Designation: ~~F106 – 12~~ F106 – 12 (Reapproved 2017)

Standard Specification for Brazing Filler Metals for Electron Devices[1]

This standard is issued under the fixed designation F106; 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 requirements or filler metals suitable for brazing internal parts and other critical areas of electron devices in a nonoxidizing atmosphere (Note 1).

1.2 These materials are available in strip or wire or preforms made by blanking the strip or bending the wire. Powders are also available.

NOTE 1—Brazing filler metals for general applications are specified in AWS Specification A 5.8.

1.3 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.

1.4 *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]
B214 Test Method for Sieve Analysis of Metal Powders
E11 Specification for Woven Wire Test Sieve Cloth and Test Sieves
F19 Test Method for Tension and Vacuum Testing Metallized Ceramic Seals
2.2 *American Welding Society:*[3]
A 5.8 Specification for Brazing Filler Metals
C 3.2 Method for Evaluating the Strength of Brazed Joints
C 3.3 Recommended Practices for Design, Manufacture and Inspection of Critical Brazed Components

3. Classification

3.1 Brazing filler metals which are vacuum grade and are classified on the basis of chemical composition shown in Table 1. The difference between Grade 1 and 2 is the allowable impurity content. Grade 1 requires generally lower levels of impurities.

4. Ordering Information

4.1 Orders for material to this specification shall include the following information:
4.1.1 Quantity,
4.1.2 Dimensions and tolerances (Table 2),
4.1.3 Form (rod, bar, wire, etc.),
4.1.4 AWS classification (Table 1),
4.1.5 Grade 1,
4.1.6 Special requirements or exceptions, and
4.1.7 *Certification*— State if certification is required.

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[1] This specification is under the jurisdiction of ASTM Committee F01 on Electronics and is the direct responsibility of Subcommittee F01.03 on Metallic ~~Materials~~Materials, Wire Bonding, and Flip Chip.

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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 American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126.

TABLE 1 Chemical Composition Requirements (in Wt. %) for Vacuum Grade Filler Metals for Electron Devices[A,B,C]

NOTE 1—All finished material shall be reasonably smooth and bright and free from dirt, oil, grease, or other foreign material.

NOTE 2— A complete designation of specified material must include the grade designation number (for example, BVAg-6b, Grade 1).

NOTE 3—Single values shown are maximum percentages, except where otherwise specified.

AWS Classification	UNS Designation	Ag	Au	Cu	Ni	Co	Sn	Pd	In	Zn	Cd	Pb	P	C
Grade 1-Vacuum grade filler metals														
BVAg-0	P07017	99.95 min.	. . .	0.05	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-6b	P07507	49.0–51.0	. . .	Remainder	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-8	P07727	71.0–73.0	. . .	Remainder	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-8b	P07728	70.5–72.5	. . .	Remainder	0.3–0.7	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-18	P07607	59.0–61.0	. . .	Remainder	. . .	. . .	9.5–10.5	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-29	P07627	60.5–62.5	. . .	Remainder	. . .	. . .	. . .	. . .	14.0–15.0	0.001	0.001	0.002	0.002	0.005
BVAg-30	P07687	67.0–69.0	. . .	Remainder	. . .	. . .	. . .	4.5–5.5	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-31	P07587	57.0–59.0	. . .	31.0–33.0	. . .	. . .	. . .	Remainder	. . .	0.001	0.001	0.002	0.002	0.005
BVAg-32	P07547	53.0–55.0	. . .	20.0–22.0	. . .	. . .	. . .	Remainder	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-2	P00807	. . .	79.5–80.5	Remainder	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-3	P00351	. . .	34.5-35.5	Remainder	2.5-3.5	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-4	P00827	. . .	81.5–82.5	. . .	Remainder	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-7	P00507	. . .	49.5–50.5	. . .	24.5–25.5	0.06	. . .	Remainder	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-8	P00927	. . .	91.0–93.0	. . .	. . .	. . .	. . .	Remainder	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-9	P00354	. . .	34.5-35.5	Remainder	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVAu-10	P00503	. . .	49.5-50.5	Remainder	. . .	. . .	. . .	. . .	. . .	0.001	0.001	0.002	0.002	0.005
BVPd-1	P03657	. . .	. . .	. . .	0.06	Remainder	. . .	64.0–66.0	. . .	0.001	0.001	0.002	0.002	0.005
Grade 2 - Vacuum grade filler metals														
BVCu-1x	C14181	. . .	. . .	99.99 min.	. . .	. . .	. . .	. . .	. . .	0.002	0.002	0.002	0.002	0.005

