



Specification for Fluxes for Brazing and Braze Welding



American Welding Society®



AWS A5.31M/A5.31:2012
An American National Standard

Approved by the
American National Standards Institute
February 17, 2012

Specification for Fluxes for Brazing and Braze Welding

2nd Edition

Supersedes ANSI/AWS A5.31-92(R2003)

Prepared by the
American Welding Society (AWS) A5 Committee on Filler Metals and Allied Materials

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

Eighteen fluxes for brazing and braze welding are classified according to the filler metal, form, and activity temperature range. Classification is in accordance with a classification system that employs the designator "FB" to indicate fluxes for brazing and braze welding applications. In addition to selected tests for each classification, major topics include general requirements, testing procedures, and packaging requirements. An annex listing general application guidelines is included.

This specification makes use of both the International System of Units (SI) and U.S. Customary Units. The measurements may not be exact equivalents; therefore, each system shall be used independently.



International Standard Book Number: 978-0-87171-807-5
American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126
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Foreword

This foreword is not part of AWS A5.31M/A5.31:2012, *Specification for Fluxes for Brazing and Braze Welding*, but is included for informational purposes only.

This document is the first of the A5.31 specifications that makes use of both the International System of Units (SI) and U.S. Customary Units. The measurements are not exact equivalents; therefore each system must be used independently of the other, without combining values in any way. In selecting rational metric units, AWS A1.1, *Metric Practice Guide for the Welding Industry*, and International Standard ISO 544, *Welding Consumables—Technical Delivery Conditions for Welding Filler Materials—Type of Product, Dimensions, Tolerances, and Markings*, are used where suitable. Tables and figures make use of both SI Units and U.S. Customary Units, which with the application of the specified tolerances provides for interchangeability of products in both the SI Units and U.S. Customary Units.

This is the second revision of the original specification issued in 1992. The first edition of the *Brazing Manual*, published in 1955, included a numerical list of fluxes. The next two editions, published in 10-year intervals, made numerous changes to the initial listings, but lacked the inclusion of the testing and restrictions normally incorporated in a specification. The *Brazing Manual* was revised again in 1991 and published as the AWS *Brazing Handbook*. The fifth edition of the *Brazing Handbook* was published in 2007.

In 1978, the American Welding Society's Brazing and Soldering Committee recognized the need for a flux specification. About two years later, collaboration between the Committee on Filler Metals and Allied Materials and the Subcommittee on Filler Metals and Fluxes for Brazing led to the initial preparation of the specification. At that point, the magnitude of the challenge to prepare a specification in an industry built on a foundation of proprietary products became apparent. After over a decade of activity by a dedicated group of brazing specialists, the first National Specification, AWS/ANSI A5.31-92, was issued. AWS A5.31M/A5.31:2012 represents over two decades of activity by a dedicated group of brazing specialists.

The present edition, which supersedes ANSI/AWS A5.31-92 (R2003), includes the following updates:

The International System of Units (SI) is used as the primary unit of measurement

Three classes of dispensable fluxes: FB3-L, FB3-M, FB3-N

Sodium Glare Test was removed

Test base metal options added for select flux classifications

Revised shelf life requirements

Revised test specimen and preparation requirements

Test lot definition

Revised retest requirements

Revised particle size test requirements

Adherence Test title now reads as Adhesion Test

Revised fluidity test requirements

A flux viscosity test reference is included

Supplemental Annexes—Informative references and safety considerations

New substantive revisions are noted within the specification in italic font.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS A5 Committee on Filler Metals and Allied Materials, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

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Specification for Fluxes for Brazing and Braze Welding

1. General Requirements

1.1 Scope. This specification prescribes the requirements for the classification of brazing fluxes used with brazing or braze welding filler metals such as those classified in AWS A5.8M/A5.8, *Specification for Filler Metals for Brazing and Braze Welding*.

1.2 Units of Measurement. This specification makes use of both the International System of Units (SI) and U.S. Customary Units. The measurements are not exact equivalents; therefore, each system must be used independently of the other without combining in any way when referring to material properties. The specification with the designation A5.31M uses SI Units. The specification A5.31 uses U.S. Customary Units. The latter are shown within brackets [] or in appropriate columns in tables and figures. Standard dimensions based on either system may be used for sizing of brazing fluxes or packaging or both under A5.31M or A5.31 specifications.

