



Designation: B1013 – 22

# Standard Specification for High Fluidity (HF) Zinc-Aluminum Alloy Thin Wall Die Castings<sup>1</sup>

This standard is issued under the fixed designation B1013; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers commercial zinc, zinc-aluminum castings and continuous cast bar stock, as designated and specified in [Table 1](#).

1.2 Systems of nomenclature used to designate zinc and zinc-aluminum (ZA) alloys used for casting are described in [Appendix X1](#).

1.3 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.4 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

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

2.2 *ASTM Standards*:<sup>2</sup>

<sup>1</sup> 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 April 1, 2022. Published April 2022. Originally approved in 2020. Last previous edition approved in 2020 as B1013 – 20. DOI: 10.1520/B1013-22.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[B557 Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products](#)

[B899 Terminology Relating to Non-ferrous Metals and Alloys](#)

[B949 Specification for General Requirements for Zinc and Zinc Alloy Products](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E23 Test Methods for Notched Bar Impact Testing 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 *NADCA Standards*:<sup>3</sup>

[NADCA Product Specification Standards for Die Castings](#)

2.4 *ISO Standards*:<sup>4</sup>

[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*:<sup>5</sup>

[Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)](#)

[MIL-STD-129 Military Marking for Shipment and Storage](#)

[MIL-STD-2073-1D Marking for Shipment and Storage \(Military Agencies\)](#)

## 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

<sup>3</sup> Available from North American Die Casting Association, 2000 5th Ave., River Grove, IL 60171, <http://www.diecasting.org>.

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

<sup>5</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

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

**TABLE 1 Chemical Requirements**

Common Name	HF Alloy <sup>A, B, C</sup>
UNS	Z33512
Element	Composition % <sup>A, B, C</sup>
Aluminum	4.3–4.7
Magnesium	0.005–0.012
Copper, max	0.035
Iron, max	0.03
Lead, max	0.003
Cadmium, max	0.002
Tin, max	0.001
Zinc <sup>D</sup>	Remainder

<sup>A</sup> For purposes of acceptance and rejection, the observed value or calculated value obtained from analysis should be rounded to the nearest unit in the last right-hand place of figures, used in expressing the specified limit, in accordance with the rounding procedure prescribed in Practice E29.

<sup>B</sup> Zinc alloy castings may contain nickel, chromium, silicon, and manganese in amounts of 0.02, 0.02, 0.035, and 0.06 %, respectively. No deleterious effects on alloy performance have ever been noted due to the presence of these elements in these concentrations and, therefore, analyses are not required for these elements.

<sup>C</sup> The UNS designations were established in accordance with Practice E527. The last digit of a UNS number differentiates between alloys of similar composition. The UNS designations for ingot and casting versions of an alloy were not assigned in the same sequence for all alloys.

<sup>D</sup> Determined arithmetically by difference.

die and solidified, also a product produced by such a process; alternately known as pressure die casting.

3.2.2 *high fluidity alloy, n*—a zinc alloy by nature of its composition is capable of producing die castings with thinner wall sections compared to typical die cast alloys; often less than 0.012 in. (0.30 mm) in thickness.

3.2.3 *thin wall die casting, n*—a die casting with wall sections that can be less than 0.012 in. (0.30 mm) in thickness.

## 4. Ordering Information

4.1 See Specification B949.

## 5. Chemical Requirements

5.1 The ingots shall conform to the requirements as to chemical composition as prescribed in Table 1. Conformance shall be determined in accordance with Specification B949.

## 6. Sampling for Determination of Chemical Composition (see Specification B949)

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

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

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

6.2.1 A sample shall be taken from each of two representative castings selected from each lot defined in 16.2.

6.3 *Methods of Sampling*—See Specification B949.

## 7. Methods for Chemical Analysis

7.1 The determination of chemical composition shall be made in accordance with Specification B949.

7.2 In case of dispute, the results secured by an approved method (or combination of approved methods), or by a method agreed upon by both parties, shall be the basis of acceptance.

7.2.1 Approved methods include: Test Methods E536, ISO 3815–1, or ISO 3815–2.

7.2.1.1 Test Methods E536 is generally applicable but must be slightly modified to cover the higher Al range. ISO 3815–1 and 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 or traceable reference materials, or both, along with valid quality assurance techniques, will be able to perform and validate the methods and demonstrate acceptable precision and accuracy.

7.3 For purposes of determining compliance with specified composition limits as given in Table 1, an observed or calculated value shall be rounded to the nearest unit in the last right-hand place of figures shown in Table 1, in accordance with the rounding method of Practice E29.

## 8. Physical Properties, Mechanical Properties, and Tests

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

8.1.1 Appendix X2 shows typical mechanical properties, determined on separately cast test bars produced under carefully controlled conditions.

8.1.2 While these typical mechanical properties of separately cast test bars are useful for comparing the relative properties of various casting alloys, they should not be used to establish design limits or acceptance criteria.

