



Standard Specification for Zinc and Tin Alloy Wire Used in Thermal Spraying for Electronic Applications¹

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1. Scope

1.1 This specification covers zinc and tin alloy wire, including zinc-aluminum, zinc-aluminum-copper, zinc-tin, zinc-tin-copper and tin-zinc, used as thermal spray wire in the electronics industry.

1.1.1 Certain alloys specified in this standard are also used as solders for the purpose of joining together two or more metals at temperatures below their melting points, and for other purposes (as noted in **Annex A1**). Specification **B 907** covers Zinc, Tin and Cadmium Base Alloys Used as Solders which are used primarily for the purpose of joining together two or more metals at temperatures below their melting points and for other purposes (as noted in the Annex part of Specification **B 907**). Specification **B 833** covers Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) used primarily for the corrosion protection of steel (as noted in the Annex part of Specification **B 833**).

1.1.2 Tin base alloys are included in this specification because their use in the electronics industry is similar to the use of certain zinc alloys but different than the major use of the tin and lead solder compositions specified in Specification **B 32**.

1.1.3 These wire alloys have a nominal liquidus temperature not exceeding 850°F (455°C).

1.2 The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are for information only.

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 *ASTM Standards:*²

B 32 Specification for Solder Metal

B 833 Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing)

B 899 Terminology Relating to Non-ferrous Metals and Alloys

B 907 Specification for Zinc, Tin and Cadmium Base Alloys Used as Solders

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 46 Test Methods for Chemical Analysis of Lead and Tin-Base Solder³

E 47 Test Methods for Chemical Analysis of Zinc Die-Casting Alloys³

E 51 Method for Spectrographic Analysis of Tin Alloys by the Powder Technique³

E 87 Methods for Chemical Analysis of Lead, Tin, Antimony, and Their Alloys (Photometry Method)³

E 527 Practice for Numbering Metals and Alloys (UNS)

E 536 Test Methods for Chemical Analysis of Zinc and Zinc Alloys

2.2 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴

2.3 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage⁴

3. Terminology

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

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.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098.

TABLE 1 Zinc and Zinc Alloy Wire Compositions

Composition % ^{A,B,C}															Temperature	
F C F C	UNS ^D	Cd	Zn	Sn	Pb	Sb	Ag	Cu	Al	Bi	As	Fe	Ni	Mg	Solidus	Liquidus
Zn 98	Z30402	0.005	REM	0.003	0.005	0.10	0.015	0.005	1.5–2.5	0.02	0.002	0.02	0.005	0.02	720 382	770 410
Zn 96	XXXX ^E	0.005	REM	0.003	0.005	0.10	0.015	0.005	3.5–4.5	0.02	0.002	0.02	0.005	0.02	720 382	720 382
Zn 95	Z30502	0.005	REM	0.003	0.005	0.10	0.015	0.005	4.5–5.5	0.02	0.002	0.02	0.005	0.02	720 382	720 382
Zn 94	XXXX ^E	0.005	REM	0.003	0.005	0.10	0.015	1.3–1.5	3.5–4.5	0.02	0.002	0.02	0.005	0.02	730 388	734 390
Zn 87	Z30705	0.005	REM	0.003	0.005	0.10	0.015	0.005	12.5–13.5	0.02	0.002	0.05	0.005	0.02	720 382	815 435
Zn 85	Z30702	0.005	REM	0.003	0.005	0.10	0.015	0.005	14.0–16.0	0.02	0.002	0.06	0.005	0.02	720 382	842 450
Zn/Sn 50	Z56900	0.005	REM	49.0–51.0	0.05	0.10	0.015	0.005	0.100	0.02	0.002	0.02	0.005	0.02	388 198	680 360
Zn/Sn 49	Z56930	0.005	REM	47.5–50.5	0.05	0.10	0.015	0.8–1.3	0.100	0.02	0.002	0.02	0.005	0.05	392 200	592 311
Sn/Zn 60	XXXX ^E	0.005	REM	59.0–61.0	0.005	0.10	0.015	0.01	0.100	0.005	0.002	0.02	0.005	0.05	390 199	666 352
Sn/Zn 70	XXXX ^E	0.005	REM	69.0–71.0	0.005	0.10	0.015	0.01	0.100	0.005	0.002	0.02	0.005	0.05	390 199	601 316
Sn/Zn 75	XXXX ^E	0.004	REM	74.0–76.0	0.20	0.10	0.015	0.05	0.050	0.020	0.020	0.02	0.005	0.05	390 199	572 300
Sn/Zn 80	XXXX ^E	0.005	REM	79.0–81.0	0.05	0.10	0.015	0.01	0.100	0.005	0.002	0.02	0.005	0.05	390 199	536 280

^A 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.

