Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 2355B
Superseding AMS 2355A
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QUALITY ASSURANCE SAMPLING AND TESTING OF ALUMINUM AND MAGNESIUM ALLOYS
Wrought Products Except Forgings

1. SCOPE: This specification covers the quality assurance sampling and testing of aluminum and magnesium wrought alloy products. It does not cover forged products.

1.1 Application: To provide users of Aerospace Material Specifications (AMS), Aerospace Material Documents (AMD), and other specifications in which this specification is referenced, quality assurance sampling and testing procedures which shall be used to determine conformance of wrought aluminum and magnesium alloy products, except forgings, to applicable specifications for such materials.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply; the applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM B193 - Resistivity of Electrical Conductor Materials
ASTM B342 - Electrical Conductivity by use of Eddy Currents
ASTM E8 - Tension Testing of Metallic Materials
ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E55 - Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition, Sampling
ASTM E227 - Spectrochemical Analysis of Aluminum and Its Alloys by the Point-to-Plane Technique Using an Optical Emission Spectrometer
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

3. TECHNICAL REQUIREMENTS:

3.1 General:

3.1.1 Omission from this specification of confirmatory tests of certain material properties or attributes controlled by the applicable specification for a material does not relieve the vendor of responsibility for furnishing materials which conform in all respects to the applicable specification for a material.

3.1.2 In the event of a conflict between the requirements specified herein and the requirements of a particular specification for a material, the following rules shall apply:

3.1.2.1 When the requirements of the material specification are more stringent, they shall take precedence.

3.1.2.2 When the requirements of this AMS are more stringent, they shall take precedence except as noted in 3.1.2.3.

3.1.2.3 If any tests mentioned in 3.3.2 are not required by the material specification, they shall not be considered a requirement.

3.1.2.4 When instructions are issued by the purchaser regarding quality assurance sampling procedures, such instructions shall take precedence over the requirements of either this specification or the particular specification in which this specification is invoked.

3.2 Responsibility for Tests: The vendor shall supply all samples and shall be responsible for accomplishing the required tests.

3.3 Detail Requirements:

3.3.1 Inspection Lot: An inspection lot shall be as defined in 3.3.1.1 or 3.3.1.2, the applicable definition being as specified for the type of test and type of product being tested.

3.3.1.1 For tempers, other than -F, of heat treatable alloys, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions traceable to a heat treat lot or lots, and subjected to inspection at one time.

3.3.1.2 For all tempers of non-heat treatable alloys and for the -F temper of heat treatable alloys, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions subjected to inspection at one time.

3.3.2 Sampling: Samples shall be taken as specified in 3.3.2.1, 3.3.2.2, 3.3.2.3, 3.3.2.4, and 3.3.2.5, the applicable location being as specified for the type of test and type of product being tested.

3.3.2.1 Sampling for Chemical Analysis:

3.3.2.1.1 Ingot Analysis: At least one sample shall be taken by the producer from each group of ingots of the same alloy poured simultaneously from the same source of molten metal and analyzed to determine conformance to the chemical composition limits specified in the applicable material specification (see 8.2). Ingots not conforming to the requirements of the applicable material specification shall be rejected. Complete ingot analysis records shall be available at the producer's plant to the purchaser.

3.3.2.1.2 Finished Product Analysis: When compliance with 3.3.2.1.1 cannot be established, samples from finished products shall be selected as specified in 3.3.2.2 for the type of product being tested and analyzed to determine conformance to the applicable material specification.

3.3.2.2 Sampling for Tensile Properties: The location from which the sample is taken shall be as specified in 3.3.3 for the type of test and type of product being tested. The orientation with respect to direction of predominant grain flow shall be as specified in the applicable material specification or, if not specified therein, shall be as specified in 3.3.3. The samples shall be taken from randomly selected pieces of the product. Only one tansile test specimen shall be taken from any one piece when more than one piece is available. Unless otherwise specified, the number of samples shall be as specified in 3.3.2.2.1, 3.3.2.2.2, or 3.3.2.2.3 for the type of product being tested. All material in the annealed (-0) or as-fabricated (-F) tempers of heat treatable alloys shall have additional samples taken equal in number to those specified for the product in 3.3.2.2.1, 3.3.2.2.2, or 3.3.2.2.3 for subsequent heat treatment and testing to demonstrate response to heat treatment as specified in the applicable material specification.

3.3.2.2.1 For sheet, one sample shall be selected for each 2000 lb (908 kg) or fraction thereof of a lot; however, not more than one sample is required from a mill coil even though slit into narrower coils or cut into shorter coils or into flat sheet, proyiding that further fabrication does not affect the temper.

3.3.2.2.2 For plate, one sample shall be selected for each 4000 lb (1816 kg) or fraction thereof of a lot; however, not more than one sample is required from a mill plate even though it is cut into two or more pieces.

