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Standard Specification for Low Melting Point Alloys and Solders[1]

This standard is issued under the fixed designation ~~B774;~~B774/B774M; 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~~ Scope*

1.1 This specification covers low-melting point metal alloys and solders, including bismuth-tin, bismuth-lead, bismuth-tin-lead, bismuth-tin-lead-cadmium, bismuth-tin-lead-indium-cadmium, bismuth-tin-lead-indium, indium-lead, and indium-lead-silver, and indium-tin joining together two or more metals at temperatures below their melting points; blocking for support and removable borders; radiation shielding; fusible plugs; fuses; tube bending; and punch setting.

1.1.1 This specification shall include those alloys having a liquidus temperature not exceeding ~~361°F (183°C),~~361 °F [183 °C], the melting point of the tin lead eutectic.

1.1.2 This specification includes low-melting point alloys in the form of solid bars, ingots, powder and special forms, and in the form of solid ribbon and wire.

1.2 The values stated in either inch-pound units or SI 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~~ separately as standard. Within the text, SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the 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 Material Safety Data Sheet (MSDS) for this product/material as provided by the manufacturer, to establish appropriate ~~safety~~ safety, health, and ~~health~~environmental practices, and determine the applicability of regulatory limitations prior to use.*

1.4 *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 *ASTM Standards:*[2]

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

E88 Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition

2.2 *Military Standard:*[3]

MIL-STD 129 Marking for Shipment and Storage

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[1] This specification is under the jurisdiction of ASTM Committee B02 on Nonferrous Metals and Alloys and is the direct responsibility of Subcommittee B02.02 on Refined Lead, Tin, Antimony, and Their Alloys.

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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] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.

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

2.3 *Federal Standard:*[3]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

3. Terminology

3.1 *Definitions:*

3.1.1 *producer, n*—the primary manufacturer of the material.

3.1.2 *supplier, n*—the seller of the material to the purchaser (may or may not be the producer).

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *liquidus, n*—the lowest temperature at which an alloy is fully transformed from a solid to a liquid.

3.2.2 *lot, n*—the term "lot" as used in this specification shall be defined as follows: *for solid alloy metal*, a lot shall consist of all the metal of the same time designation, produced from the same batch of raw materials under essentially the same conditions, and offered for inspection at one time.

3.2.3 *lot number, n*—the term "lot number" as used in this specification refers to a numerical designation for a lot that is traceable to a date of manufacture.

3.2.4 *solidus, n*—the highest temperature at which an alloy is fully transformed from a liquid to a solid.

4. Classification

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

4.1.1 *Alloy Composition*—The composition is identified by three numbers that relate to the melting point in degrees Fahrenheit where it is eutectic or six numbers where it is a range alloy.

4.1.2 *Form*—The form is indicated by a single letter in accordance with Table 1.

4.1.3 *Powder Mesh Size*—The powder mesh size is identified by a size symbol number (Table 2).

5. Ordering Information

5.1 Orders for material under this specification shall 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),

TABLE 1 Form

Symbol	Form
B	bar
I	ingot
P	powder
R	ribbon
~~S~~	~~special (includes pellets, preforms, shot, etc.~~
S	special (includes pellets, preforms, shot, etc.)
W	wire

TABLE 2 Powder Mesh Size

Size Symbol	Powder Mesh Size
3	325
2	200
1	100

5.1.6 Marking (see Section 17),

5.1.7 ASTM specification designation and year of issue, marked on the purchase order and on the 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 use care to have each lot of alloy as uniform in quality as practicable and of satisfactory appearance in accordance with the best industrial practices. Each bar, ingot, or other form in which the alloy is sold shall be uniform in composition within the entire lot.

7. Chemical Composition

7.1 The composition of the alloys covered by this specification shall be as shown in Table 3.

NOTE 1—By mutual agreement between the supplier and the purchaser, analysis may be required and limits established for elements or compounds not specified in Table 3.

8. Physical and Performance Requirements

8.1 Alloy must freeze within ~~2°F~~ 2 °F [1.1 °C] of its solidus.

8.2 *Powder Mesh Size*—The powder mesh size shall be as specified in 5.1.1 and 4.1.3.

9. Dimensions and Unit Weight

9.1 *Bar and Ingot*—The dimensions and unit weight of bar and ingot shall be agreed between the supplier and purchaser.