8.1.3 If tension or impact tests are made on separately cast test bars, test specimens conforming to the dimensions shown in Test Methods B557 (the figure entitled, Standard Tension Test Specimen for Die Castings), Test Methods E8/E8M (the figure entitled Standard Test Specimen for Cast Iron), and of Test Methods E23 (the figure entitled, Charpy (Simple-Beam) Impact Test Specimens, Types A, B, and C) shall be used, and process operating variables shall be optimized for the specific mold or die being used.

8.1.4 When specified in the contract or purchase order, castings shall withstand proof tests without failure as defined by agreement between the purchaser and the producer or supplier.

8.2 Appendix X3 shows typical physical properties of zinc and zinc-aluminum (ZA) casting alloys and does not constitute a part of this specification but is provided for informational purposes only.

## 9. Dimensions, Mass, and Permissible Variations

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 For die castings, 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. Source Inspection

10.1 See appropriate sections of Specification B949.

## 11. Rejection and Rehearing

11.1 See appropriate sections of Specification B949.

## 12. Certification

12.1 See appropriate sections of Specification B949.

## 13. Identification Marking

13.1 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.

## 14. Preparation for Delivery

14.1 *Packaging*—Unless otherwise specified, the 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.

14.2 *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.

14.3 *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 for MIL-STD-2073-1D. The applicable levels shall be as specified in the contract or order.

## 15. General Quality

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

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

15.3 *Workmanship*—Castings shall be of uniform quality and free of injurious discontinuities that will adversely affect their serviceability.

15.4 *Finish*—When specified in the contract or purchase order for die castings, the as-cast surface finish required 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.

15.5 *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 specified in NADCA Product Specification Standards for Die Castings.

## 16. Quality Assurance

16.1 *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.

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

16.3 The producer or supplier shall examine each casting of a randomly or statistically selected sample to determine conformance to the requirements with respect to general quality and specific requirements of the contract, purchase order, or part drawing. The results of this inspection shall be recorded.

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

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

## 17. Keywords

17.1 bar stock; castings; concast; continuous cast bar stock; die castings; high fluidity; high fluidity alloy; pressure die castings; thin wall die casting; zinc; zinc-aluminum alloys; zinc metal

**APPENDIXES**
**(Nonmandatory Information)**
**X1. NOMENCLATURE SYSTEMS FOR ZINC AND ZINC-ALUMINUM ALLOYS**

X1.1 The information in this appendix does not constitute a part of this specification but is provided for informational purposes only. The nomenclature covers a commercial zinc-aluminum alloy in ingot form for remelting for the manufacture of pressure die castings as designated and specified in **Table 1**.

X1.2 Several different systems of nomenclature have evolved over the years to designate the zinc alloys used for casting as listed in **Table X1.1**.

**TABLE X1.1 Nomenclature Systems for Zinc-Aluminum Alloys**

Common	UNS
HF alloy	Z33512

X1.2.1 Common names refer to the established and common reference to the zinc casting alloy.

X1.2.2 UNS numbers are established in Practice **E527** (SAE J1086) as part of a Unified Numbering System to provide unique designations for each metal grade and alloy in use worldwide. Zinc alloys start with the prefix “Z” followed by five numbers. The first digit is based on the major alloying element, the second digit provides a further sub-classification based on secondary and tertiary alloying elements, the third digit designates the nominal composition of the major alloying element, the fourth digit designates the nominal concentration of the second most important alloying element, and the fifth digit allows a unique number to be established to differentiate between similar compositions.

**X2. TYPICAL MECHANICAL PROPERTIES OF ZINC AND ZINC-ALUMINUM ALLOY TEST SPECIMENS**

X2.1 The data in **Table X2.1** does not constitute a part of this specification. However, it will indicate to the purchaser the mechanical properties that may be expected of test specifications made under best known conditions from remelted alloy ingot as provided in this specification.

X2.2 It is not considered good engineering practice to specify mechanical property values for tension or impact specimens cut from castings, and the values in **Table X2.1** do not represent the properties of specimens cut from castings. See **8.1.4** for proof tests.

**TABLE X2.1 Mechanical Properties of HF Alloy**

Ultimate Tensile Strength <sup>A</sup> ksi (MPa)	Yield Strength ksi (MPa)	Elongation % in	
		2 in. (51 mm) gauge length	Impact Energy <sup>B</sup> ft-lb (Joules)
as cast: 40 (276) aged: 34 (234)	as cast: 35 (241) aged: 29 (200)	as cast: 5.3 aged: 9.9	as cast: 28 (38) aged: 21 (28)
Hardness, Brinell <sup>C</sup> 250 kg, 5 mm ball		Young's Modulus <sup>D</sup> psi (GPa)	Poisson's Ratio
as cast: 93 aged: 71		13.3 × 10 <sup>6</sup> (91.7)	0.30

<sup>A</sup> Sample cross-section dimensions 0.040 × 0.500 in.; tensile strength increased to 54 ksi when sample cross-section was reduced to 0.020 × 0.300 in.

<sup>B</sup> Sample dimensions 0.25 × 0.25 × 3 in.

<sup>C</sup> Tested under 250 kg weight with 5 mm ball.

<sup>D</sup> Calculated using stress-strain curve.