



AEROSPACE MATERIAL SPECIFICATION	AMS4415™	REV. B
	Issued 2008-07 Reaffirmed 2015-05 Revised 2021-09	
Superseding AMS4415A		
Aluminum Alloy Extrusions 8.9Zn - 2.2Cu - 2.2Mg - 0.15Zr (7136-T76511, -T76510) Solution Heat Treated, Stress-Relieved, Straightened, and Overaged		

RATIONALE

AMS4415B is the result of a Five-Year Review and update of this specification with changes to address product outside the specified size range (1.1, 3.4.1.1, 4.4.1, 5.1.1, 8.7), prohibit unauthorized exceptions (3.7, 4.4.1, 5.1.1, 8.6), updates related to SI properties (Table 2B, 8.4), quality requirements for ultrasonic inspection (3.5.1) and condition (2.1, 2.3, 3.2), and to allow the use of the immediate prior specification revision (8.5).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of extruded bars, rods, wire, profiles (shapes), and tubing 0.040 to 4.000 inches (1.00 to 100.00 mm) in nominal diameter, least dimension, or wall thickness (see 8.7).

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 +1 724-776-4970 (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

SAE Executive Standards Committee Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2021 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
http://www.sae.org

SAE WEB ADDRESS:

For more information on this standard, visit
<https://www.sae.org/standards/content/AMS4415B>

ARP823 Minimizing Stress-Corrosion Cracking in Wrought High-Strength Aluminum Alloy Products

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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 B594 Ultrasonic Inspection of Aluminum-Alloy Wrought Products

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B666/B666M Identification Marking of Aluminum and Magnesium Products

ASTM E1004 Determining Electrical Conductivity Using the Electromagnetic (Eddy Current) Method

ASTM G34 Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

ASTM G47 Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

2.3 ANSI Accredited Publications

Copies of these documents are available online at <http://webstore.ansi.org>.

ANSI H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum

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%, but not less than 1% or more than 3%, and overaged to the -T76511, -T76510 temper (refer to ANSI H35.1/H35.1M).

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 2.

Table 2A - Minimum tensile properties, inch/pound units (see 8.4)

Nominal Diameter, Least Thickness, (Bars, Rods, Wire, Profiles) or Nominal Wall Thickness (Tubing) Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
	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	7
2.000-3.000	91.0	88.0	8
3.001-4.000	90.0	86.0	8

Table 2B - Minimum tensile properties, SI units (see 8.4)

Nominal Diameter, Least Thickness, (Bars, Rods, Wire, Profiles) or Nominal Wall Thickness (Tubing) Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50 mm %	Elongation in 5D or 5.65√A
	1.00- 6.30	621	593	7
6.30- 12.50	627	600	7	-
12.50- 50.00	634	607	7	6
50.00- 80.00	627	607	8	7
80.00-100.00	621	593	8	7

3.4.1.1 Mechanical property requirements for product outside the size range covered by Table 2 shall be agreed upon between purchaser and producer and reported per 4.4.1.

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 G34 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 G47.

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 E1004.

3.4.3.1 For material less than 0.750 inch (19.04 mm) thick, any heat treat lot with a conductivity reading below 36% IACS (20.9 MS/m) 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 (20.9 MS/m) 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 B594. Product sizes 0.500 to 1.499 inches (12.70 to 38.07 mm) inclusive, shall meet ultrasonic Class B. Product sizes over 1.499 inches (38.07 mm) shall meet ultrasonic Class A.

3.6 Tolerances

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

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of extrusions shall supply all samples for producer'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.