Designation: B894 – 10 (Reapproved 2015)

Standard Specification for ACuZinc5[1] (Zinc-Copper-Aluminum) Alloy Die Castings[2]

This standard is issued under the fixed designation B894; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers ACuZinc5, zinc-copper-aluminum alloy die castings. (UNS Z46541).[3]

1.2 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to become familiar with all hazards including those identified in the appropriate Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate safety and health practices, and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 The following documents of the issue in effect on date of order acceptable form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards:*[4]

B892 Specification for ACuZinc5

B899 Terminology Relating to Non-ferrous Metals and Alloys

B949 Specification for General Requirements for Zinc and Zinc Alloy Products

E10 Test Method for Brinell Hardness of Metallic Materials

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

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E536 Test Methods for Chemical Analysis of Zinc and Zinc Alloys

2.3 *Federal Standards:*[5]

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

2.4 *ISO Standards:*[6]

ISO 3815-1 Zinc and zinc alloys — Part 1: Analysis of solid samples by optical emission spectrometry

ISO 3815-2 Zinc and zinc alloys — Part 2: Analysis by inductively coupled plasma optical emission spectrometry

2.5 *Military Standard:*[7]

MIL-P-116 Methods of Preservation

MIL-STD-129 Marking for Shipment and Storage

2.6 *NADCA Standard:*[8]

NADCA Product Specification Standards for Die Castings

3. Terminology

3.1 Terms shall be defined in accordance with Terminology B899.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *die casting, n*—a casting process in which molten metal is injected under high velocity and pressure into a metal die and solidified, also a product produced by such a process. Alternately known as pressure die casting.

4. Ordering Information

4.1 Orders for die castings shall include the following basic information in addition to the information specified in Specification B949, Section 4:

4.1.1 Part name and number,

4.1.2 Alloy (Table 1), and

4.1.3 Drawing of die casting, when required, giving all necessary dimensions and showing latest revisions and allowances for machining, if any. Location of ejector pin marks or

[1] ACuZinc and ACuZinc5 are registered trade names of the General Motors Corporation.

[2] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.04 on Zinc and Cadmium.

Current edition approved May 1, 2015. Published May 2015. Originally approved in 1999. Last previous edition approved in 2010 as B894 – 10$^{\varepsilon 1}$. DOI: 10.1520/B0894-10R15.

[3] See Footnote B in Table 1.

[4] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[5] Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

[6] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

[7] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://www.dodssp.daps.mil.

[8] Available from North American Die Casting Association 241 Holbrook Dr Wheeling, Illinois 60090-5809, http://www.diecasting.org.

***A Summary of Changes section appears at the end of this standard**

TABLE 1 ACuZinc5 Chemical Requirements, Composition, Zinc-Copper-Aluminum Die Castings[A]

Elements	Composition,%
	(Z46541)[B]
Copper	5.0 to 6.0
Aluminum	2.5 to 3.3
Magnesium	0.025 - 0.05
Iron	0.075 max
Lead	0.005 max
Cadmium	0.004 max
Tin	0.003 max
Zinc	Remainder[C]

[A] The following applies to all specified limits in this table: For purposes of determining conformance with this specification, the observed value or calculated value obtained from analysis shall be rounded off to the nearest unit in the last right-hand place of figures used in expressing the specified limit, in accordance with the rounding method of Practice E29.
[B] UNS designations were established in accordance with Practice E527.
[C] Determined arithmetically by difference.

parting lines shall be at the option of the producer, unless specifically designated on the drawing.

4.2 Additional tests, options and special inspection requirements as provided below should be justified only on the basis of need. These shall be specified in the contract or purchase order, as additional procedures and extended delivery time may be involved.

4.2.1 Chemical analysis (7.1.1),
4.2.2 Quality assurance (Section 6),
4.2.3 Special proof tests or mechanical properties (Section 8),
4.2.4 General quality options for internal soundness or for finish (Section 10),
4.2.5 Source inspection (Section 11),
4.2.6 Certification (Section 13),
4.2.7 Marking for identification (Section 14), and
4.2.8 Special packaging (Section 15).

5. Materials and Manufacture

5.1 The metal used in the manufacture of die castings shall be zinc alloy of a specified chemical composition conforming to the requirements of Specification B892.

