Designation: B907 – 16

Standard Specification for Zinc, Tin and Cadmium Base Alloys Used as Solders[1]

This standard is issued under the fixed designation B907; 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 solder metal alloys (commonly known as soft solders), including zinc-aluminum, zinc-aluminum-copper, zinc-tin, zinc-tin-copper, zinc-cadmium-tin, zinc-cadmium, tin-zinc, cadmium-zinc, cadmium-zinc-silver, and cadmium-silver, used as solders for the purpose of joining together two or more metals at temperatures below their melting points.

1.1.1 Certain alloys specified in this standard are also used as Thermal Spray Wire in the electronics industry and are covered for this purpose in Specification B943. Specification B833 covers Zinc and Zinc Alloy Wire for Thermal Spraying (Metallizing) used primarily for the corrosion protection of steel (as noted in Annex A1 of this specification).

1.1.2 Tin base alloys are included in this specification because their use in the electronics industry is different than the major use of the tin and lead solder compositions specified in Specification B32.

1.1.3 These solders include alloys having a nominal liquidus temperature not exceeding 850°F (455°C).

1.1.4 This specification includes solder in the form of solid bars, ingots, wire, powder and special forms, and in the form of solder paste.

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 *Toxicity*—**Warning**: Soluble and respirable forms of cadmium may be harmful to human health and the environment in certain forms and concentrations. Therefore, ingestion and inhalation of cadmium should be controlled under the appropriate regulations of the U.S. Occupational Safety and Health Administration (OSHA). Cadmium-containing alloys and coatings should not be used on articles that will contact food or beverages, or for dental and other equipment that is normally inserted in the mouth. Similarly, if articles using cadmium-containing alloys or coatings are welded, soldered, brazed, ground, flame-cut, or otherwise heated during fabrication, adequate ventilation must be provided to maintain occupational cadmium exposure below the OSHA Permissible Exposure Level (PEL).

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 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

B943 Specification for Zinc and Tin Alloy Wire Used in Thermal Spraying for Electronic Applications

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]

E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

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

E88 Practice for Sampling Nonferrous Metals and Alloys in

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

Current edition approved May 1, 2016. Published July 2016. Originally approved in 2000. Last previous edition approved in 2013 as B907 – 13. DOI: 10.1520/B0907-16.

[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.

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

TABLE 1 Solder Compositions

Table 1a: Zinc Base Alloys

	UNS[D]	Composition %[A,B,C] Cd	Zn	Sn	Pb	Sb	Ag	Cu	Al	Bi	As	Fe	Ni	Mg	Temperature Solidus F	Solidus C	Liquidus F	Liquidus C
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 97	Z30505	0.005	REM	0.003	0.005	0.10	0.015	0.005	2.5–3.5	0.02	0.002	0.02	0.005	0.02	720	382	743	395
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 90	Z34550	0.004	88.0–92.0	0.003	0.005	0.10	0.015	3.0–6.0	3.0–6.0	0.02	0.002	0.100	0.005	0.05	720	382	797	425
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 80	Z30800	0.005	REM	0.003	0.005	0.10	0.015	0.005	19.5–20.5	0.02	0.002	0.08	0.005	0.02	720	382	896	480
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
Zn/Sn 27[E]	Z13371	33.0	26.0–28.0	REM	0.05	0.10	0.015	0.05	0.050	0.02	0.020	0.02	0.005	0.05	351	177	500	260
Zn/Cd 90[E]	Z50940	REM	89.0–91.0	0.003	0.05	0.10	0.015	0.05	0.100	0.02	0.002	0.02	0.005	0.05	509	265	738	392
Zn/Cd 60[E]	Z50980	REM	59.0–61.0	0.003	0.05	0.10	0.015	0.05	0.100	0.02	0.002	0.02	0.005	0.05	509	265	648	342

