SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-QQ-A-225 | REV. B

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Superseding AMS-QQ-A-225A

Aluminum and Aluminum Alloy, Bar, Rod, Wire, or Special Shapes; Rolled, Drawn, or Cold Finished; General Specification For

RATIONALE

AMS-QQ-A-225B has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENT NOTICE

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of August, 2004. It is recommended, therefore, that this specification not be specified for new designs.

"NONCURRENT" refers to those specifications which have previously been widely used and which may be required for production or processing of existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. "NONCURRENT" specifications are available from SAE upon request.

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NOTICE

This document is intended to replace Federal Specification QQ-A-225G. The original issue and revision A of AMS-QQ-A-225 were taken directly from Federal Specification QQ-A-225G, and contained only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. This revision B changes the heat treatment specification MIL-H-6088 (cancelled) to AMS 2772 (the superseding document) to ensure that the vital heat treat parameters used for heat-treat-response-test samples conform to parameters used for heat treatment of parts (See 6.8).

The original Federal Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, (b) the use of the existing government specification and standard format, and (c) the exclusion of any qualified product list (QPL) sections.

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1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers the general requirements for aluminum and aluminum alloy bar, rod, wire, or special shapes; rolled, drawn, or cold finished. Specific requirements for these products are covered by the applicable detail specification (See 6.3).

1.2 Classification:

1.2.1 Tempers: Bar, rod, wire, or special shapes are classified in tempers as specified in the detail specifications. Definitions of these tempers are specified in ANSI H35.1.

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2772	Heat Treatment of Aluminum Alloy Raw Materials
AMS-STD-2154	Inspection, Ultrasonic, Wrought, Metals, Process for

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094 or www.dsp.dla.mil.

FED-STD-123	Marking for Shipment (Civil Agencies)
MIL-STD-1537	Electrical Conductivity Test for Measurement of Heat Treatment of Aluminum Alloys, Eddy Current Method
MIL-STD-1916	DOD Preferred Methods for Acceptance of Product

2.3 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM B 117	Salt Spray (Fog) Testing
ASTM B 557	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666	Identification Marking of Aluminum Products
ASTM E 34	Chemical Analysis of Aluminum and Aluminum Base Alloys

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2.3 (Continued):

ASTM E 227	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E 290	Semi-Guided Bend Test for Ductility of Metallic Materials
ASTM E 607	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere
ASTM E 1251	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge
ASTM G 47	Determining Susceptibility to Stress Corrosion Cracking of High-Strength Aluminum Alloy Products

2.4 ANSI Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036 or www.ansi.org.

ANSI H35.1	Alloy and Temper Designation System for Aluminum
ANSI H35.2	Dimensional Tolerances for Aluminum Mill Products

3. REQUIREMENTS:

3.1 General Requirements:

Each product covered by this specification shall meet the requirements specified herein and in the applicable detail specification.

3.2 Chemical Composition:

The chemical composition of any product shall be as specified in the applicable detail specification.

3.3 Mechanical Properties:

3.3.1 Tensile Properties of Products Other Than Wire: Products, other than wire, shall exhibit tensile properties meeting requirements of applicable detail specifications. The requirements for minimum elongation shall not apply to any product of nominal thickness less than 0.062 inch or to product of such configuration or dimensions that a test specimen complying with ASTM B 557 cannot be prepared.

3.3.2 Tensile Properties of Wire: Elongation and yield strength need not be determined when the product is wire of a nominal diameter of 0.125 inch or less.

3.3.3 Tensile Properties of Product Sizes and Tempers Not Covered by a Detail Specification: Tensile properties of such product shall be as specified in the contract or purchase order (See 6.2).

3.3.4 Bend Properties: When minimum bend properties are specified in the detail specification or other procurement documents, test specimens shall be prepared and tested in accordance with 4.4.2.3 as applicable.

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3.4 Dimensional Tolerances:

Unless otherwise specified, the dimensional tolerances shall not exceed those specified in ANSI H35.2. Tolerances for sizes not covered in ANSI H35.2 shall be as specified in the contract or purchase order (See 6.2).

