# AEROSPACE MATERIAL SPECIFICATION

| AMS-QQ-A-591 | REV. B |
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Superseding AMS-QQ-A-591A

## Aluminum Alloy Die Castings

RATIONALE

AMS-QQ-A-591B stabilizes this document because it no longer state of the art and other documents contain similar but not necessarily equivalent requirements.

STABILIZED NOTICE

AMS-QQ-A-591B has been declared "STABILIZED" by AMS Committee D. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because it is no longer state of the art and other documents contain similar but not necessarily equivalent requirements. Previously this document was Noncurrent. This document has never been technically updated. Users of this document should refer to the cognizant engineering organization for disposition of any issues with reports/certifications to this specification; including exceptions listed on the certification. NOTE: In many cases, the purchaser may represent a sub tier supplier and not the cognizant engineering organization.

AMS Committee D recommends that the following similar but not identical specifications may be considered for future procurement. This listing does not constitute authority to substitute these specifications for the “STABILIZED” specification.

AMS4290 Aluminum Alloy, Die Castings 9.5Si - 0.50Mg (360.0-F), As Cast

AMS4291 Aluminum Alloy, Die Castings, 8.5Si - 3.5Cu (A380.0-F), As Cast





**TO PLACE A DOCUMENT ORDER:** **Tel: 877-606-7323 (inside USA and Canada)**
**Tel: +1 724-776-4970 (outside USA)**
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NOTICE

This document has been taken directly from U.S. Military Specification QQ-A-591F and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace QQ-A-591F. Any part numbers established by the original specification remain unchanged.

The original Military 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, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this SAE technical document.

1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers aluminum alloy die castings.

1.2 Classification:

1.2.1 Alloys: Aluminum die castings shall be furnished in the alloys shown in table I, as specified (see 6.2).

2. APPLICABLE DOCUMENTS:

The following publications, of the issue 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 U.S. Government Publications:

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

FED-STD-151 Metals; Test Methods
FED-STD-184 Identification Marking of Aluminum, Magnesium and Titanium

MIL-STD-105 Sampling Procedures and Tables for Inspection by Attributes

2.2 ASTM Publications:

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

ASTM B 85 Casting, Die Aluminum Alloy
ASTM B 557 Aluminum and Magnesium Alloy Products, Tension Testing Wrought and Cast

2.3 National Motor Freight Traffic Association, Inc., Agent:

Available from American Trucking Associations, Inc., Traffic Department, 1616 P Street, N.W., Washington, DC 20036.

National Motor Freight Classification

2.4 Uniform Classification Committee, Agent:

Available from Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.

Uniform Freight Classification

3. REQUIREMENTS:

3.1 Manufacture:

The die castings shall be made by forcing molten material under pressure into a mold or die. Unless otherwise specified or shown on the applicable drawing (see 6.2), die castings shall be made by the cold-chamber process.

3.2 Chemical composition:

3.2.1 The chemical composition of the material shall be within the limits shown in table I.

3.2.2 The supplier shall furnish an analysis of each lot showing the percentage of each of the elements specified in table I. Chemical analysis of the individual lots by the contractor may be waived at the discretion of the Government inspector, provided that the foundry's method of composition control is acceptable to him, or that all the material in the lot can be identified as being from melts previously analyzed and found to be in conformance with the chemical composition requirements of the alloy specified herein.

3.3 Soundness:

3.3.1 When specified (see 6.2), the soundness of die castings shall conform to standards furnished or approved by the purchaser. The number and extent of blowholes, sponginess, and other defects in the die castings shall not exceed those shown by the standards, and such defects shall be substantially absent in designated areas.

3.3.1.1 The standards supplied or approved by the purchaser for determining conformance with soundness requirements shall consist of either sectionalized die castings, photographs thereof, or radiographs of at least the important sections of die castings.

3.3.2 When specified (see 6.2), the weight of each casting shall be not less than a specified minimum when weighed in accordance with 4.5.3.3.

3.4 Foundry control:

Unless otherwise specified (see 6.2), die castings shall be produced under foundry control approved by the purchaser. Foundry control shall consist of examination of die castings by radiographic or other approved methods for determining internal defects until the gating and other foundry practices have been established to produce die castings meeting the quality standards furnished by the purchaser or agreed upon by the purchaser and supplier. When foundry practices have been so established, the production method shall not be changed without demonstrating to the satisfaction of the purchaser that the change does not adversely affect the quality of the die castings.