1.3 Safety. Safety issues and concerns are addressed in this standard, although health issues and concerns are beyond the scope of this standard. Some safety and health information can be found in non-mandatory Annex Clauses B5 and B8.

Safety and health information is available from the following sources:

American Welding Society:

- (1) ANSI Z49.1, Safety in Welding, Cutting, and Allied Processes
- (2) AWS Safety and Health Fact Sheets (see Annex Clause B8)
- (3) Other safety and health information on the AWS website

Material or Equipment Manufacturers:

- (1) Material Safety Data Sheets supplied by the materials manufacturers
- (2) Operating manuals supplied by equipment manufacturers

Applicable Regulatory Agencies

Work performed in accordance with this standard may involve the use of materials that have been deemed hazardous, and may involve operations or equipment that may cause injury or death. This standard does not purport to address all safety and health risks that may be encountered. The user of this standard should establish an appropriate safety program to address such risks as well as to meet applicable regulatory requirements. ANSI Z49.1 should be considered when developing the safety program.

2. Normative References

The standards listed below contain provisions that, through reference in this text, constitute mandatory provisions of this AWS standard. For undated references, the latest edition of the referenced standard shall apply. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply.

2.1 American Welding Society (AWS) standards:¹

- (1) AWS A3.0M/A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*
- (2) AWS A5.01M/A5.01 (ISO 14344 MOD), *Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes*
- (3) AWS A5.02/A5.02M, *Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes*
- (4) AWS A5.8M/A5.8, *Specification for Filler Metals for Brazing and Braze Welding*

2.2 American National Standards Institute (ANSI) standard:²

- (1) ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*

2.3 ASTM International standards:³

- (1) ASTM E1, *Standard Specification for Wire Cloth and Sieves for Testing Purposes*
- (2) ASTM E29, *Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*

2.4 International Organization for Standardization (ISO) standard:⁴

- (1) ISO 544, *Welding consumables—Technical delivery conditions for welding filler materials—Type of product, dimensions, tolerances, and markings*

2.5 SAE International standard:⁵

- (1) SAE HS-1086, *Metals & Alloys in the Unified Numbering System*

3. Classification

3.1 The brazing fluxes covered in this A5.31M/A5.31 specification are classified using a system that is independent of the International System of Units (SI) and U.S. Customary Units. Classification is according to the filler metal, form, and activity temperature range, as specified in Table 1.

3.2 Materials classified under one classification shall not be classified under any other classification of this specification.

4. Acceptance

Acceptance⁶ of the brazing flux shall be in accordance with the tests and requirements of the appropriate clauses of this specification. Material shall be deemed acceptable to a given classification if it meets all requirements as prescribed in this specification.

¹ AWS standards are published by the American Welding Society, 550 N.W. LeJeune Rd., Miami, FL 33126.

² This ANSI standard is published by the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

³ ASTM International standards are published by ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428–2959.

⁴ ISO standards are published by the International Organization for Standardization, 1, ch. de la Voie-Creuse, Case postale 56, CH-1211 Geneva 20, Switzerland.

⁵ SAE International standards are published by SAE International, 400 Commonwealth Drive, Warrendale, PA 15096–0001.

⁶ See Annex Clause B3, “Acceptance,” for further information concerning acceptance of material to be shipped.

Table 1
Classification of Brazing Fluxes with Brazing or Braze Welding Filler Metals