^B All values not given as a range are maximum values unless stated otherwise.

^C Remainder (REM) determined arithmetically by difference.

^D The UNS designations were established in accordance with Practice E 527. The last digit of a UNS number differentiates between alloys of similar composition.

^E UNS numbers to be added when assigned.

4. Classification

4.1 *Type Designation*—The type designation uses the following symbols to properly identify the material:

4.1.1 *Alloy Composition*—The composition is identified by a two or four-letter symbol and a number. The letters typically indicate the chemical symbol for the critical element(s) in the wire and the number indicates the nominal percentage, by weight, of the primary element in the wire (see Table 1).

5. Ordering Information

5.1 Orders for material under this specification indicate the following information, as required, to adequately describe the desired material.

5.1.1 Type designation (see 4.1),

5.1.2 Detailed requirements for special forms,

5.1.3 Dimensions of wire (see 9.2),

5.1.4 Unit weight,

5.1.5 Packaging (see Section 17),

5.1.6 Marking (see Section 16),

5.1.7 ASTM Specification number and issue, marked on (a) purchase order and (b) package or spool, and

5.1.8 Special requirements, as agreed upon between supplier and purchaser.

6. Materials and Manufacture

6.1 The producer shall have each lot of wire as uniform in quality as practicable and of satisfactory appearance in accordance with best industrial practices.

7. Chemical Composition

7.1 The wire shall conform to the requirements prescribed in Table 1.

7.2 The manufacturer shall perform chemical analyses as directed in Test Methods E 536 or by other methods of at least equal accuracy to confirm that the wire conforms to the requirements of composition. In case of dispute, analysis by Test Methods E 536 shall be accepted. Analysis of alloy wires not covered by Test Methods E 536 shall be agreed upon between the manufacturer and the purchaser.

NOTE 1—By mutual agreement between supplier and purchaser, analysis may be required and limits established for elements or compounds not specified in Table 1.

8. Dimensions and Unit Weight

8.1 The dimensions and unit weight of wire are specified in 5.1.3 and 5.1.4. The tolerance on specified outside diameter shall be $\pm 5\%$ or ± 0.002 in. (0.05 mm), whichever is greater.

9. Workmanship, Finish and Appearance

9.1 The wire shall be clean and free of corrosion, adhering foreign material, scale, seams, nicks, burrs, and other defects which would interfere with the operation of thermal spraying equipment. The wire shall uncoil readily and be free of bends or kinks that would prevent its passage through the thermal spray gun.

9.2 The wire shall be a continuous length per spool, coil, or drum. Splices or welds are permitted, provided that they do not interfere with the thermal spray equipment or coating process.

9.3 The starting end of each coil shall be tagged to indicate winding direction and to be readily identifiable with ASTM designation.

10. Sampling

10.1 Sampling methodology should ensure that the sample selected for testing is representative of the material. The method for sampling consists of one of the following methods:

10.1.1 Analysis may be performed on finished wire, on material selected when the wire is cast, or on samples taken from semi-finished wire.

10.1.1.1 If the analysis is performed on finished wire, the frequency of sampling for determination of chemical composition shall be in accordance with Table 2. For spools and coils,

TABLE 2 Frequency of Sampling

Size of Lot, lb (kg)	Number of Samples (spools, coils, containers or pieces)
Up to 1000 (450), incl	3
Over 1000 to 10 000 (450 to 4500), incl	5
Over 10 000 (4500)	10

the sample is obtained by cutting back 6 ft (1.8 m) of wire from the free end and then taking the next 6 ft for test. In other forms, an equivalent sample is selected at random from the container.

10.1.1.2 If the analysis is performed on material selected while the wire is being cast, at least one sample shall be selected for each source of molten metal.

10.1.1.3 If the analysis is performed on samples taken from semi-finished product, at least one sample shall be analyzed for each 4500 kg (10 000 lb) or fraction thereof.

10.2 The manufacturer shall determine the diameter of the wire at the end and the beginning of each continuous wire in a production pack, coil, or spool of wire. Each determination shall be the result of at least three measurements.

10.3 The buyer reserves the right to reject wire that, during use, is found to be defective.

11. Specimen Preparation

11.1 Each sample of wire is prepared in accordance with Section 10 as applicable.

12. Test Methods

12.1 *Visual and Dimensional Examination:*

12.1.1 The wire must be examined to verify that the dimensions, unit weight, and workmanship are in accordance with the applicable requirements.

12.2 *Alloy Composition*—In case of dispute, the chemical analysis is made in accordance with Test Methods E 46, E 47 (for tin only) Method E 51, E 87, and E 536.