Table 1b: Tin Base Alloys

	UNS	Composition %[A,B,C] Cd	Zn	Sn	Pb	Sb	Ag	Cu	Al	Bi	As	Fe	Ni	Mg	Temperature Solidus F	Solidus C	Liquidus F	Liquidus C
Sn/Zn 60	L13281	0.005	REM	59.0–61.0	0.05	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
Sn/Zn 91	L13241	0.005	REM	90.0–92.0	0.05	0.10	0.015	0.01	0.100	0.005	0.002	0.02	0.005	0.05	390	199	390	199

Table 1c: Cadmium Base Alloys

	UNS	Composition %[A,B,C] Cd	Zn	Sn	Pb	Sb	Ag	Cu	Al	Bi	As	Fe	Ni	Mg	Temperature Solidus F	Solidus C	Liquidus F	Liquidus C
Cd 60	L01181	REM	39.0–41.0	0.003	0.05	0.10	0.015	0.05	0.100	0.02	0.002	0.02	0.005	0.05	509	265	601	316
Cd 70	L01171	REM	29.0–31.0	0.003	0.05	0.10	0.015	0.05	0.100	0.02	0.002	0.02	0.005	0.05	509	265	572	300
Cd 78	L01255	REM	11.0–13.0	0.003	0.05	0.10	4.5–5.5	0.05	0.100	0.02	0.002	0.02	0.005	0.05	480	249	601	316
Cd 83	L01161	REM	16.0–18.0	0.003	0.05	0.10	0.015	0.05	0.100	0.02	0.002	0.02	0.005	0.05	509	265	509	265
Cd 95	L01331	REM	0.007	0.003	0.05	0.10	4.5–5.5	0.05	0.100	0.02	0.002	0.02	0.005	0.05	640	338	739	393

[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 E527. The last digit of a UNS number differentiates between alloys of similar composition.
[E] These alloys are listed with the zinc base alloys even though they contain significant amounts of cadmium because their use is similar to those of the other alloys in Table 1A.

Cast Form for Determination of Chemical Composition
E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)
E536 Test Methods for Chemical Analysis of Zinc and Zinc Alloys

2.2 *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

2.4 *Military Standard:*[4]
Mil-Std-129 Marking for Shipment and Storage

[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.

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 in the solder and the number indicates the nominal percentage, by weight, of the critical element in the solder (see Table 1).

4.1.2 *Form*—The form is indicated by a single letter in accordance with Table 2.

4.1.3 *Powder Mesh Size (applicable only to solder paste)*—The powder mesh size is identified by a single letter in accordance with Table 3.

TABLE 2 Form

Symbol	Form
B	Bar
I	Ingot
P	Powder
R	Ribbon
S	Special[A]
W	Wire

[A] Includes pellets, preforms, etc.

TABLE 3 Powder Mesh Size

Size Symbol	Powder Mesh Size
A	<325
B	<200
C	<100
D	<60

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 ribbon and wire solder (see 9.2),

5.1.4 Unit weight,

5.1.5 Packaging (see Section 18),

5.1.6 Marking (see Section 17),

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 *Solder Alloy*—The solder alloy composition is as specified in Table 1.

NOTE 1—By mutual agreement between supplier and purchaser, analysis may be required and limits established for elements or compounds not specified in Table 4.

8. Physical Properties and Performance Requirements

8.1 *Solder Paste*—Solder paste must exhibit smoothness of texture (no lumps) and the absence of caking and drying during storage and application. Some applications may require a fast drying formulation.

8.1.1 *Powder Mesh Size*—The solder powder mesh size shall be as specified (see Section 4.1.3) when the extracted solder powder is tested as agreed upon between supplier and purchaser.

8.1.2 *Viscosity*—The viscosity of solder paste and the method used to determine the viscosity must be agreed upon between the supplier and the purchaser.

8.2 The following variables must be taken into account when relating one viscosity measurement to another: type of viscometer used, spindle size and shape, speed (r/min), temperature and the recent mixing history of the sample, and the use or non-use of a helipath.

TABLE 4 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

9. Dimensions and Unit Weight

9.1 *Bar and Ingot Solder*—The dimensions and unit weight of bar and ingot solder will be as agreed upon between supplier and purchaser.