[A] All vacuum grade filler metals are considered to be spatter free (refer to Melting Test, Section 10).

[B] All other elements in addition to those listed in the table above, with a vapor pressure higher than 10^{-7} Torr at 932°F (500°C) (such as Mg, Sb, K, Na, Li, Tl, S, Cs, Rb, Sc, Hg, Tc, Sr, and Ca) are limited to 0.001 % max each for Grade 1 vacuum grade filler metals and 0.002 % max each for Grade 2 vacuum grade filler metals. The accumulative total of all these high vapor pressure elements including zinc, cadmium, and lead is limited to 0.010 % max. The total of other impurities not included in the preceding list is limited to 0.05 % max, except for BVCu-1x, which shall be 0.01 max.

[C] For the braze alloys shown, analysis shall regularly be made only for the major alloying elements specified and the elements Zn, Cd, Pb, P, C (by Melting Test), Hg, Mg, and Sb. However, the presence of the other elements (listed above in Footnote B), with a vapor pressure higher than 10^{-7} Torr at 932°F (500°C), outside the limits specified shall constitute cause for rejection of the material.

TABLE 2 Dimensional Tolerances (All Plus or Minus)

Width Tolerances, in. (mm)		
Thickness	8 in. (200 mm) wide and under	Over 8 in. (200 mm) wide
Less than 0.020 (0.5)	0.005 (0.125)	0.015 (0.38)
0.020 to 0.050 (0.5 to 1.25), incl	0.010 (0.250)	0.015 (0.38)

Thickness Tolerances—Strip		
Thickness, in. (mm)	8 in. (200 mm) wide and under	Over 8 in. (200 mm) wide
Up to 0.002 (0.05), incl	0.0002 (0.005)	0.0005 (0.0125)
Over 0.002 to 0.003 (0.05 to 0.075), incl	0.0003 (0.0075)	0.0006 (0.015)
Over 0.003 to 0.004 (0.075 to 0.10), incl	0.0004 (0.010)	0.0007 (0.018)
Over 0.004 to 0.006 (0.10 to 0.15), incl	0.0005 (0.0125)	0.0008 (0.02)
Over 0.006 to 0.013 (0.15 to 0.33), incl	0.0010 (0.025)	0.0013 (0.033)
Over 0.013 to 0.021 (0.33 to 0.53), incl	0.0015 (0.038)	0.0018 (0.046)
Over 0.021 to 0.026 (0.53 to 0.66), incl	0.0020 (0.05)	0.0020 (0.05)
Over 0.026 to 0.050 (0.66 to 0.125), incl	0.0020 (0.05)	0.0050 (0.125)

Camber Tolerances—Strip (Edgewise Bowl)
0.5 in. (12.5 mm) max in 6 ft (1.8 m)

Diameter Tolerances—Wire	
Diameter, in. (mm)	Tolerance, in. (mm)
0.010 to 0.020 (0.250 to 0.5)	0.0003 (0.0075)
Over 0.020 to 0.030 (0.5 to 0.75)	0.0005 (0.0125)
Over 0.030 to 0.040 (0.75 to 1.0)	0.0007 (0.018)
Over 0.040 to 0.050 (1.0 to 1.25)	0.0008 (0.02)
Over 0.050 to 0.060 (1.25 to 1.5)	0.0010 (0.025)
Over 0.060 to 0.080 (1.5 to 2.0)	0.0015 (0.038)
Over 0.080 to 0.250 (2.0 to 6.3)	0.0020 (0.05)

5. Materials and Manufacture

5.1 The brazing filler metals shall be vacuum grade and fabricated by any method that yields a product conforming to the requirements of this specification.