13. Inspection

13.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been tested or inspected as directed in this specification and the requirements have been met. When specified in the purchase order to contract, a report of the test results shall be furnished.

13.2 An inspection lot shall be defined as a collection of material of the same kind that has been produced to the same specification from the same heat by a single supplier at one time under essentially identical conditions and that are submitted for acceptance or retest as a group.

14. Rejection and Rehearing

14.1 Material that fails to conform to the requirements of this specification may be rejected. Rejection must 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.

15. Certification

15.1 When specified in the purchase order or contract a producer's certification must 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 results must be furnished.

16. Product Marking

16.1 Each spool or container must be marked to show the specification number, type designation, dimensions, and unit weight of wire or other form and lot number. The producer's name or trademark must be marked on the spool or container.

17. Packaging and Package Marking

17.1 The material shall be separated by size and prepared for shipment in such a manner as to ensure acceptance by common carrier and to afford protection from the normal hazards of transport.

17.2 Packaging materials for electric arc spray wire shall be nonconductive.

17.3 *Size(s) of Packaging:*

17.3.1 Coil inside diameter may range from 30 to 56 cm (12 to 22 in.).

17.3.2 Coil weight shall be approximately 20 to 25 kg (45 to 55 lb).

17.3.3 Production pack drums shall measure approximately 56 cm (22 in.) in diameter and approximately 81 cm (32 in.) high. Each drum shall contain a continuous wire, which is coiled around a central core.

17.3.4 Net weight per drum shall be 205 to 250 kg (450 to 550 lb).

17.3.5 When special preservation, packaging and packing requirements are agreed upon between purchaser and supplier, marking for shipment of such material must be in accordance with **Fed. Std. No. 123** for civil agencies and **MIL-STD-129** for military agencies.

17.4 Each shipping unit shall be legibly marked with the purchase order number, size, gross, tare, net weights, and the name of the supplier. The specification number shall be shown when required.

18. Keywords

18.1 electronic applications; thermal spray; tin-zinc alloys; wire; zinc-aluminum alloys; zinc-aluminum-copper alloy; zinc-tin-copper alloy; zinc-tin alloy

**SUPPLEMENTARY REQUIREMENTS**

The following supplementary requirements apply for all agencies of the United States Government or only when specified by the purchaser as part of the purchase order or contract.

S1. Responsibility for Inspection

S1.1 The producer or supplier shall be responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein

unless disapproved by the purchaser. The purchaser retains the right to perform any of the inspections and tests set forth in this specification, where such inspections and tests are deemed necessary, to ensure that the supplies and services conform to the prescribed requirements.

ANNEX**(Mandatory Information)****A1. INTENDED USE****A1.1 Alloy Compositions:**

A1.1.1 *Zn 98*—This is a high temperature, high strength solder for joining aluminum to aluminum and offers high corrosion resistance.

A1.1.2 *Zn 96*—This zinc-aluminum solder is similar to Zn 97 but with a slightly shorter temperature range.

A1.1.3 *Zn 95*—This zinc-aluminum eutectic solder is used where temperature limitations are critical and in applications where an extremely short melting range is required.

A1.1.4 *Zn 94*—This zinc-aluminum-copper solder has a lower melting temperature than Zn 90.

A1.1.5 *Zn 87*—This alloy is similar to Zn 85 but with a lower liquidus temperature.

A1.1.6 *Zn 85*—This alloy is also used as a thermal spray wire for the corrosion protection of steel. It has the highest temperature (830°F) of all the aluminum solder compositions.

A1.1.7 *Zn/Sn 50*—This medium strength zinc-tin alloy is used when a long melting range is required.

A1.1.8 *Zn/Sn 49*—This zinc-tin-copper alloy was developed primarily for the repair of galvanized steel sheet. Its wide

melting range makes it an ideal alloy for coating large areas where galvanizing has been removed. It is also used as a medium temperature, high strength aluminum solder.

A1.1.9 *Zn/Sn 60*—This alloy is used as a thermal spray wire by the electronics industry in the production of capacitors. It is used in higher temperature applications to solder aluminum to aluminum and aluminum to copper. It has good strength and good corrosion resistance.

A1.1.10 *Zn/Sn 70*—This alloy is used as a thermal spray wire by the electronics industry in the production of capacitors. It is also a general-purpose aluminum solder similar to SnZn40 but with a lower melting point.

A1.1.11 *Zn/Sn 75*—This is an intermediate strength alloy that is similar to SnZn40 and SnZn30, but with a lower melting point.

A1.1.12 *Zn/Sn 80*—This alloy is used as a thermal spray wire by the electronics industry in the production of capacitors. It is also a medium strength aluminum solder with a lower melting point. It exhibits fair corrosion resistance when exposed to the elements.

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