions have been used typically for structural applications requiring a combination of high tensile and compressive strength and good corrosion resistance, but usage is not limited to such applications.

1.3 Certain processing procedures may cause this product to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

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 724-776-4970 (outside USA), www.sae.org.

AMS2355	Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
AMS2772	Heat Treatment of Aluminum Alloy Raw Materials
ARR823	Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products
AS1990	Aluminum Alloy Tempers

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2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666/B 666M	Identification Marking of Aluminum and Magnesium Products
ASTM E 1004	Determining Electrical Conductivity Using the Electromagnetic (Eddy Current) Method
ASTM G 34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
ASTM G 47	Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX /Aluminum Alloy Products

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI H35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS2355.

TABLE 1 - COMPOSITION

Element	min	max
Silicon	--	0.12
Iron	--	0.15
Copper	1.9	2.5
Manganese	--	0.05
Magnesium	1.8	2.5
Chromium	--	0.05
Zinc	8.4	9.4
Titanium	--	0.10
Zirconium	0.10	0.20
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

Extrusions shall be solution heat-treated, stress relieved by stretching after solution treatment to produce a nominal permanent set of 1.5 percent, but not less than 1 percent or more than 3 percent, and overaged to the -T76511, -T76510 temper (See AS1990).

3.2.1 Extrusions in the T76511 temper may receive minor straightening, after stretching, of an amount necessary to meet tolerance requirements of 3.6.

3.2.2 Extrusions shall be supplied with an as-extruded surface finish. Repair to remove minor surface imperfections is permissible provided such imperfections can be removed within specified dimensional tolerances.

3.3 Heat Treatment

Shall be performed in accordance with the requirements of AMS2772, except as follows:

3.3.1 Solution Heat Treatment

Heat to 870 to 890 °F (466 to 477 °C), hold at heat for a time commensurate with product thickness and rapidly cool in a suitable quenching medium.

3.3.2 Overaging Heat Treatment

Overaging shall be performed at the specific times and temperatures necessary to meet the requirements of 3.4 (See 8.2).

3.4 Properties

Extrusions shall conform to the following requirements, determined on the mill product in accordance with AMS2355:

3.4.1 Longitudinal tensile properties shall conform to the requirements specified in Table 2A and 2B.

TABLE 2A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Diameter or Least Thickness (bars, rods, wire, profiles) or Nominal Wall Thickness (tubing) Inches	Tensile Strength	Yield Strength At 0.2% Offset	Elongation in 2 Inches or 4D
	ksi	ksi	%
0.040 - 0.249	90.0	86.0	
0.250 - 0.499	91.0	87.0	7
0.500 - 1.999	92.0	88.0	
2.000 - 3.000	91.0	88.0	
3.001 - 4.000	90.0	86.0	8

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Diameter or Least Thickness (bars, rods, wire, profiles) or Nominal Wall Thickness (tubing) Millimeters	Tensile Strength	Yield Strength At 0.2% Offset	Elongation in 50 mm	Elongation in 5D or 5.65√A
	MPa	MPa	%	
1.00 - 6.30	621	593	7	-
6.30 - 12.50	627	600	7	-
12.50 - 50.00	634	607	-	6
50.00 - 80.00	627	607	-	7
80.00 - 100.00	621	593	-	7

3.4.2 Corrosion Resistance

3.4.2.1 Exfoliation-Corrosion Resistance

Specimens, cut from extrusions, shall not exhibit exfoliation corrosion greater than that exhibited by Photo EB of ASTM G 34 at a T/10 plane.

3.4.2.2 Stress-Corrosion Cracking

When specified, specimens cut from extrusions 0.750 inches (19.04 mm) and over in diameter or thickness shall show no evidence of stress corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 25.0 ksi (172 MPa) for a minimum 20 day exposure, as determined in accordance with ASTM G 47.

3.4.3 Electrical Conductivity (EC)

Electrical conductivity shall be equal to or greater than 36.0% IACS (International Annealed Copper Standard) when performed in accordance with ASTM E 1004.

3.4.3.1 For material less than 0.750 inch thick, any heat treat lot with a conductivity reading below 36 percent IACS is acceptable provided that lot is tested for, and meets the exfoliation corrosion resistance requirements of 3.4.2.1

3.4.3.2 Extrusions with electrical conductivities less than 36% IACS may receive additional precipitation heat treatment. If, upon completion of such treatment, they meet the property requirements as specified in 3.4, they shall be acceptable.

3.5 Quality

Product, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign material and from imperfections detrimental to the usage of the product.

3.5.1 When specified, bars, rods, and profiles (shapes) over 0.500 inches (12.70 mm) in thickness or diameter shall be subjected to ultrasonic inspection in accordance with ASTM B 594. Extrusions, 0.500 to 1.499 inches (12.70 to 38.07 mm), inclusive, in nominal thickness, not exceeding 600 pounds (272 kg) in weight per piece, or a 10 to 1 width to thickness ratio, shall meet ultrasonic Class B. Extrusions, 1.500 inches (38.10 mm) and over in nominal thickness, not exceeding 600 pounds in weight (272 kg) per piece, or a 10 to 1 width-to-thickness ratio, shall meet ultrasonic Class A.

3.6 Tolerances

Shall conform to all applicable requirements of ANSI H35.2 or ANSI H35.2M.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The vendor of extrusions shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the extrusions conform to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile testing (3.4.1), electrical conductivity (3.4.3), tolerances (3.6) and ultrasonic inspection (3.5.1) (when specified) are acceptance tests and, except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Exfoliation-corrosion resistance (3.4.2.1) and stress-corrosion cracking resistance (3.4.2.2) are periodic tests and shall be performed at a frequency selected by the vendor unless the purchaser specifies frequency of testing.