9.2 *Wire Solder*—The dimensions and unit weight of wire solder 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.

9.3 Other forms:

9.3.1 Dimension for ribbon and special forms will be agreed upon between supplier and purchaser.

9.3.2 The unit weight of solder paste is specified in 5.1.4.

10. Workmanship, Finish, and Appearance

10.1 See Specification B949.

11. Sampling

11.1 Care must be taken to ensure that the sample selected for testing is representative of the material. The method for sampling consists of one of the following methods:

11.1.1 Samples taken from the final solidified cast of fabricated product.

11.1.2 Representative samples obtained from the lot of molten metal during casting. The molten sample is poured into a cool mold, forming a bar approximately ¼ in. (6.4 mm) thick.

11.2 *Frequency of Sampling*—Frequency of sampling for determination of chemical composition shall be in accordance with Table 4. 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.

11.3 *Other aspects of Sampling*—Other aspects of sampling conforms in the case of bar and ingots, to Practice E88. For fabricated solders the appropriate reference is Practice E55.

12. Specimen Preparation

12.1 *Solid Ribbon and Wire Solder*—Each sample of solid ribbon and wire solder is prepared in accordance with 12.1 as applicable.

12.2 *Bar and Ingot Solder*—Each sample piece is cut in half and one half marked and held in reserve. The remaining half is melted in a clean container, mixed thoroughly and poured into a cool mold, forming a bar approximately ¼ in. (6.4 mm) thick. Sampling is performed by one of the following methods:

12.3 *Sawing*—Saw cuts are made across the bar at equal intervals of not more than 1 in. (2.5 cm) throughout its length. If it is impractical to melt the bar or ingot as specified above, saw cuts are made across each piece at equal intervals of not more than 1 in. (2.5 cm) throughout its length. No lubricants are used during sawing. The specimen consists of not less than 5 oz (143 g).

12.4 *Drilling*—The bar is drilled at least halfway through from the opposite sides. A drill of about ½ in. (12.7 mm) in diameter is preferred. In drilling, the holes are placed along a diagonal line from one corner of the ingot to the other. The drillings are clipped into pieces not over ½ in. (12.7 mm) in length and mixed thoroughly. The specimen consists of not less than 5 oz (143g).

13. Test Methods

13.1 Visual and Dimensional Examination

13.1.1 *Ribbon and Wire Solder*—Ribbon and wire solder must be examined to verify that the dimensions, unit weight, and workmanship are in accordance with the applicable requirements.

13.1.2 *Solder Paste*—Solder paste must be examined for smoothness of texture (no lumps), caking, drying, unit weight, and workmanship in accordance with the applicable requirements.

13.1.3 *Bar and Ingot Solder*—Bar and ingot solder must be examined to verify that the unit weight, marking, and workmanship are in accordance with the applicable requirements.

13.2 *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.

14. Inspection

14.1 See Specification B949.

15. Rejection and Rehearing

15.1 See Specification B949.

16. Certification

16.1 See Specification B949.

17. Product Marking

17.1 See Specification B949.

17.2 The Producer's name or trademark must be stamped or cast on each bar or ingot. The alloy grade designation or nominal composition, or both, must be stamped on each bar or ingot for identification along with the specification number.

17.3 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.

18. Packaging and Package Marking

18.1 The material must be packaged to provide adequate protection during normal handling and transportation. The type of packaging and gross weight of containers will, unless otherwise agreed upon, be at the producer's or supplier's discretion, provided that they are such as to ensure acceptance by common or other carriers for safe transportation to the delivery point.

18.1.1 For bar and ingot solder a lot number must be marked on each shipping container or inside package.

18.1.2 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.

18.2 Each shipping container must be marked with the purchase order number, unit weight, and producer's name or trademark.

