



Standard Specification for Zinc and Zinc-Aluminum (ZA) Alloys in Ingot Form for Foundry and Die Castings¹

This standard is issued under the fixed designation B 240; 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.

ε¹ NOTE—Summary of Changes was corrected editorially in March 2009.

1. Scope*

1.1 This specification covers commercial zinc and zinc-aluminum (ZA) alloys in ingot form for remelting for the manufacture of pressure die castings, foundry castings and continuous cast bar stock as designated and specified in [Table 1](#). Seven alloy compositions are specified, designated as follows:

Common	Traditional	ASTM ^A	UNS ^A
Alloy 3	Zamak 3	AG 40A	Z33521
Alloy 7	Zamak 7	AG 40B	Z33522
Alloy 5	Zamak 5	AC 41A	Z35530
Alloy 2	Zamak 2	AC 43A	Z35540
ZA-8	ZA-8	...	Z35635
ZA-12	ZA-12	...	Z35630
ZA-27	ZA-27	...	Z35840

^A See [Table 1](#), footnote B.

1.2 Zinc alloys Z33521, Z33522, Z35530, and Z35540 are used primarily for remelting in the manufacture of pressure die castings. Zinc-aluminum alloys Z35635, Z35630, and Z35840 are used for remelting in the manufacture of both foundry and pressure die castings. Castings made from these ingots are specified in Specification [B 86](#), Standard Specification for Zinc and Zinc-Aluminum Alloys for Foundry and Die Castings.

1.3 The values stated in inch-pound units are to be regarded as standard.

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

1.5 *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 acceptance form a part of this specification to the extent referenced herein:

2.2 ASTM Standards:²

[B 86](#) Specification for Zinc and Zinc-Aluminum (ZA) Alloy Foundry and Die Castings

[B 275](#) Practice for Codification of Certain Nonferrous Metals and Alloys, Cast and Wrought

[B 897](#) Specification for the Configuration of Zinc and Zinc Alloy Jumbo and Block Ingot

[B 899](#) Terminology Relating to Non-ferrous Metals and Alloys

[B 908](#) Practice for the Use of Color Codes for Zinc Casting Alloy Ingot

[E 29](#) Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

[E 47](#) Test Methods for Chemical Analysis of Zinc Die-Casting Alloys³

[E 88](#) Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition

[E 527](#) Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

[E 536](#) Test Methods for Chemical Analysis of Zinc and Zinc Alloys

[E 634](#) Practice for Sampling of Zinc and Zinc Alloys for Optical Emission Spectrometric Analysis

2.3 Other ASTM Document:

¹ 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.

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² 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.

³ Withdrawn.

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

TABLE 1 Chemical and North American Color Code Requirements

	Alloy 3 ^{A,B,C,D}	Alloy 7 ^{A,B,C,D}	Alloy 5 ^{A,B,C,D}	Alloy 2 ^{A,B,C,D}	ZA-8 ^{B,C,E}	ZA-12 ^{B,C,E}	ZA-27 ^{B,C,E}
	Zamak 3 (AG40A)	Zamak 7 (AG40B)	Zamak 5 (AC41A)	Zamak 2 (AC43A)	ZA-8	ZA-12	ZA-27
	Z33521	Z33522	Z35530	Z35540	Z35635	Z35630	Z35840
Color Code ^F	None	Brown	Black	Green	Blue	Orange	Purple
Element							
Aluminum	3.9-4.3	3.9-4.3	3.9-4.3	3.9-4.3	8.2-8.8	10.8-11.5	25.5-28.0
Magnesium	0.03-0.06	0.010-0.020	0.03-0.06	0.025-0.05	0.02-0.03	0.02-0.03	0.012-0.020
Copper	0.10 max	0.10 max	0.7-1.1	2.7-3.3	0.9-1.3	0.5-1.2	2.0-2.5
Iron, Max	0.035	0.075	0.035	0.035	0.035	0.05	0.07
Lead, Max	0.0040	0.0030	0.0040	0.0040	0.005	0.005	0.005
Cadmium, Max	0.0030	0.0020	0.0030	0.0030	0.005	0.005	0.005
Tin, Max	0.0015	0.0010	0.0015	0.0015	0.002	0.002	0.002
Nickel	---	0.005-0.020	---	---	---	---	---
Zinc ^G	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder	Remainder

^A Zinc alloy ingot for die casting may contain nickel, chromium, silicon, and manganese in amounts of up to 0.02, 0.02, 0.035 and 0.05 %, respectively. No harmful effects have ever been noted due to the presence of these elements in up to these concentrations and, therefore, analyses are not required for these elements, except that nickel analysis is required for Z33522.

