AEROSPACE MATERIAL SPECIFICATION

AMS4210™	REV. M

Issued 1940-10
Reaffirmed 2012-03
Revised 2021-04

Superseding AMS4210L

Aluminum Alloy, Castings
5.0Si - 1.2Cu - 0.50Mg (355.0-T51)
Precipitation Heat Treated
(Composition similar to UNS A03550)

RATIONALE

AMS4210M corrects errors in Composition (Table 1).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of castings.

1.2 Application

These castings have been used typically for parts where strength is not a prime consideration, but usage is not limited to such applications. AMS4212 covers a similar material in the solution and precipitation heat treated condition with higher strength requirements.

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.

AMS2175	Castings, Classification and Inspection of
AMS2360	Room Temperature Tensile Properties of Castings
AMS2694	In-Process Welding of Castings
AMS2771	Heat Treatment of Aluminum Alloy Castings
AMS2804	Identification, Castings

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
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4210M/

AMS4212 Aluminum Alloy Castings, 5.0Si - 1.2Cu - 0.50Mg (355.0-T6), Solution and Precipitation Heat Treated

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 B557 Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

ASTM B557M Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E29 Using Significant Digits in Test Data to Determine Conformance with Specifications

ASTM E34 Chemical Analysis of Aluminum and Aluminum-Base Alloys

ASTM E716 Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry

ASTM E1251 Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM E1742/E1742M Radiographic Examination

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E34, by spectrochemical methods in accordance with ASTM E1251, or by other analytical methods acceptable to purchaser (see 3.4.1).

Table 1 - Composition

Element	Min	Max
Silicon	4.5	5.5
Iron (3.1.1)	--	0.6
Copper	1.0	1.5
Manganese (3.1.1)	--	0.50
Magnesium	0.40	0.6
Chromium	--	0.25
Zinc	--	0.35
Titanium	--	0.25
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.1.1 If iron content exceeds 0.45%, manganese content shall be not less than one-half the iron content.

3.1.2 Test results may be rounded in accordance with the “rounding off” method of ASTM E29.

3.2 Condition

Precipitation heat treated.

3.3 Casting

Castings shall be produced from metal conforming to 3.1, determined by analysis of a specimen (3.4.1) cast after the last melt addition. The method for control of any subsequent additions prior to pouring (i.e., grain refining, correction for magnesium fade, etc.) shall be documented as a control factor (see 4.4.2).

3.4 Test Specimens

3.4.1 Chemical Analysis Specimens

Shall be cast from each melt after the last melt addition and shall be tested to qualify the melt lot as in 3.1. Spectrochemical sample shall be prepared in accordance with ASTM E716.

3.4.2 Tensile Specimens

3.4.2.1 Unless specimens cut from castings are specified by purchaser, separately cast specimens conforming to ASTM B557 or ASTM B557M shall be cast from each melt after the last melt addition. Specimens shall be cast in molds representing the mold formulation used for castings. Chills are not permitted on test specimen cavity except on the end face of the specimen when approved in accordance with 4.4.2. A tensile specimen shall be processed with each heat treat lot (see 8.2.2) and tested for conformance to 3.6.1.1.

3.4.2.2 When purchaser specifies specimens cut from castings, such specimens shall be machined to conform to ASTM B557 or ASTM B557M, and shall be either 0.500 inch (12.70 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or standard sheet-type specimens as required by 3.6.1.2 or 3.6.1.3.

3.5 Heat Treatment

Precipitation heat treatment shall be in accordance with AMS2771, except that set temperature and soak time shall be 430 to 450 °F (221 to 232 °C) for 7 to 9 hours. Test specimen(s) shall be put into a batch furnace with each load of castings or into a continuous furnace at intervals of not longer than 3 hours.

3.6 Properties

Castings and representative tensile specimens produced in accordance with 3.4.2 and heat treated in accordance with 3.5 shall conform to the following requirements:

3.6.1 Tensile Properties

Shall be as follows, determined in accordance with ASTM B557 or ASTM B557M; conformance to the requirements of 3.6.1.1 shall be used as basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.2 or 3.6.1.3 apply:

3.6.1.1 Separately Cast Specimens

Tensile strength shall be not lower than 25.0 ksi (172 MPa).