3.5 Corrosion Resistance:

When resistance to stress-corrosion cracking testing is specified in the detail specification or other procurement documents, specimens made from a product having at least a 0.750 inch diameter or thickness in the thinnest portion of the cross section shall show no evidence of cracking when stressed in tension in the short-transverse direction and tested in accordance with 4.4.2.4.1.

3.6 Internal Soundness:

When specified (See 6.2), product 0.500 through 6.000 inches thickness in the thinnest portion of the cross-section shall pass an ultrasonic inspection complying with AMS-STD-2154, as applicable to ultrasonic quality class levels specified in procurement documents. The maximum weight of each inspection unit (See 4.3.1) shall be 600 pounds for thicknesses ranging from 0.500 through 3.000 inches. The maximum weight of each inspection unit shall be 1000 pounds for units of thicknesses ranging from 3.001 through 6.000 inches.

3.6.1 Billets to be Formed Into Wire, Thin-Section Shapes, and Thin-Wall Tubing: When specified (See 6.2), billets to be formed into these products shall pass an ultrasonic inspection complying with AMS-STD-2154 as applicable to ultrasonic quality class levels specified in procurement documents. The maximum weight of each inspection unit shall be 600 pounds for nominal billet diameters or thicknesses ranging from 0.5 to 3.0 inches, and 1000 pounds for nominal diameters or thicknesses ranging beyond 3.0 to 6.0 inches.

3.7 Electrical Conductivity:

Electrical conductivities shall comply with requirements specified in detail specifications, as applicable to composition and temper (See 4.3.8 and 4.4.1.2).

3.8 Heat Treatment:

Unless otherwise specified in the contract or purchase order, heat treatment to the applicable tempers designated in the detail specification (See 1.2.1) shall be in accordance with AMS 2772, as applicable.

3.9 Finish:

Unless otherwise specified, rod up to and including 3.00 inches in nominal diameter and bar up to and including 2.00 inches nominal thickness (with maximum width for rectangles of 4.00 inches) shall be processed to size by cold finishing.

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3.10 Marking for Identification:

Bar, rod, wire, and special shapes shall be marked in accordance with ASTM B 666, as applicable, and the detail specification, as required.

3.11 Workmanship:

Finished product to be fabricated into aerospace parts, and parts having similar performance requirements (See 6.1), shall be uniform in quality and condition, clean, smooth, free from hard and soft spots, internal voids, and cracks (See 3.6), pipes, laps, cracks and seams, surface folds and crevices, fins, kinks, damaged ends, and other injurious flaws. The levels of quality of finished product for relatively non-critical applications shall be as specified in applicable procurement documents. Discoloration which does not affect properties shall not be cause for rejection.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the procuring activity. Purchaser reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

4.1.1 Responsibility for Compliance: All items shall meet all requirements of Sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the purchaser for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements; however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the purchaser to accept defective material.

4.2 Classification of Inspections:

The inspections specified herein are quality conformance inspections.

4.3 Sampling of Product:

4.3.1 Unit of Inspection: The unit of inspection for uncoiled product shall be one billet, bar, rod, or special shape. The unit of inspection for coiled product shall be one coil.

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4.3.2 Inspection Lot: An inspection lot shall be as follows:

4.3.2.1 Heat-Treated Material: For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of inspection units of the same alloy, temper, cross-sectional configuration, and dimensions traceable to a heat-treated lot or lots and subjected to contractor's inspection at one time.

4.3.2.2 Nonheat-Treated Material: For nonheat-treated tempers, an inspection lot shall consist of an identifiable quantity of inspection units of the same alloy, temper, cross-sectional configuration, and dimensions subjected to contractor's inspection at one time.

4.3.3 Sampling for Chemical Analysis:

4.3.3.1 Ingot Analysis: At least one sample shall be taken from each group of ingots of the same alloy, poured simultaneously from the same source of molten metal by the producer, and analyzed to determine conformance with 3.2. Ingots not conforming to the requirements of the specification shall be rejected. Complete ingot analysis records shall be available at the producer's plant to purchaser-authorized representatives upon request.