3.3.2.2.3 For wire, rod, bar, shapes, tubing, and pipe having a nominal weight of less than 1 lb per lineal ft (1.49 kg/m), one sample shall be selected for each 1000 lb (454 kg) or fraction thereof of a lot. For such products having a weight of 1 lb per lineal ft (1.49 kg/m), or more, one sample shall be selected for each 1000 ft (304.8m) or fraction thereof of each lot.

3.3.2.3 Sampling for Dimensional and Workmanship Inspection: Each piece shall be inspected to determine conformance to the applicable material specification with respect to workmanship and identification marking. Inspections for dimensions shall be made to insure conformance with the tolerances specified. The vendor may use a system of statistical quality control for dimensional, marking, and workmanship inspection.

3.3.2.4 Sampling for Conductivity Testing: Sampling for conductivity testing shall be performed in accordance with the requirements of the applicable material specification.

3.3.2.5 Sampling for "Capability" Requirements: When a requirement in the applicable material specification is expressed as a "capability" requirement, testing of each lot of material is not required for that characteristic. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material is subject to rejection.

3.3.3 Tensile Test Specimen Orientation, Location, and Size: Tensile test specimens shall be cut from the material in the direction shown below unless otherwise specified, and shall be cut from the locations and to the sizes specified.

3.3.3.1 Sheet and Plate:

3.3.3.1.1 Aluminum: For non-heat-treatable aluminum alloys, tensile test specimens shall be taken parallel to the direction of rolling. For heat-treatable aluminum alloys, tensile test specimens shall be taken perpendicular to the direction of rolling for widths of 9 in. (229 mm) and greater, and parallel to the direction of rolling for widths less than 9 in. (229 mm). When short transverse tensile properties are specified in the applicable material specification and are to be determined, short transverse tensile test specimens shall be taken with axis of specimen parallel to the thickness direction of the product.

3.3.3.1.2 Magnesium: For non-heat-treatable magnesium alloys, tensile test specimens shall be taken parallel to the direction of rolling. For heat-treatable magnesium alloys, tensile test specimens shall be taken parallel and perpendicular to the direction of rolling for widths of 9 in. (229 mm) and greater, and parallel to the direction of rolling for widths less than 9 in. (229 mm). When short transverse tensile properties are specified in the applicable material specification and are to be determined, short transverse tensile test specimens shall be taken with axis of specimen parallel to the thickness direction of the product.

3.3.3.1.3 Location and Size of Tensile Test Specimen:

3.3.3.1.3.1 Longitudinal and Long Transverse Specimens: The standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 shall be used for sheet and plate less than 0.500 in. (12.7 mm) in thickness. For plate 0.500 in. (12.7 mm) and greater in thickness the standard 1/2 in. (12.7 mm) round tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 or a smaller round specimen proportional to it shall be used. The tensile test specimen shall be taken midway between the two surfaces of plate 0.500 through 1.500 in. (12.7 through 38.1 mm) in thickness and midway between the center and surface of plate over 1.500 in. (38.1 mm) in thickness. Material less than 3/4 in. (19.05 mm) in width shall be tested in full-section when the standard 1/2 in. (12.7 mm) round tensile test specimen or a smaller round specimen proportional to it cannot be used; elongation requirements of material specifications apply to such sizes only when round specimens are used.

3.3.3.1.3.2 Short Transverse Specimens: For plate 2-3/8 in. (60.32 mm) and greater in thickness, sub-size specimens as specified in 3.3.4.3 shall be used. The tensile test specimens shall be taken as specified in 3.3.3.1.1.

3.3.3.2 Wire, Rod, and Bar:

3.3.3.2.1 Aluminum and Magnesium: Tensile test specimens shall be taken in the longitudinal direction, except that when long transverse tensile properties are specified in the applicable material specification and are to be determined, the tensile test specimens shall be taken perpendicular to the rolling or extruding direction. When short transverse tensile properties are specified for rectangular bar in the applicable material specification and are to be determined, short transverse tensile test specimens shall be taken with axis of specimen parallel to the thickness direction of the bar.

3.3.3.2.2 Location and Size of Tensile Test Specimens:

3.3.3.2.2.1 Longitudinal Specimens: If the size or shape makes it impractical to use full-section tensile test specimens, the standard 1/2 in. (12.7 mm) round tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 or a smaller round specimen proportional to it shall be used, except that for rectangular bar less than 0.500 in. (12.7 mm) in thickness, the standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 may be used. For material 1.500 in. (38.1 mm) and less in diameter or thickness not tested in full-section, the tensile test specimen shall be taken from the center of the section. For material greater than 1.500 in. (38.1 mm) in diameter or thickness, the specimen shall be taken midway between the center and surface; for rectangular bar, the specimen shall also be located midway between the center and edge. Elongation and yield strength requirements of material specifications do not apply to wire less than 0.125 in. (3.18 mm) in diameter or thickness.