5.2 The material covered by this specification shall be of uniform quality and shall be free of harmful contamination.

6. Quality Assurance

6.1 *Responsibility for Inspection*—When specified in the contract or purchase order, the producer or supplier is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer or supplier may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification. Quality assurance standards shall be agreed upon between the producer or supplier and purchaser at the time a contract or order is placed.

6.2 For normal inspection purposes, an inspection lot shall consist of the production from each die during a single production run, as defined and recorded by the producer, and shipped, or available for shipment, at one time.

6.2.1 The producer or supplier shall examine each die casting of a randomly or statistically selected sample to determine conformance to the requirements of the contract, purchase order, or part drawing. The results of this inspection shall be recorded.

6.2.1.1 Unless otherwise specified in the contract, purchase order, or part drawing, detailed dimensional conformance shall normally be determined on one or more production samples.

6.2.2 When specified in the contact, purchase order, or part drawing, special inspection lot definitions may be established, for a specific part.

7. Chemical Requirements

7.1 *Limits*—The die casting shall conform to the requirements as to chemical composition in Table 1. Conformance shall be determined by the producer by analyzing samples taken at the time castings are made. If the producer has determined the chemical composition of the metal during the course of manufacture, he shall not be required to sample and analyze the finished product.

7.1.1 When a detailed chemical analysis is required with a shipment, is shall be called for in the contract or purchase order.

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

7.2 *Number of Samples*—When required, samples for determination of chemical composition shall be taken to represent the following:

7.2.1 A sample shall be taken from each of two representative castings selected from each lot defined in 6.2.

7.3 *Methods of Sampling*—Samples from die castings for determination of chemical composition shall be taken in accordance with Specification B949, Section 6.5 and 6.6.

7.4 *Method of Analysis*—The determination of chemical composition shall be made in accordance with Specification B949, Section 5.2.2.

7.4.1 In case of dispute, the results secured by Test Methods E536, ISO 3815-1, or ISO 3815-2 shall be the basis of acceptance.

NOTE 1—Test Methods E536 is not directly applicable to ACuZinc5. ISO 3815-1and ISO 3815-2 are generic methods applied to zinc and zinc alloys. Each of the methods may be modified and formatted for the alloy to be assayed. An experienced chemist, using suitable and/or traceable standards along with valid quality assurance techniques, will be able to perform and validate the methods and demonstrate acceptable precision and accuracy.

8. Mechanical Properties and Tests

8.1 Unless specified in the contract or purchase order, or specified on the detail drawing, acceptance of die castings under this specification shall not depend on mechanical properties determined by tension or impact tests.

8.1.1 Tensile strength, yield strength and elongation values shown in Table 1. They are Weibull analysis values to be used

for design guidance. They are B_{50} and B_1 values with 50 % confidence and were obtained from tests on 5.3 mm diameter separately cast test bars which had a 25.4 mm gage length. The bars were tested in the as-cast condition.

NOTE 2—The property values of test bars cut from castings will vary depending on the solidification rate of the individual casting. Solidification and cooling rate are significantly influenced by casting section size. Also due to cooling rate and section size variation, the properties of bars machined from castings may vary from those of separately cast test bars. For these reasons, acceptance or rejection of the casting shall be based on chemistry. Hardness and mechanical properties may be used when agreed by the purchaser and supplier, and specified on the engineering drawing.

8.1.2 Hardness (Test Method E10)—The hardness shall be determined on the casting unless otherwise specified on the part drawing. A Brinell hardness test will be performed using a 500 kg load and a 10 mm ball unless otherwise specified and agreed to by supplier and user. If the part is too small for a Brinell test, a Rockwell F or K hardness test is suggested.

9. Permissible Variations in Dimensions

9.1 Permissible variations in dimensions shall be within the limits specified on the drawings or in the contract or purchase order.

9.1.1 Any dimensions for which a tolerance is not specified shall be in accordance with NADCA Product Specification Standards for Die Castings.

9.2 Dimensional tolerance deviations waived by the purchaser shall be confirmed in writing to the producer or supplier.

10. General Quality

10.1 *Internal Soundness*—When specified, the soundness of die castings shall conform to standards or requirements agreed upon between the producer or supplier and the purchaser. The number and extend of imperfections shall not exceed those specified by the purchaser. The standards or requirements may consist of radiographs, photographs, or sectioned die castings.