AWS Flux Classification	Form	Filler Metal Type	Activity Temperature Range	
			°C	°F
FB1-A	Powder	BAISi	580–615	1080–1140
FB1-B	Powder	BAISi	560–615	1040–1140
FB1-C	Powder	BAISi	540–615	1000–1140
FB2-A	Powder	BMg	480–620	900–1150
FB3-A	Paste	BAG and BCuP	565–870	1050–1600
FB3-C	Paste	BAG and BCuP	565–925	1050–1700
FB3-D	Paste	BAG, BCu, BNi, BAu, and RBCuZn	760–1205	1400–2200
FB3-E	Liquid	BAG and BCuP	565–870	1050–1600
FB3-F	Powder	BAG and BCuP	650–870	1200–1600
FB3-G	Slurry	BAG and BCuP	565–870	1050–1600
FB3-H	Slurry	BAG	565–925	1050–1700
FB3-I	Slurry	BAG, BCu, BNi, BAu, and RBCuZn	760–1205	1400–2200
FB3-J	Powder	BAG, BCu, BNi, BAu, and RBCuZn	760–1205	1400–2200
FB3-K	Liquid	BAG and RBCuZn	760–1205	1400–2200
FB3-L	Dispensable paste	BAG and BCuP	565–870	1050–1600
FB3-M	Dispensable paste	BAG and BCuP	565–925	1050–1700
FB3-N	Dispensable paste	BAG, BCu, BNi, BAu, and RBCuZn	760–1205	1400–2200
FB4-A	Paste	BAG and BCuP	595–870	1100–1600

Notes:

1. The selection of a flux designation for a specific type of work may be based on the form, the filler metal type, and the classification above, but the information here is generally not adequate for flux selection. Refer to Annex Clause B7 and the AWS *Brazing Handbook* for further assistance.
2. See 12.2 and 12.3 for the difference between paste flux and slurry flux.

5. Certification

By affixing the AWS specification and classification designations to the packaging or the classification to the product, the manufacturer certifies that the product meets the requirements of this specification. ⁷

6. Rounding-Off Procedure

For the purpose of determining compliance with the requirements of this standard, the actual test values obtained shall be subjected to the rounding-off rules of ASTM E29 or Rule A in Clause B.3 of ISO 80000-1 (the results are the same). If the measured values are obtained by equipment calibrated in units other than those of the specified limit, the measured values shall be converted to the units of the specified limit before rounding off. If an average value is to be compared to the specified limit, rounding off shall be done only after calculating the average. An observed or calculated value shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the limiting values for other quantities. The rounded-off results shall fulfill the requirements for the classification under test.

7. Summary of Tests

7.1 The tests required for each flux classification are specified in Table 2. The purpose of these tests is to determine the water content, the maximum particle size, and adhesion to a test specimen. The tests are also used to determine the

⁷ See Annex Clause B4, “Certification,” for further information concerning certification and the testing called for to meet this requirement.

Table 2
Required Tests

AWS Flux Classification	Form	Water Content	Particle Test	Adhesion	Fluidity	Fluxing Action	Flow	Life
FB1-A	Powder				X	X	X	
FB1-B	Powder				X	X	X	
FB1-C	Powder				X	X	X	
FB2-A	Powder				X	X	X	
FB3-A	Paste	X	X	X	X	X	X	X
FB3-C	Paste	X	X	X	X	X	X	X
FB3-D	Paste	X	X	X	X	X	X	X
FB3-E	Liquid	X	X			X	X	
FB3-F	Powder				X	X	X	X
FB3-G	Slurry	X	X	X	X	X	X	X
FB3-H	Slurry	X	X	X	X	X	X	X
FB3-I	Slurry	X	X	X	X	X	X	X
FB3-J	Powder				X	X	X	X
FB3-K	Liquid	X	X			X	X	
FB3-L	<i>Dispensable paste</i>		X	X	X	X	X	
FB3-M	<i>Dispensable paste</i>		X	X	X	X	X	X
FB3-N	<i>Dispensable paste</i>		X	X	X	X	X	X
FB4-A	Paste	X	X	X	X	X	X	X

fluidity at high temperature, the fluxing action, the brazing filler metal flow, and the active life of the flux at high temperature. The base metal for the test specimen, the filler metal, and the testing procedures to be employed, and the results required are given in Clauses 9 through 19 and in Table 3.

7.2 Shelf Life. When stored in its original unopened container, these materials shall meet the requirements of this specification for a minimum shelf life of 12 months from date of manufacture. Flux beyond the shelf life may be used if it continues to meet the user's requirements. The user may wish to test flux over 12 months old to ensure that it meets the requirements of this specification.

8. Retests

If the results of any test fail to meet the requirement, the test shall be repeated twice. The results of both retests shall meet the requirement. Samples for retest may be taken from the original test sample or from a new sample. If the results of one or both retests fail to meet the requirement, the material under test shall be considered as not meeting the requirements of this specification for that classification.