3.6.1.2 Specimens Cut from Castings

When specified by purchaser without designating specific sample locations, the average tensile strength of specimens sampled from thin and thick sections (see 4.3.3.1) shall be not less than 18.75 ksi (129.3 MPa).

3.6.1.3 Specimens Cut from Designated Casting Areas

When specified by purchaser, specimens taken from locations indicated on the drawing shall meet tensile property requirements specified on the drawing. Property requirements may be designated in accordance with AMS2360.

3.7 Quality

Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the castings.

3.7.1 When acceptance standards are not specified, Grade C of AMS2175 shall apply and radiographic indications of gas holes, sand spots, and inclusions shall be cause for rejection when closer to the edge than twice their maximum dimension.

3.7.2 Methods of inspection and frequency of inspection shall be as agreed upon by purchaser and producer. A “Casting Class” of AMS2175 may be selected to specify the method and frequency of inspection.

3.7.3 Castings shall be produced under radiographic control. This control shall consist of 100% radiographic inspection of castings until process control factors (4.4.2) have been established to ensure production of acceptable castings. Unless otherwise specified by purchaser, continued radiographic inspection of production castings shall be performed at a frequency determined by the producer to ensure continued maintenance of internal quality.

3.7.3.1 Radiographic inspection shall be conducted in accordance with ASTM E1742/E1742M, unless otherwise specified by purchaser.

3.7.4 When specified by purchaser, castings shall be fluorescent penetrant inspected using a method specified by purchaser, or, if not specified, a method in accordance with ASTM E1417/E1417M.

3.7.5 Castings shall not be peened, plugged, impregnated, or welded, unless authorized by purchaser.

3.7.5.1 When authorized by purchaser, welding in accordance with AMS2694 or other welding program approved by purchaser may be used.

3.8 Any exceptions shall be authorized by purchaser and reported as in 4.5.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of castings 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 castings conform to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1) and tensile properties (3.6.1) are acceptance tests and shall be performed to represent each melt or heat treat lot as applicable.

4.2.2 Periodic Tests

Radiographic inspection (3.7.3) following the establishment of process control (4.4.2) is a periodic test and shall be performed at a frequency determined by the producer to ensure continued maintenance of internal quality, unless frequency is specified by purchaser.

4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, when a change in material and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing

Shall be in accordance with the following:

4.3.1 One chemical analysis specimen in accordance with 3.4.1 from each melt for conformance to 3.1.

4.3.2 One or more separately cast tensile specimens in accordance with 3.4.2 from each heat treat lot, for conformance to 3.6.1.1, unless purchaser specifies use of specimens cut from a casting as in 4.3.3.

4.3.3 When purchaser specifies that specimens be cut from castings, one or more castings from each heat treat lot, for conformance to 3.6.1.2 or 3.6.1.3, as applicable.

4.3.3.1 For determining conformance to 3.6.1.2, when specimen locations are not shown on the drawing, not less than four (preferably ten) tensile specimens shall be cut from thick and thin sections and tested.

4.3.4 One or more preproduction castings of each casting part number in accordance with 4.4.1.

4.4 Approval

4.4.1 Sample castings from new or reworked patterns and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived by purchaser.

4.4.2 Producer shall establish for production of sample castings of each part number parameters for process control factors which will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. Producer shall also establish a procedure for production of separately cast tensile specimens. Method for production of separately cast tensile specimens shall be consistent for all material cast to this specification. If it is necessary to make any change in parameters for process control factors, producer shall submit for reapproval a statement of the proposed change in processing and, when requested, sample castings, test specimens, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.4.2.1 Control factors for producing tensile specimens and castings include, but are not limited to, the following. Supplier's procedures shall identify tolerances, ranges and/or control limits, as applicable. Control factors for separately cast tensile specimens shall generally represent, but need not be identical to, those factors used for castings.

Type of furnace
Furnace atmosphere
Alloy additions, fluxing, deoxidation, and gas removal procedures
Gating and risering practices
Mold composition and molding practice
Core composition, and fabrication method, when applicable
Metal pouring temperature; variation of ±50 °F (±28 °C) from the established limit is permissible
Solidification and cooling procedures
Precipitation heat treatment cycle
Cleaning operations
Straightening procedure, when applicable
Methods of inspection
Radiographic inspection sampling plan, if used

4.4.2.1.1 Any of the above process control factors for which parameters are considered proprietary by the producer may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.