10.2 Imperfections inherent in die castings shall not be cause for rejection provided it is demonstrated that the die castings are in accordance with the requirements and standards agreed upon.

10.3 *Workmanship*—Die castings shall be of uniform quality, free of injurious discontinuities that will adversely affect their serviceability.

10.4 *Finish*—When specified in the contract or purchase order the as-cast surface finish required shall conform to standards agreed upon between the purchaser and the producer, supplier, or as prescribed in NADCA Product Specification Standards for Die Castings.

10.5 *Pressure Tightness*—When specified in the contract or purchase order the pressure tightness of die castings shall conform to standards agreed upon between the purchaser and the producer or supplier, or as prescribed in NADCA Product Specification Standards for Die Castings.

11. Source Inspection

11.1 Source inspection provisions shall be in accordance with Specification B949, Section 7.

12. Rejection and Retest

12.1 When one or more samples, depending on the approved sampling plan fail to meet the requirements of this specification, the represented lot is subject to rejection except as otherwise provided in 12.2.

12.2 Lots rejected for failure to meet the requirements of this specification may be resubmitted for test provided:

12.2.1 The producer has removed the nonconforming material or the producer has reworked the rejected lot as necessary to correct the deficiencies.

12.3 Individual castings that show injurious imperfections during subsequent manufacturing operations may be rejected. The producer or supplier shall be responsible only for replacement of the rejected castings to the purchaser. As much of the rejected original material as possible shall be returned to the producer or supplier.

13. Certification

13.1 When specified in the purchase order or contract, certification of the product shall be in accordance with Specification B949, Section 9.

14. Identification Marking

14.1 When specified in the contract or purchase order, or in the detail drawing, all castings shall be properly marked for identification with the part number and name or brand of the producer as specified.

15. Preparation for Delivery

15.1 *Packaging*—Unless otherwise specified, the die castings shall be packaged to provide adequate protection during normal handling and transportation. Each Package shall contain only one type of item unless otherwise agreed upon. The type of packaging and gross weight of containers shall, unless otherwise agreed upon, be at the producer's discretion, provided they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

15.2 *Marking*—Each shipping container shall be legibly marked with the purchase order number, gross and net weights, and the supplier's name or trademark. Marking for shipment shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for Military agencies.

15.3 *Preservation*—Material intended for prolonged storage in unheated locations shall be adequately packed and protected to avoid deterioration and damage. When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of MIL-P-116. The applicable levels shall be specified in the contract or order.

16. Keywords

16.1 ACuZinc; ACuZinc5; castings; die castings; pressure die castings; zinc; zinc alloy die castings; zinc metal; zinc-copper-aluminum alloys

APPENDIXES

(Nonmandatory Information)

X1. Thermal-Physical Properties of ACuZinc5 Zinc-Copper-Aluminum Die Castings

X1.1 Table X1.1

TABLE X1.1 Thermal-Physical Properties of ACuZinc5 Zinc-Copper-Aluminum Die Castings

Thermo-Physical Properties	20°C	50°C	100°C
Electrical Resistivity (nΩ•m)	64	70.1	80.3
Electrical Conductivity (%IACS)	26.9	24.6	21.5
Thermal Conductivity (W/m•k)	106	108	110.5
Specific Heat (J/g/K)	0.34	0.36	0.40
Thermal Diffusivity (cm^2/s)	0.41	0.40	0.40
Coefficient of Thermal Expansion (u m/mK)	24.1	26.4	27.3
Density (g/cm^3)	6.85	ND	ND

X2. Mechanical Properties of ACuZinc5 Zinc-Copper-Aluminum Die Castings

X2.1 Table X2.1

TABLE X2.1 Mechanical Properties of ACuZinc5 Zinc-Copper-Aluminum Die Castings

	Weibull Analysis Values	
Mechanical Properties	B_{50}	B_1
Tensile Strength, MPa	355	310
Yield Strength, MPa	284	240
Elongation, %	9.4	4.6
Young's Modulus	100×10^3 MPa	
Brinell Hardness Number (500 kg, 10 mm ball)	105–115	
Poisson's Ratio	0.29	
Creep Rate, $s^{-1} \times 10^{-6}$ 25.5 MPa, 150°C	0.5	