3.3.3.2.2.2 Long Transverse Specimens: The standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 shall be used for bar less than 0.500 in. (12.7 mm) in thickness and 8 in. (203.2 mm) and over in width. For bar 0.500 in. (12.7 mm) and greater in thickness, the standard 1/2 in. (12.7 mm) round tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 or a smaller round specimen proportional to it shall be used. The tensile test specimen shall be taken midway between the two surfaces of bar 0.500 through 1.500 in. (12.7 through 38.1 mm) in thickness and midway between the center and surface of bar over 1.500 in. (38.1 mm) in thickness. For rod over 3 in. (76.2 mm) in diameter, the location and size of the tensile test specimen shall be as agreed upon by purchaser and vendor.

3.3.3.2.2.3 Short Transverse Specimens: For rectangular bar 2-3/8 in. (60.32 mm) and greater in thickness, sub-size specimens as specified in 3.3.4.3 shall be used. The tensile test specimens shall be taken as specified in 3.3.3.2.1.

3.3.3.3 Tubing:

3.3.3.3.1 Drawn Aluminum and Extruded Aluminum and Magnesium: Tensile test specimens shall be taken in the longitudinal direction, except that when long transverse tensile properties are specified for square or rectangular tubing in the applicable material specification and are to be determined, the tensile test specimens shall be taken perpendicular to the direction of extrusion.

3.3.3.3.2 Location and Size of Tensile Specimens:

3.3.3.3.2.1 Longitudinal Specimens: Tensile test specimens from round tubing 2 in. (50.8 mm) and less in nominal OD and from square tubing 1-1/2 in. (38.1 mm) and less on a side shall be the full-section of the tubing, unless the limitations of the testing machine preclude the use of such a specimen. For tubing of larger size, or when it is not possible to test the full-section, the standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length; or standard 1/2 in. (12.7 mm) round tensile test specimens with 2 in. (50.8 mm) gage length or smaller round specimen proportional to it; or standard 1/2 in. (12.7 mm) longitudinal tensile test specimen for large-diameter tubular products of ASTM E8 may be used. When the size of the material makes it impracticable to use any of these specimens, round specimens proportional to the standard 1/2 in. (50.8 mm) round tensile test specimen of ASTM E8 shall be used. For tubing having a wall thickness of 1.500 in. (38.1 mm) and less not tested in full-section, the tensile test specimen shall be taken from the center of the wall. For tubing having a wall thickness greater than 1.500 in. (38.1 mm), the specimen shall be taken midway between the center of the wall thickness and the inner or outer surface of the tubing.

3.3.3.3.2.2 Long Transverse: The standard 1/2 in. (12.7 mm) round tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 or a smaller round specimen proportional to it shall be used for thicknesses of 3/8 in. (9.525 mm) and over and having widths of 2-3/8 in. (60.32 mm) and over, except that for square or rectangular tubing less than 0.500 in. (12.7 mm) in thickness the standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 may be used. For tubing from which these machined specimens cannot be obtained, a round or rectangular specimen of the largest possible dimensions shall be used. For tubing having a wall thickness of 1.500 in. (38.1 mm) and less, the tensile test specimen shall be taken from the center of the wall. For tubing having a wall thickness greater than 1.500 in. (38.1 mm) the specimen shall be taken midway between the center of the wall thickness and the inner or outer surface of the tubing.

3.3.3.4 Shapes:

3.3.3.4.1 Aluminum and Magnesium: Tensile test specimens shall be taken in the longitudinal direction, except that when long transverse tensile properties are specified in the applicable material specification and are to be determined, tensile test specimens shall be taken perpendicular to the extruding direction.

3.3.3.4.2 Location and Size of Tensile Test Specimens:

3.3.3.4.2.1 Longitudinal Specimens: If the size or shape makes it impractical to use full-section tensile test specimens, the standard 1/2 in. (12.7 mm) round tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 or smaller round specimen proportional to it shall be used, except that for shapes less than 0.500 in. (12.7 mm) in thickness having parallel surfaces, the standard 1/2 in. (12.7 mm) wide rectangular tensile test specimen or pin-loaded tensile test specimen with 2 in. (50.8 mm) gage length of ASTM E8 may be used. For shapes from which these machined specimens cannot be obtained and which cannot be tested in full-section, a round or rectangular specimen of the largest possible dimensions shall be used. For shapes 1.500 in. (38.1 mm) and less in thickness not tested in full-section, the tensile test specimen shall be taken from the center of the predominant or thickest part of the shape. For shapes greater than 1.500 in. (38.1 mm) in thickness, the specimen shall be taken midway between the center and surface and midway between the center and edge of the predominant or thickest part of the shape. Elongation requirements of material specifications do not apply to specimens from shapes less than 0.062 in. (1.59 mm) in thickness or to round or rectangular specimens of non-standard proportions.

3.3.3.4.2.1.1 Size, location, and direction of tensile test specimens from complicated shapes shall be as agreed upon by purchaser and vendor.