19. Keywords

19.1 bar; ingot; zinc-aluminum alloys; zinc-aluminum-copper alloys; tin-zinc alloys; zinc-tin alloys; zinc-tin-copper alloys; zinc-cadmium alloys; tin-cadmium-zinc alloys; cadmium-zinc alloys; cadmium-zinc-silver alloys; cadmium-silver alloys; powder; ribbon; solder alloy; solder metal; solder uses; wire

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 97*—Similar to Zn 98 but with a slightly longer temperature range.

A1.1.3 *ZN 96*—This zinc-aluminum solder is similar to Zn 97 but with a slightly shorter temperature range.

A1.1.4 *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.

A1.1.5 *ZN 94*—This zinc-aluminum-copper solder has a lower melting temperature than Zn 90.

A1.1.6 *Zn 90*—This is high strength, high temperature, solder normally used for joining aluminum to aluminum and aluminum to dissimilar metals. Commonly used without flux in

accessible joints. The tensile strength of this alloy (39,000 PSI) surpasses that of many aluminum alloys.

A1.1.7 *Zn 87*—This alloy is similar to Zn 85 but with a lower liquidus temperature.

A1.1.8 *Zn 85*—This solder is the highest temperature (830°F) of all the aluminum solders. Care must be taken not to melt the base metal when using this alloy. It is also used as a thermal spray wire for the corrosion protection of steel.

A1.1.9 *Zn 80*—This alloy is used when a long temperature range is required to solder large areas.

A1.1.10 *Zn/Sn 50*—This medium strength zinc-tin alloy is used when a long melting range is required.

A1.1.11 *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.

A1.1.12 *Zn/Sn 27*—This alloy is used primarily for aluminum radiator repair. It is an intermediate strength solder and will join most solderable metals.

A1.1.13 *Zn/Cd 90*—This alloy, with a melting temperature of 760°F (404°C) is used in high temperature applications where high strength is required with application temperatures below that of brazing alloys.

A1.1.14 *Zn/Cd 60*—This alloy has very good wetting qualities, and is used when soldering aluminum alloys that are difficult to wet.

A1.1.15 *Sn/Zn 60*—This alloy is used in higher temperature applications to solder aluminum to aluminum and aluminum to copper. It has good strength and good corrosion resistance. This material is also used as a thermal spray wire by the electronics industry in the production of capacitors.

A1.1.16 *Sn/Zn 70*—This is a general-purpose aluminum solder similar to SnZn40 but with a lower melting point. It is also used by the electronics industry as a thermal spray wire in the production of capacitors.

A1.1.17 *Sn/Zn 75*—This is an intermediate strength alloy that is similar to SnZn40 and SnZn30, but with a lower melting point.

A1.1.18 *Sn/Zn 80*—This alloy is a medium strength aluminum solder with a lower melting point. Fair corrosion resistance when exposed to the elements. Used in the electronics industry as a thermal spray wire in the production of capacitors.

A1.1.19 *Sn/Zn 91*—This eutectic alloy has the lowest melting point of the zinc bearing aluminum soldering alloys. It flows easily and wets aluminum readily, with strength that approaches that of the intermediate solders. Corrosion resistance is only fair if exposed to the elements.

A1.1.20 *Cd 60*—This is a general purpose, medium temperature alloy that has shear strengths approaching 10,000 PSI.

A1.1.21 *Cd 70*—This alloy performs similarly to Cd60 but with a lower and shorter melting range.

A1.1.22 *Cd 78*—This is high temperature solder that is used where high strength and resistance to vibration is required. Its high electrical conductivity in relationship to other solders makes it a good choice for electrical applications. It is also used to join dissimilar metals because of it good elongation qualities.

A1.1.23 *Cd 83*—This cadmium-zinc eutectic alloy is used when high strength and short melting ranges are required. It is used extensively as a preform in furnace soldering.

A1.1.24 *Cd 95*—This is a general purpose cadmium-silver alloy that will join all solderable metals except aluminum. Above its liquidus it is extremely fluid and will penetrate the closest joints. With tensile strengths to 25,000 PSI, its performance in application is similar to higher temperature brazing alloy.

SUMMARY OF CHANGES

Committee B02 has identified the location of selected changes to this standard since the last issue (B907 – 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.