Designation: B943 – 16

Standard Specification for Zinc and Tin Alloy Wire Used in Thermal Spraying for Electronic Applications[1]

This standard is issued under the fixed designation B943; 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 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 B907 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 B907). Specification B833 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 B833).

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 B32.

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 standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered 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 Safety Data Sheet (SDS) 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]

B32 Specification for Solder Metal

B833 Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) for the Corrosion Protection of Steel

B899 Terminology Relating to Non-ferrous Metals and Alloys

B907 Specification for Zinc, Tin and Cadmium Base Alloys Used as Solders

B949 Specification for General Requirements for Zinc and Zinc Alloy Products

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

E46 Test Methods for Chemical Analysis of Lead- and Tin-Base Solder (Withdrawn 1994)[3]

E51 Method for Spectrographic Analysis of Tin Alloys by the Powder Technique (Withdrawn 1983)[3]

E87 Methods for Chemical Analysis of Lead, Tin, Antimony and Their Alloys (Photometric Method) (Withdrawn 1983)[3]

B527 Test Method for Tap Density of Metal Powders and Compounds

E536 Test Methods for Chemical Analysis of Zinc and Zinc Alloys

2.2 *Federal Standard:*[4]

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

2.3 *ISO Standards:*[5]

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

[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] The last approved version of this historical standard is referenced on www.astm.org.

[4] Available from DLA Document Services, Building 4/D, 700 Robbins Ave., Philadelphia, PA 19111-5094, http://quicksearch.dla.mil.

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

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

2.4 *Military Standard:*[4]
MIL-STD-129 Marking for Shipment and Storage

3. Terminology

3.1 Terms shall be defined in accordance with Terminology B899.

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 See Specification B949.

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 E536 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 E536 shall be accepted. Analysis of alloy wires not covered by Test Methods E536 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 ±5 % or ±0.002 in. (0.05 mm), whichever is greater.

9. Workmanship, Finish, and Appearance

9.1 See Specification B949.

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, 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.

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	Z30506	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	Z34530	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	L13281	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	L13271	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	L13261	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	L13251	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 E29.
[B] All values not given as a range are maximum values unless stated otherwise.
[C] Remainder (REM) determined arithmetically by difference.
[D] The USN designations were established in accordance with Practice B527. The last digit of a UNS number differentiates between alloys of similar composition.

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

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 10 000 lb (4500 kg) 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 E46, E51, E87, E536, ISO 3815-1, or ISO 3815-2.

13. Inspection

13.1 See Specification B949.

14. Rejection and Rehearing

14.1 See Specification B949.

15. Certification

15.1 See Specification B949.

16. Product Marking

16.1 See Specification B949.

17. Packaging and Package Marking

17.1 The material shall be separated by size and prepared for shipment in such a matter 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 12 to 22 in. (30 to 56 cm).

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

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

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

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.

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B943–13) that may impact the use of this standard. (Approved May 1, 2016.)

(1) References to Specification B949 were added where appropriate.

(2) References to section numbers in Specification B949 were eliminated.