TABLE I. Chemical composition - percent maximum except where indicated as a range 1/

| Alloy | Silicon | Iron | Copper | Manganese | Magnesium | Nickel | Zinc | Tin | Other elements total | Aluminum |
|---|---|---|---|---|---|---|---|---|---|---|
| 360.0 | 9.0-10.0 | 2.0 | 0.6 | 0.35 | 0.40-0.60 | 0.50 | 0.50 | 0.15 | 0.25 | Remainder |
| A360.0 | 9.0-10.0 | 1.3 | 0.6 | 0.35 | 0.40-0.60 | 0.50 | 0.50 | 0.15 | 0.25 | Remainder |
| 380.0 | 7.5- 9.5 | 2.0 | 3.0-4.0 | 0.50 | 0.10 | 0.50 | 3.0 | 0.35 | 0.50 | Remainder |
| A380.0 | 7.5- 9.5 | 1.3 | 3.0-4.0 | 0.50 | 0.10 | 0.50 | 3.0 | 0.35 | 0.50 | Remainder |
| 383-0 | 9.5-11.5 | 1.3 | 2.0-3.0 | 0.50 | 0.10 | 0.30 | 3.0 | 0.15 | 0.50 | Remainder |
| 384-0 | 10.5-12.0 | 1.3 | 3.0-4.5 | 0.50 | 0.10 | 0.50 | 3.0 | 0.35 | 0.50 | Remainder |
| 413.0 | 11.0-13.0 | 2.0 | 1.0 | 0.35 | 0.10 | 0.50 | 0.50 | 0.15 | 0.25 | Remainder |
| A413.0 | 11.0-13.0 | 1.3 | 1.0 | 0.35 | 0.10 | 0.50 | 0.50 | 0.15 | 0.25 | Remainder |
| C443.0 | 4.5- 6.0 | 2.0 | 0.6 | 0.35 | 0.10 | 0.50 | 0.50 | 0.15 | 0.25 | Remainder |
| 518.0 | 0.35 | 1.8 | 0.25 | 0.35 | 7.50-8.50 | 0.15 | 0.15 | 0.15 | 0.25 | Remainder |

1/Analysis shall be made regularly only for the elements specifically mentioned in table I. If, however, the presence of other elements is suspected or indicated in the course of routine analysis, further analysis shall be made to determine that the total of other elements is not in excess of the limits specified.

3.5 Dimensions:

The dimensions of the die casting shall be within the dimensions and tolerances specified on the applicable drawings.

3.6 Repair:

Die castings shall not be repaired in any manner without documented permission of the purchaser. When such permission is granted, it shall not relieve the supplier from his responsibility of supplying castings which shall meet all the requirements of the drawings and the specification.

3.7 Identification marking:

Unless otherwise specified (see 6.2), each die casting shall be identified with the part number and manufacturer's name, brand, or trademark, by the use of raised numerals in a location indicated on the drawing. When no location is shown on the drawing, the number shall be so located as not to be removed when machining to the required dimension. Marking shall be in accordance with FED-STD-184.

3.7.1 Die castings on which it is impracticable to provide raised numerals shall be marked by impression stamping or by any other method as agreed upon by the purchaser and supplier. The location of impression stamping must be approved by the purchaser when no location is shown on the drawing.

3.8 Location of ejector pin marks and parting lines:

Unless otherwise specified (see 6.2), the location of ejector pin marks and parting lines shall be at the option of the producer.

3.9 Workmanship:

The die castings shall be of uniform quality, free from injurious blowholes, porosity, hard spots, shrinkage defects, cracks, and other discontinuities that will adversely affect the serviceability of the castings.

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 as specified herein. Except as otherwise specified in the contract or 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 Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Lot:

4.2.1 Inspection lot: The supplier has the option of operating on the basis of either one of the following two definitions of an inspection lot:

4.2.1.1 An inspection lot shall consist of not more than 1,000 pounds (45 kg) of die castings of the same part number submitted for inspection at one time. However, if this method of inspection is used, the foundry's method of periodic composition control shall be acceptable to the procuring agency and no die castings shall be released for finishing until the composition of the representative chemical samples has been found to conform with the composition limits of this specification.

4.2.1.2 An inspection lot shall consist of the production of each die or compound die of each machine for each 24 hour period during the first week of continuous operation, and the production for each 48 hour period thereafter of continuous operation. Any change in the machine, composition, die or continuity of operation shall be considered as the start of a new lot. Die castings inspected by this method shall be so marked or handled during the finishing operations as not to lose their identity.

4.3 Sampling:

Samples taken for purposes of tests prescribed in this specification shall be selected in such manner as to represent correctly the material furnished and avoid needless destruction of finished material when samples representatives of the material are available from other sources.

4.3.1 For chemical analysis: Two samples shall be taken from each of two representative castings selected from each lot.

4.3.1.1 If the producer's method of composition control is acceptable, sampling for chemical analysis may be waived at the discretion of the purchaser.

4.3.2 For soundness: Unless otherwise specified (see 6.2), the sampling for radiographic inspecting or comparison with standards shall be in accordance with table II.

TABLE II. Size of radiographic or comparative sample

| Number of die castings in lot | Sample number of die castings | Acceptable number of defective die castings, maximum |
|---|---|---|
| 1-5 | All | 0 |
| 6-100 | 6 | 0 |
| 101-500 | 7 | 0 |
| 501-2000 | 17 | 1 |
| 2001-6000 | 27 | 2 |
| Over 6000 | 39 | 3 |

4.4 Examination:

4.4.1 Workmanship: Each die casting shall be carefully examined to determine conformance with the requirements of this specification with respect to workmanship.