4.3.3.2 Analysis of Product: Specimens of product shall be analyzed when compliance of an inspection lot with 3.2 is doubtful. The sampling procedure applied shall comply with the most applicable procedure from among the following.

4.3.3.2.1 Ingot Identities Known: When ingot identities of the workpieces comprising an inspection lot are known, one specimen taken from one workpiece from among the product of each ingot shall be analyzed in accordance with 4.4.2.1. Ingot analysis certification may be substituted in place of performing chemical analysis unless disapproved by the procuring activity.

4.3.3.2.2 Ingot Identities Indeterminable: When the identities of ingots used to produce the units comprising the inspection lot can not be determined, specimens for analysis in accordance with 4.4.2.1 shall be taken using the most applicable procedure from among those following. When taking specimens, only one specimen shall be taken from any one inspection unit when more than one unit is available. Not more than one analysis per unit sample need be taken, except for verification.

4.3.3.2.2.1 Product Having a Nominal Weight Per Inspection Unit Less Than One Pound Per Lineal Foot: From each inspection lot of such product weighing 1000 pounds or less, one specimen shall be taken. From each inspection lot weighing more than 1000 pounds, one additional specimen shall be taken from each 1000 pounds and remaining fraction thereof.

4.3.3.2.2.2 Product Having a Nominal Weight Per Inspection Unit of One Pound or More Per Lineal Foot: From each lot of such product comprising 1000 linear feet or less, one specimen shall be taken. From each inspection lot comprising more than 1000 linear feet, one additional specimen shall be taken from each 1000 feet and remaining fraction thereof.

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4.3.4 Sampling for Tension and Bend Test: Specimens of product for testing to determine compliance with 3.3 shall be removed in compliance with the most applicable procedure from among the following.

4.3.4.1 Product Having a Nominal Weight Per Inspection Unit Less Than One Pound Per Lineal Foot:

4.3.4.1.1 Lots Weighing 1000 Pounds or Less: From each inspection lot of product weighing 1000 pounds or less, one specimen for the tension test and, when specified, one specimen for the bend test shall be taken. Only one specimen for either test shall be taken from any one unit when the lot contains more than one unit.

4.3.4.1.2 Lots Weighing More Than 1000 Pounds: From each inspection lot of product weighing more than 1000 pounds, one specimen for the tension test and, when specified, one specimen for the bend test shall be taken for each 1000 pounds and fraction thereof. Only one specimen for either test shall be taken from any one unit when the lot contains more than one unit.

4.3.4.2 Product Having a Nominal Weight Per Inspection Unit of One Pound or More Per Lineal Foot:

4.3.4.2.1 Lots Having 1000 Lineal Feet or Less: From each inspection lot of product consisting of 1000 lineal feet or less, one specimen for the tension test and, when specified, one specimen for the bend test shall be taken. Only one specimen for either test shall be taken from any one unit when the lot contains more than one unit.

4.3.4.2.2 Lots Having More Than 1000 Lineal Feet: From each inspection lot consisting of more than 1000 lineal feet, one specimen for the tension test and, when specified, one specimen for the bend test shall be taken for each 1000 lineal feet and fraction thereof. Only one specimen for either test shall be taken from any one unit when the lot contains more than one unit.

4.3.5 Sampling for Inspection of Workmanship, Dimensions, and Marking: Each length of rod, bar, or special shape and each coil of wire or rod shall be inspected for compliance with 3.4, 3.9, 3.10, and 3.11. Producers may use statistical quality control procedures in lieu of inspecting each piece when those procedures and results are fully documented and available at the producers plant to the procuring activity.

4.3.6 Sampling for Stress-Corrosion Tests: When thickness permits (See 3.5.1), two samples shall be taken for each 4000 pounds or less of the first three production lots of each of the applicable tempers for each size range listed in the table of minimum mechanical properties in the detail specification. Thereafter, surveillance testing shall be performed on at least one sample per month of the applicable tempers for each size range listed in the table of minimum properties of the detail specification produced during the month, unless otherwise specified in the detail specification or purchase orders.

4.3.7 Sampling for Ultrasonic Inspection: When ultrasonic inspection is specified, each inspection unit shall be inspected for conformance to 3.6.

