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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4210J

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Superseding AMS 4210H

Submitted for recognition as an American National Standard

(R) ALUMINUM ALLOY, CASTINGS
5.0Si - 1.2Cu - 0.50Mg (355.0-T51)
Precipitation Heat Treated

UNS A03550

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. AMS 4212 covers a similar material in the solution and precipitation heat treated condition with higher strength requirements.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2360	Room Temperature Tensile Properties of Castings
AMS 2694	Repair Welding of Aerospace Castings
AMS 2771	Heat Treatment of Aluminum Alloy Castings
MAM 2771	Heat Treatment of Aluminum Alloy Castings (Metric)
AMS 2804	Identification, Castings
AMS 4212	Aluminum Alloy, Castings, 5.0Si - 1.2Cu - 0.50Mg, (355.0-T6), Solution and Precipitation Heat Treated

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 557	Tension Testing Wrought and Cast Aluminum - and Magnesium-Alloy Products
ASTM B 557M	Tension Testing Wrought and Cast Aluminum - and Magnesium-Alloy Products (Metric)
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 29	Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E 34	Chemical Analysis of Aluminum and Aluminum-Base Alloys
ASTM E 101	Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E 227	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E 607	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere
ASTM E 716	Sampling of Aluminum and its Alloys for Spectrochemical Analysis

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-453 Inspection, Radiographic
MIL-STD-2175 Casting, Classification and Inspection of
MIL-STD-6866 Inspection, Liquid Penetrant

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 E 34, by spectrochemical methods in accordance with ASTM E 101, ASTM E 227, or ASTM E 607, or by other analytical methods acceptable to purchaser (See 3.4.1).

TABLE 1 – Composition

Element	min	max
Silicon	4.5	5.5
Copper	1.0	1.5
Magnesium	0.40	0.6
Iron (3.1.1)	--	0.6
Manganese (3.1.1)	--	0.50
Zinc	--	0.35
Titanium	--	0.25
Chromium	--	0.25
Other Impurities, each	--	0.05
Other Impurities, 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 maybe rounded in accordance with the "rounding off" method of ASTM E 29.

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.

3.4 Cast Test Specimen:

Chemical analysis specimens and tensile specimens shall be cast as follows:

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 E 716.

3.4.2 Tensile Specimens: Unless specimens cut from castings are specified by purchaser, separately-cast specimens, conforming to ASTM B 557 or ASTM B 557M, 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 and tested for conformance to 3.6.1.1.

3.4.2.1 When purchaser specifies specimens cut from castings, such specimens shall be machined to conform to ASTM B 557 or ASTM B 557M, 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 AMS 2771 or MAM 2771 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 three hours.

3.6 Properties:

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

3.6.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B 557 or ASTM B 557M; 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 AMS 2360.

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 MIL-STD-2175 shall apply.

3.7.2 Methods of inspection and frequency of inspection shall be as agreed upon by purchaser and vendor. A "Casting Class" of MIL-STD-2175 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 vendor to ensure continued maintenance of internal quality.

3.7.3.1 Radiographic inspection shall be conducted in accordance with MIL-STD-453, 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 MIL-STD-6866.

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 AMS 2694 or other welding program approved by purchaser may be used.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of castings 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 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 vendor 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.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be in accordance with the following:

4.3.1 One chemical analysis specimen 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 that specimens be cut from castings.

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 Vendor 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. Vendor 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. Control factors for producing separately-cast tensile specimens need not be the same as those used for production of castings. If necessary to make any change in parameters for process control factors, vendor 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 castings include, but are not limited to, the following:

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

4.4.2.1 (Continued)

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 vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Reports:

The vendor of castings shall furnish with each shipment a report showing the results of tests for chemical composition of at least one casting or of separately-cast specimens from each melt and the results of tests for tensile properties of separately-cast specimens representing each heat treat lot or, when specified, of specimens cut from castings from each heat treat lot. This report shall include the purchase order number, melt and heat treat lot numbers, AMS 4210J, part number, and quantity.

4.6 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, disposition of the castings may be based on the results of testing two additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the castings represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Shall be in accordance with AMS 2804.

5.1.1 Impregnated castings shall be marked "IMP".

5.2 Packaging:

5.2.1 Castings shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the castings to ensure carrier acceptance and safe delivery.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with ASTM B 660, Level C, unless Level A is specified in the request for procurement.