4.4.2 Dimensional: The first completely formed, apparently sound casting made from each die intended for use in lot production, shall be measured and gaged for conformance with 3.5. When nonconformance occurs, corrective action shall be taken and first casting dimensional examination again preformed. Unless otherwise specified (see 6.2), at least 0.1 percent of the die castings subsequently made with the die shall be measured and gaged.

4.4.3 Examination of preparation for delivery: An examination shall be made to determine compliance with the requirements of section 5. The sample unit shall be one shipping container fully prepared for delivery. Sampling shall be in accordance with MIL-STD-105. The inspection level shall be S-2 with an accepted quality level (AQL) of 4.0 expressed in terms of percent defective.

4.5 Tests:

4.5.1 Chemical analysis: The sample selected in accordance with 4.3.1 shall be analyzed in accordance with method 111 or 112 of FED-STD-151. A single analysis of a composite sample may be made. In case of dispute, reference analysis shall be by method 111. If another method of analysis is desired, it shall be as agreed upon by the supplier and purchaser.

4.5.2 Foundry control: Unless otherwise specified (see 6.2), all die castings produced shall be examined radiographically, or by other approved methods, until such time as the proper die casting practice has been reached that will produce die castings free from serious internal defects in all parts of the die castings subject to stress in service.

4.5.3 Soundness:

4.5.3.1 Unless otherwise specified (see 6.2), when soundness is required in accordance with 3.3.1, it shall be determined by radiographic examination of die castings selected in accordance with 4.3.2.

4.5.3.2 When specified (see 6.2), soundness shall be determined by comparison with sectionalized standard die castings.

4.5.3.3 When the minimum weight of the individual casting is specified (see 6.2), a sufficient number of the die castings in each lot shall be weighed to establish compliance with the weight requirement. If any of the castings so weighed fall below the specified weight, each casting of the lot shall be weighed, and those weighing less than the specified weight shall be rejected.

4.6 Rejection and retest:

If any sample except soundness fails to conform to this specification, the entire lot shall be rejected subject to retest provisions in FED-STD-151. If the number of defective die castings in any soundness sample (see table II) exceeds the acceptable number for that sample, the lot represented by that sample shall be rejected subject to retest provisions in FED-STD-151.

5. PREPARATION FOR DELIVERY:

5.1 Packaging:

Packaging shall be level A, B, or commercial, as specified (see 6.2).

5.1.1 Level A: The aluminum alloy die castings shall be packaged in accordance with the level A packaging requirements of MIL-STD-649.

5.1.2 Level B: The aluminum alloy die castings shall be packaged in accordance with level B packaging requirements of MIL-STD-649.

5.1.3 Commercial: The aluminum alloy die castings shall be packaged in accordance with normal commercial practice. The complete package shall be designed to protect the castings against damage during multiple shipments, handling, and storage.

5.2 Packing:

Packing shall be level A, B, or commercial, as specified (see 6.2).

5.2.1 Level A: The aluminum alloy die castings, packaged as specified in 5.1, shall be packed in accordance with level A packing requirements of MIL-STD-649.

5.2.2 Level B: The aluminum alloy die castings, packaged as specified in 5.1, shall be packed in accordance with the level B packing requirements of MIL-STD-649.

5.2.3 Commercial: The aluminum alloy die castings, packaged as specified in 5.1, shall be packed in fiberboard boxes to insure delivery at destination; provide for redistribution by the initial receiving activity; and be acceptable by common carrier under the National Motor Freight Classification and Uniform Freight Classification.

5.3 Marking:

5.3.1 Civil agencies: Marking shall be as specified in the contract or order.

5.3.2 Military agencies: Marking shall be as specified in MIL-STD-129.

6. NOTES:

6.1 Intended use:

6.1.1 The aluminum alloy die castings covered by this specification have good resistance to corrosion, although alloys 360.0, A360.0, 383.0, 413.0, A413.0, C443.0 and 518.0 are, as a group, more resistant to corrosion than 380.0, A380.0, and 384.0.

6.1.2 Alloys 360.0, A360.0, 413.0, and A413.0, have excellent casting qualities, good mechanical qualities, and good resistance to corrosion. Alloy C443.0 has a high elongation but a comparatively low yield strength and is not as suitable for the production of intricate die castings as are alloys 360.0, A360.0, 413.0, and A413.0. Die castings of alloy 518.0 have good strength, ductility, resistance to corrosion, finishing qualities, and color. However, this alloy is extremely difficult to die cast.

6.1.3 Alloys 380.0, A380.0, and 384.0 are used for a wide variety of die castings generally not required to withstand severely corrosive conditions. When suitably protected, however, they will satisfactorily withstand rather severe exposure. They develop relatively high tensile properties and are of a composition which can be made largely from good grades of secondary materials. Alloys of this type would be in more abundant supply in an emergency period.

6.1.4 Alloy 383.0 is superior to alloy A380.0 with respect to hot cracking, pressure tightness, and die-filling capacity. Tensile properties are approximately the same.