In the event that during preparation or after the completion of any test, it is clearly determined that prescribed or proper procedures were not followed in preparing the test sample or in conducting the test, the test shall be considered invalid, without regard to whether the test was actually completed or whether test results met or failed to meet the requirement. That test shall be repeated following the proper prescribed procedures. In this case, the requirement for doubling the number of test specimens does not apply.

9. Test Specimen

9.1 The test specimen, Figure 1, shall be a rectangular sheet, 30 mm [1.25 in] wide (with a tolerance of ± 6.35 mm [± 0.25 in]), 60 mm [2.5 in] long (with a tolerance of ± 6.35 mm [± 0.25 in]), and approximately 1.6 mm [0.062 in] thick (with a tolerance of ± 0.127 mm [± 0.005 in]) of the base metal given in Table 3. When two base metals are listed, either composition is acceptable.

Table 3
Filler Metal and Base Metal for Tests, Flow and Life Test Temperature, and Flow Test Minimum Area

AWS Flux Classification	AWS Filler Metal Classification	Base Metal			Flow and Life Test Temperature ^a		Flow Test Area Minimum	
		Common Name		UNS Number ^b	°C	°F	mm ²	in ²
FB1-A	BAISi-4	3003	Aluminum	A93003	613	1135	129	0.2
FB1-B	BAISi-4	3003	Aluminum	A93003	613	1135	129	0.2
FB1-C	BAISi-4	3003	Aluminum	A93003	613	1135	NR ^c	NR ^c
FB2-A	BMg-1	AZ31B	Magnesium	M11311	610	1130	NR ^c	NR ^c
FB3-A	BAg-7	1008	Carbon Steel	G10080	705	1300	161	0.25
		321	Stainless Steel	S32100				
FB3-C	BAg-24	304	Stainless Steel	S30400	760	1400	161	0.25
		321	Stainless Steel	S32100				
FB3-D	RBCuZn-D	304	Stainless Steel	S30400	955	1750	161	0.25
		1008	Carbon Steel	S32100				
	BNi-2	304	Stainless Steel	S30400	1040	1900	161	0.25
		321	Stainless Steel	S32100				
FB3-E	BAg-7	304	Stainless Steel	S30400	705	1300	NR ^c	NR ^c
		321	Stainless Steel	S32100				
FB3-F	BAg-7	1008	Carbon Steel	G10080	705	1300	161	0.25
		321	Stainless Steel	S32100				
FB3-G	BAg-7	1008	Carbon Steel	G10080	705	1300	161	0.25
		321	Stainless Steel	S32100				
FB3-H	BAg-24	1008	Carbon Steel	G10080	760	1400	161	0.25
		321	Stainless Steel	S32100				
FB3-I	RBCuZn-D	304	Stainless Steel	S30400	955	1750	161	0.25
		1008	Carbon Steel	G10080				
	BNi-2	304	Stainless Steel	S30400	1040	1900	161	0.25
		321	Stainless Steel	S32100				
FB3-J	RBCuZn-D	304	Stainless Steel	S30400	955	1750	161	0.25
		1008	Carbon Steel	G10080				
	BNi-2	304	Stainless Steel	S30400	1040	1900	161	0.25
		321	Stainless Steel	S32100				
FB3-K ^d	RBCuZn-D	1008	Carbon Steel	G10080	955	1750	NR ^c	NR ^c
		321	Stainless Steel	S32100				
FB3-L	BAg-7	1008	Carbon Steel	G10080	705	1300	161	0.25
		321	Stainless Steel	S32100				
FB3-M	BAg-24	304	Stainless Steel	S30400	760	1400	161	0.25
		321	Stainless Steel	S32100				
FB3-N	RBCuZn-D	304	Stainless Steel	S30400	955	1750	161	0.25
		321	Stainless Steel	S32100				
	BNi-2	304	Stainless Steel	S30400	1040	1900	161	0.25
		321	Stainless Steel	S32100				
FB4-A	BAg-6	C613	Aluminum Bronze	C61300	830	1525	161	0.25

^a Temperature tolerances shall be $\pm 8^{\circ}\text{C}$ [$\pm 14^{\circ}\text{F}$].