^B ASTM alloy designations were established in accordance with Practice B 275. UNS assignments were established in accordance with Practice E 527. The last digit of a UNS number differentiates between alloys of similar composition. UNS designations for ingot and casting versions of an alloy were not assigned in the same sequence for all alloys.

^C 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 E 29.

^D When this material is required to conform to ISO Standard 301, the chemical limits for thallium and indium each shall not exceed 0.001 %.

^E Zinc-aluminum ingot for foundry and pressure die casting may contain nickel, chromium, and manganese in amounts of up to 0.01 % each or 0.03 % total. No harmful effects have ever been noted due to the presence of these elements in up to these concentrations and, therefore, analyses are not required for these elements.

^F Refer to Practice B 908. (Note: Colors indicated are for North American applications.)

^G Determined arithmetically by difference.

Methods for Emission Spectrochemical Analysis⁴

2.4 ISO Standard⁵

ISO 301 Zinc Alloy Ingots Intended for Casting

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.

3. Terminology

3.1 Terms shall be defined in accordance with Terminology B 899.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *continuous casting, n*—a casting technique in which a cast is continuously withdrawn through the bottom of the mold as it solidifies, so that its length is not determined by mold dimensions; used chiefly to produce semifinished mill products such as billets, blooms, ingots, slabs and tubes; also known as concast.

3.2.2 *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 ingot under this specification shall include the following information:

4.1.1 Quantity in pounds,

4.1.2 Alloy (Table 1),

4.1.3 Size, if not manufacturer's standard (see Section 7),

4.1.4 Specification number and date,

4.1.5 Source inspection (Section 10),

4.1.6 Marking (Section 12), and

4.1.7 Whether certification is required (Section 13).

5. Materials and Manufacturer

5.1 The material covered by this specification shall be of uniform quality and reasonably free from dross, adhering foreign matter, and surface oxide.

6. Chemical Requirements

6.1 The ingots shall conform to the requirements as to chemical composition prescribed in Table 1. Conformance shall be determined by the manufacturer by analyzing samples taken at the time the ingots are poured or samples taken from the ingots. Unless otherwise agreed in the contract or purchase order, sampling procedure will be the manufacturer's choice.

7. Ingot Sizes and Shapes

7.1 Zinc casting alloy ingots are typically supplied in ingot bundles weighing 1700 to 2400 lb.

7.2 Ingots and bundles vary in size and weight depending on the alloy and supplier.

7.2.1 Standard ingots have a nominal weight in the range of 17 to 24 lb. and are generally 24 to 26 in. long.

7.2.2 Margash bars or ingots come in two sizes with a nominal weight in the range of either 12 to 14 lb. or 20 to 24 lb.

7.3 Zinc casting alloy ingot may be ordered in jumbos or blocks, as specified in Specification B 897.

7.4 Zinc casting alloy ingot may also be ordered in other shapes.

⁴ *Methods for Emission Spectrochemical Analysis: General Practices, Nomenclature, Standard Methods, Proposed Methods, Suggested Methods*, ASTM International, 1982.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

8. Sampling for Determination of Chemical Composition

8.1 In the event of a dispute, if the ingots are shipped in carload lots of the same alloy, not less than five ingots shall be taken at random from the carload for sampling. If the shipment is less than a carload lot, one sample ingot shall be taken for each 10,000 lb. (4500 kg) or fraction thereof. Either party may request that a sample be taken from each melt of 1000 lb. (450 kg) or more.

8.2 The samples for chemical analysis shall be taken by sawing, milling, or drilling in such a manner as to be representative of the average cross section of the ingot. The weight of a prepared sample shall be not less than 75 g in accordance with Practice E 88.

8.3 The saw drill, or cutter used for taking the sample shall be thoroughly cleaned. No lubricant shall be used in the operation, and the sawings or metal chips shall be carefully treated with a magnet to remove any particles or iron introduced in taking the sample by the method prescribed in 8.2.

8.4 An optional method of sampling for analysis may be by melting together representative portions of each ingot selected and then sampling the liquid composite by casting suitable specimens for either spectrographic or chemical analysis.

8.5 *Samples for Spectrochemical and Other Methods of Analysis*⁴—Samples for spectrochemical and other methods of analysis shall be suitable for the form of material being analyzed and the type of analytical method used (for example, see Practice E 634).

9. Methods for Chemical Analysis

9.1 The determination of chemical composition shall be made in accordance with suitable analytical methods. 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.