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4.3.8 Sampling for Electrical Conductivity Tests: Such tests for lot acceptance according to the criteria of the applicable detail specification shall be performed on previously selected prepared specimens for the tension tests (See 4.3.4).

4.4 Test Methods:

4.4.1 Nondestructive Test and Inspections:

4.4.1.1 Ultrasonic Examinations: Such inspections, when specified (See 3.6 and 6.2), shall comply with AMS-STD-2154, as applicable.

4.4.1.2 Electrical Conductivity Tests: Samples selected in accordance with 4.3.8 shall be tested for electrical conductivity in accordance with MIL-STD-1537.

4.4.1.3 Examination of Preparation for Delivery: When specified (See 6.2), an examination shall be made by a purchaser-authorized representative to determine compliance with the requirements of Section 5. The inspection unit shall be one shipping container fully prepared for delivery. A lot shall be as specified in ASTM B 660. Sampling shall be in accordance with MIL-STD-1916, VL-I .

4.4.2 Procedures for Destructive Tests:

4.4.2.1 Chemical Analysis: Chemical analysis shall be made by ASTM E 607, or ASTM E 1251. In case of dispute, a referee analysis shall be made by wet chemical procedures in accordance with ASTM E 34.

4.4.2.2 Tension Testing:

4.4.2.2.1 Types of Specimens: Specimens for tension tests shall conform to ASTM B557, as applicable. When practicable, the material should be tested in full section.

4.4.2.2.2 Location of Test Specimens: For sections which are wholly or predominantly symmetrical, the tension specimens shall be taken from the locations specified in Table I. For unsymmetrical sections, the specimens shall be taken from a location that most nearly satisfies the intent of Table I. Unless otherwise specified in the contract or purchase order, for odd-shaped sections only the predominant part shall be tested.

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TABLE I. Location of Axis of Specimen

Section Thickness or Width (Inches)	Location of Axis of Specimen with Respect to Thickness (T) and Width (W) of Section	
	Thickness	Width
Up thru 1.500 incl	T/2	W/2
Greater than 1.500	T/4	W/4

4.4.2.2.3 Evaluation of Tensile Properties: Tensile strength, yield strength and elongation shall be determined in accordance with ASTM B 557.

4.4.2.3 Bending: When bend properties are specified, bend-test specimens prepared in accordance with the applicable requirements of ASTM E 290, shall be bent through an angle of 180 degrees over a diameter equal to N times the diameter or least thickness of the specimen. Specimens shall be bent by either pressure or blows. The value for N shall be as specified in the detail specification.

4.4.2.4 Corrosion Tests:

4.4.2.4.1 Resistance to Stress-Corrosion Cracking: Test specimens shall be of configurations and dimensions complying with ASTM G 47, as applicable to product cross-sectional configuration and dimensions, and tested in accordance with ASTM G 47, as applicable, as specified in the detail specification or purchase order. Before and during testing, the specimens shall be stressed as specified in the detail specification.

4.5 Rejection and Retests:

4.5.1 Rejection: Where one or more test specimens fail to meet requirements of the detail specification, the lot represented by the specimen or specimens shall be subject to rejection except as otherwise provided in a sampling plan approved by the procuring activity or in 4.5.2. When no sampling plan is provided, or approved by the procuring activity, when there is evidence that indicates that a failed specimen was not representative of the lot of material, and when the detail specification does not specify otherwise, at least two specimens shall be selected to replace each test specimen which failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be rejected.

4.5.2 Retests: In event of failure of one or more representative specimens, retest of two additional specimens for each failing specimen from the lot will be permitted. If one of the retest specimens fail, the lot shall be rejected with no further retesting permitted.

4.5.3 Resubmittal of Rejected Lots: Lots rejected for failure to meet the requirements of the detail specification may be resubmitted for test provided the producer has reworked the lots, as necessary, to correct the deficiencies or has removed the nonconforming material.

4.6 Certified Test Reports:

When specified within the contract or purchase order, the contractor shall furnish with each shipment, or as otherwise instructed, three copies of certified test reports listing results of all tests performed on each lot, and certification that material composition of each lot meets specified requirements (See 6.5).

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