**TABLE 3 Chemical Requirements Composition, wt. %
(range or maximum rules)**

Alloy Designation	Constituents — wt %									Melting Points			
										Solidus		Liquidus	
	Bi	Pb	Sn	Cd	In	Ag	Cu	Sb	Zn	°F	°C	°F	°C
117	44.2–45.2	22.1–23.1	7.8–8.8	4.8–5.8	18.6–19.6	0.001	0.08	0.1	0.08	117	47	117	47
129–133	48.14–50.14	16.92–18.92	10.55–12.55							129	54	133	56
136	48.5–49.5	17.5–18.5	11.5–12.5	0.005	20.5–21.5	0.001	0.08	0.1	0.08	136	58	136	58
158	49.5–50.5	26.2–27.2	12.8–13.8	9.5–10.5	0.008	0.001	0.08	0.1	0.08	158	70	158	70
158–165	49.5–50.5	24.45–25.45	12.0–13.0	12.0–13.0		0.10				158	70	165	74
158–190	42.0–43.0	37.2–38.2	10.8–11.8	8.0–9.0	0.008	0.001	0.08	0.1	0.08	158	70	190	88
174	56.5–57.5	0.05	16.5–17.5	0.005	25.5–26.5	0.001	0.08	0.1	0.08	174	79	174	79
203	52.0–53.0	31.5–32.5	15.0–16.0	0.005	0.008	0.001	0.08	0.1	0.08	203	95	203	95
203–239	49.5–50.5	24.5–25.5	24.5–25.5							203	95	239	115
216–217	53.5–54.5		25.5–26.5	19.5–20.5						216	102	217	103
255	55.0–56.0	44.0–45.0	0.01	0.005	0.008	0.001	0.08	0.1	0.08	255	124	255	124
281	57.5–58.5	0.05	41.5–42.5	0.005	0.008	0.01	0.08	0.1	0.08	281	138	281	138
281–338	39.5–40.5	0.05	59.5–60.5	0.005	0.008	0.01	0.08	0.1	0.08	281	138	338	170
291–325	13.5–14.5	42.5–43.5	42.5–43.5	0.005	0.008	0.01	0..08	0.1	0.08	291	144	325	163
244	0.01	0.05	47.5–48.5	0.005	51.5–52.5	0.01	0.08	0.1	0.08	244	118	244	118
296	0.01	0.05	0.01	0.005	96.5–97.5	2.8–3.2	0.08	0.1	0.08	296	147	296	147
293	0.01	29.9–31.1	50.7–51.7	17.7–18.7	0.008	0.01	0.08	0.1	0.08	293	145	293	145
300–302	0.01	14.5–15.5	0.01	0.005	79.5–80.5	4.5–5.5	0.08	0.1	0.08	300	149	302	150
307–323	0.01	17.5–18.5	69.5–70.5	0.005	11.5–12.5	0.01	0.08	0.1	0.08	307	153	323	162
320–345	0.01	29.5–30.5	0.01	0.005	69.5–70.5	0.01	0.08	0.1	0.08	320	160	345	174

9.2 *Wire (Solid)*—The dimensions and unit weight of wire alloys shall be as specified in 5.1.3 and 5.1.4. The tolerance on the specified outside diameter shall be ±5 % or ±0.002 in. ~~(0.05 mm),~~[0.05 mm], whichever is greater.

9.3 *Other Forms:*

9.3.1 Dimensions for ribbon and special forms shall be as agreed between the supplier and purchaser.

9.3.2 The unit weight of alloy powder shall be as specified in 5.1.4.

10. Workmanship, Finish, and Appearance

10.1 All forms of the alloys shall be processed in such a manner as to be uniform in quality and free of defects that will affect life, serviceability, or appearance.

11. Sampling for Chemical Analysis

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

11.1.1 Samples may be taken from the final solidified cast or fabricated product.

11.1.2 Representative samples may be obtained from the lot of molten metal during casting. The molten sample shall be poured into a cool mold, forming a bar approximately 0.25 in. ~~(6.4 mm)~~[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 shall be obtained by cutting back 6 ft ~~(1.8 m)~~[1.8 m] of wire from the free end and then taking the next 6 ft for test. In other forms, an equivalent sample shall be selected at random from the container.

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

12. Sample Preparation

12.1 *Bar and Ingot*—Each sample piece shall be cut in half, and one half marked with sampling date and composition, and shall be held in reserve. The remaining half shall be melted in a clean container, mixed thoroughly and poured into a cool mold, forming a bar approximately 0.25 in. ~~(6.4 mm)~~[6.4 mm] thick. Sampling may be performed by one of the following methods:

12.1.1 *Sawing*—If it is impractical to melt the bar or ingot as specified in 12.1, saw cuts shall be made across each piece at equal intervals of not more than 1 in. ~~(25 mm)~~[25 mm] throughout its length. No lubricants shall be used during sawing. The sample shall consist of not less than 5 oz ~~(143 g)~~[143 g] of mixed sawings.

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~~

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