9.1.1 Approved method include: Test Methods E 536, Test Method E 47 (for tin), ISO 3815–1, or ISO 3815–2.

9.2 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 E 29.

10. Source Inspection

10.1 If the purchaser desires that his representative inspect or witness the inspections and testing of the product prior to shipment, such agreement shall be made by the purchaser and producer or supplier as part of the contract or purchase order.

10.2 When such inspection or witness of inspection and testing is agreed upon, the producer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the product meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

11. Rejection and Rehearing

11.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection should be reported to the producer or supplier promptly and in writing. In case of dissatisfaction with the results of the test, the producer or supplier may make claim for a rehearing. If the rehearing establishes that the material does not conform to the requirements of this specification, as much of the rejected original material as possible shall be returned to the producer or supplier.

12. Identification Marking

12.1 All ingots shall be properly marked for identification with the producer's name or brand.

12.2 Each bundle or skid shall be identified with the producer's heat, lot, or other identification mark.

12.3 Each ingot, bundle or skid shall be marked with the appropriate Color Code for the alloy as per North American requirements in Practice B 908.

13. Certification

13.1 When specified in the purchase order or contract, a producer's or supplier's certification shall be furnished to the purchaser that the material was manufactured, sampled tested and inspected in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test result shall be furnished.

14. Preparation for Delivery

14.1 *Packaging*—Unless otherwise specified, the ingot shall be packaged to provide adequate protection during normal handling and transportation. Each package shall contain only one alloy unless otherwise agreed upon.

15. Keywords

15.1 bar stock; castings; concast; continuous cast bar stock; die castings; foundry castings; permanent mold castings; pressure die castings; prototyping; sand castings; ZA alloys; Zamak; zinc; zinc-aluminum alloys; zinc metal

APPENDIX

(Nonmandatory Information)

X1. NOMENCLATURE SYSTEMS FOR ZINC AND ZINC-ALUMINUM (ZA) 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 commercial zinc and zinc-aluminum (ZA) alloys in ingot form for remelting for the manufacture of pressure die castings and foundry 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](#).

X1.2.1 Common names refer to the long established zinc casting alloys by number based their sequential development preceded by the word Alloy. Zinc-aluminum alloys (with a higher aluminum content than the conventional zinc die casting alloys) use the prefix ZA followed by their approximate aluminum content. These terms are in common usage.

X1.2.2 Traditional names for the long established zinc casting alloys use the prefix ZAMAK which was devised based

on the major elements present: zinc, aluminum, magnesium and copper (copper). Zinc-aluminum alloys use the prefix ZA followed by their approximate aluminum content. These terms are in common usage.

X1.2.3 ASTM designations are established in Practice [B 275](#) based on alloy chemistry. The first letter, A, refers to the principal alloying element, aluminum. The second letter, G (magnesium) or C (copper), refers to the second most significant alloying element. The first number, 4, refers to the nominal aluminum content. The second number refers to the nominal content to the second most significant alloying element. The last letter, A or B, differentiates between alloys of similar composition. Prior to the adoption of this designation system by ASTM, alloys were identified by Roman numerals, for example, XXI, XXIII and XV designated AC43A, AG40A and AC41A, respectively.

X1.2.4 UNS numbers are established in Practice [E 527](#) (SAE J1086) as part of a Unified Numbering System to provide a unique designation 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 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.

TABLE X1.1 Nomenclature Systems for Zinc and Zinc-Aluminum (ZA) Alloys

Common	Traditional	ASTM	UNS
Alloy 3	Zamak 3	AG 40A	Z33521
Alloy 7	Zamak 7	AG 40B	Z33522
Alloy 5	Zamak 5	AC 41A	Z35530
Alloy 2	Zamak 2	AC 43A	Z35635
ZA-8	ZA-8	...	Z35635
ZA-12	ZA-12	...	Z35630
ZA-27	ZA-27	...	Z35840

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B 240 - 06) that may impact the use of this standard. (Approved July 1, 2007.)

- (1) The Chemical Requirements for Alloys 3, 2, 5, ZA-8, ZA-12, and ZA-27 in [Table 1](#) have been revised to harmonize with ISO standards.
- (2) The addition of Section [7](#) on Ingot Sizes and Shapes and a

reference to Specification [B 897](#) to specify the size and configuration of jumbo and block ingots

- (3) Specification [B 897](#) was added to [2.2](#).

Committee B02 has identified the location of selected changes to this standard since the last issue (B 240 - 05) that may impact the use of this standard. (Approved August 1, 2006.)

- (1) Maximum lead content for Alloy 7 in [Table 1](#) was changed to 0.0030 %.

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