^b SAE HS-1086, *Metals and Alloys in the Unified Numbering System*.

^c NR = No flow requirement. The wetting of base metal by the brazing filler metal is all that is required.

^d An AISI 1008 steel coupon shall be used for the fluxing action and flow tests.

9.2 The surface of the test specimen shall be prepared by removing all contaminants (i.e., oil, grease, lubricants, and protective coatings), polishing with a fine abrasive, rinsing with de-ionized water, and drying at a time and temperature not to exceed one hour and 80°C [176°F].

9.3 Classification required tests will be initiated within one hour of test specimen preparation.

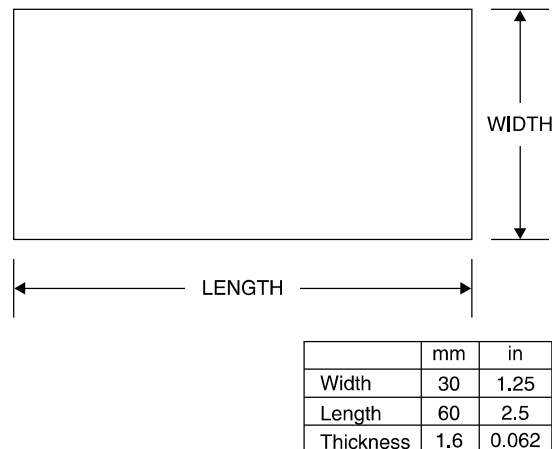


Figure 1—Test Specimen Approximately 1.6 mm [0.062 in] Thick

10. Flux Sample

The extraction of an unmodified flux sample shall be preceded by thorough mixing to a smooth, uniform consistency.

10.1 Test Lot. The test sample shall consist of flux of the same type, manufactured as one batch. Each lot shall be given a unique code number or designation.

10.2 Retest Requirements. Flux is produced using a specific formulation and process. Any change to the process or formulation (other than wording for clarification) shall require retesting of the flux to the classification requirements per 10.1.

11. Filler Metal

11.1 The filler metal sample shall be a 13 mm [0.5 in] length, plus/minus 1.3 mm [0.05 in], of 1.6 mm [0.062 in] diameter wire of the AWS classification given in Table 3. Exceptions are noted in 11.2.

11.2 When testing flux classifications AWS FB3-D, AWS FB3-I, AWS FB3-J, and AWS FB3-N with filler metal BNi-2, the filler metal shall be 0.2 g [0.007 oz] plus/minus 0.02 g [0.0007 oz] of powder or rod, except when otherwise noted.

11.3 Flux, when required, may be applied to the filler metal and dried prior to testing.

12. Water Content Test

Water content shall be determined using a commercial moisture analyzer or by the procedure specified in 12.1.

12.1 The following procedure may be used as an alternative method to determine water content. All weights shall be determined to the nearest 0.01 g [0.0004 oz] as follows:

- (1) Determine the weight of a dry clean container;
- (2) Place a 3 g [0.1 oz] minimum weight sample of the flux into the container;
- (3) Determine the weight of the wet flux by weighing the flux and the container and subtracting the weight of the container;
- (4) Place the container in a desiccator containing freshly activated silica gel mixed with an indicator. Use a minimum of 60 g [2 oz] of silica gel per sample;
- (5) Cover the desiccator and dry for 24 hours;

(6) Determine the weight of the dry flux by weighing the flux and the container and subtracting the weight of the container; and

(7) Calculate the water content as follows:

$$\text{Water content (\%)} = \frac{(\text{Wet flux weight} - \text{Dry flux weight}) \times 100}{\text{Wet flux weight}}$$

12.2 Paste fluxes shall have a water content of 15% to 35%.

12.3 Slurry fluxes shall have a water content of 30% to 60%.

12.4 Liquid flux FB3-E shall have a water content of 82% to 90%.

13. Particle Test

13.1 The test method used to measure particle size of dispensable paste fluxes shall be as agreed upon by the manufacturer and the user.