6. Chemical Composition

6.1 The finished brazing filler metal shall conform to the chemical composition shown in Table 1 for Grade 1 material.

7. Mechanical Properties

7.1 Unless otherwise specified, wire shall be furnished in soft temper most suitable for hand feeding or ring winding on mandrels. A minimum elongation of 10 % in 2 in. (50.8 mm) indicates that the wire is annealed.

7.2 Unless otherwise specified, strip shall be furnished in hard as-rolled temper to facilitate clean blanking of thin shims or preforms. A maximum elongation of 5 % in 2 in. (50.8 mm) designates the strip as hard.

8. Dimensions and Permissible Variations

8.1 These materials must conform to the dimensional limitations listed in Table 2 for strip, wire, and preforms or to Table 3 for the size distribution of powdered brazing filler metals.

9. Finish

9.1 The surface of strip, wire, or preforms shall be as smooth and free of dirt, oxide, pits, deep scratches, seams, slivers, stains, scale, blisters, edge cracks, trimming burrs, waves, wrinkles, and other defects as best commercial practice will permit.

10. Melting Test (for Cleanness and Spatter)

10.1 *Requirements*— Since cleanness and spattering are important considerations in the use of these materials, a special melting test is used to determine their suitability. For this test, the melting temperatures required are listed in Table X1.1. The material shall also comply with the requirements of 10.2.4.

10.2 *Procedure:*

10.2.1 The melting test is performed on an "as-received" sample. Cut approximately 1 g (with clean, dry tools) into a clean, dense polycrystalline 99.5 % alumina crucible or clean, fused silica crucible or boat which has been precleaned by air firing at 2012°F (1100°C), min, and stored in a dry, dust-free location until required.

10.2.2 Place samples and crucible in a dense polycrystalline or fused silica combustion tube muffle or equivalent, purge with dry –40°F (–40°C) hydrogen, and heat to 36°F (20°C) above the liquidus, hold for 10 min, and then cool to under 149°F (65°C) before stopping the hydrogen flow and removing the sample for inspection.

NOTE 2—If the sample does not melt under these conditions, the composition is wrong or the temperature measurement is incorrect.

10.2.3 If it is desired also to test for spattering, bridge the crucible or boat by a nickel channel whose legs are designed to allow a small clearance, 0.06 in. (1.6 mm) max. above the crucible. An additional requirement is that the bridge be no more than 0.38 in. (9.5 mm) above the metal bead.

10.2.4 Examine the metal bead at 5× magnification. Just a light smokiness with no discrete black specks is the worst that is permitted. Since this examination depends on experience and judgment, standards can be developed by running carbon determinations and comparing with the maximum carbon limitation listed in Table 1.

10.2.5 If the spatter test is run, examine the bottom side of the nickel bridge, also at 5× magnification, for evidence of any spatter.

TABLE 3 Standard Sieve Analyses[A]

100 mesh	through No. 60 sieve—100 % min
	through No. 100 sieve—95 % min
140°C mesh	on No. 100 sieve—trace
	on No. 140 sieve—10 % max
	through No. 325 sieve—20 % max
140°F mesh	on No. 100 sieve—trace
	on No. 140 sieve—10 % max
	through No. 325 sieve—55 % max
325 mesh	on No. 200 sieve—trace
	on No. 325 sieve—10 % max
	through No. 325 sieve—90 % min

[A] These are standard ASTM sieve sizes selected from Table 2 of Specification E11. Sieve tests are conducted in accordance with the latest edition of Test Method B214.