13.2 The particle consistency of paste flux is acceptable when the entire amount of a 60 g [2 oz] sample will pass through a 425 µm [USA Standard Testing Sieve No. 40]. The screen shall conform to ASTM E11-01. Heating the flux sample at a temperature of up to a maximum of 82°C [180°F] before testing is permissible. The flux may be worked lightly with a brush.

13.3 The particle consistency of a slurry flux is acceptable when the entire amount of a 60 g [2 oz] sample will pass through a 106 µm sieve [USA Standard Testing Sieve No. 140]. Heating the flux sample at a temperature of up to a maximum of 82°C [180°F] before testing is permissible. The flux may be worked lightly with a brush.

13.4 Liquid fluxes shall not exhibit any visible particles when examined without magnification. Heating the flux sample at a temperature of up to a maximum of 82°C [180°F] before testing is permissible.

14. Adhesion Tests

The adhesion characteristics of the flux shall be determined using the following procedures:

14.1 For temperatures below the activity temperature range, the following apply:

14.1.1 Using a brush, apply a uniform layer of flux approximately 0.8 mm [0.031 in] thick to one surface of the test specimen (see Figure 1).

14.1.2 Examination No. 1: Examine the fluxed surface for areas of nonwetting.

14.1.3 With the same test specimen inclined at a 60° minimum angle, heat in an air atmosphere furnace that has been preheated to 55°C [100°F] below the minimum activity temperature of Table 1, hold at the furnace temperature for three minutes, and air cool to room temperature.

14.1.4 Examination No. 2: Examine the fluxed surface for areas of flux loss or retraction.

14.2 The results of the tests are acceptable when each of the two examinations (see 14.1.2 and 14.1.4) indicates that the flux coating is continuous, i.e., free from areas of nonwetting or areas of flux loss or retraction.

14.3 At the minimum activity temperature (see Table 1) the following applies:

14.3.1 Apply the flux as a uniform coating of approximately 1.4 g [0.05 oz] to one surface of the test specimen (see Figure 1) (see Table 3 for base metal).

14.3.2 With the test specimen inclined at a 60° minimum angle, heat in air in a furnace preheated to the minimum activity temperature specified in Table 1, hold at the furnace temperature for three minutes, then cool to room temperature in still air.

14.4 The result of the test is acceptable when 80% or more of the surface of the test specimen remains covered and protected from high-temperature oxidation by the flux.

15. Fluidity Test

15.1 The fluidity of the flux at high temperature shall be determined using the following procedure:

15.1.1 Place approximately 10 g [0.35 oz] of flux in a nonreactive crucible. Pure platinum, gold, and silver are acceptable crucible materials.

15.1.2 Heat the crucible in a preheated furnace with an air atmosphere to the minimum activity temperature provided in Table 1 and hold at the temperature for five minutes. The use of a furnace thermocouple as a temperature indicator is acceptable.

15.1.3 Remove the crucible and immediately observe whether the flux is in its liquid (state) condition by tilting the crucible.

15.1.4 Heat the crucible in a preheated furnace with an air atmosphere at the maximum activity temperature provided in Table 1; hold at that temperature for 10 minutes.

15.1.5 Cool as rapidly as possible by resetting the furnace controls to the minimum activity temperature or by removing the sample from the furnace.

15.1.6 When the furnace thermocouple or other external temperature indicator signifies that the flux is at the minimum activity temperature, observe whether the flux is in its liquid (state) condition at that temperature by tilting the crucible again.

15.2 The result of the test is acceptable if the fluidity at the time of the second observation is approximately the same as it was at the time of the first observation.

16. Fluxing Action Test

16.1 For all fluxes except AWS FB3-K, the fluxing action shall be determined using the following procedure:

16.1.1 Apply 1.4 g [0.05 oz] of flux as a uniform coating to one surface of the test specimen (see Figure 1) of a base metal specified in Table 3. Place the prefluxed filler metal sample (see 11.1 through 11.3 and Table 3) on the test specimen.

16.1.2 With the test specimen in a horizontal position, heat it in an air atmosphere furnace preheated to the minimum activity temperature provided in Table 1. Then, hold it at that furnace temperature for two minutes, and air cool it to room temperature.

16.1.3 Clean the test specimen by soaking it in water at 60°C [140°F] minimum until visible flux residue is removed.

16.2 For flux AWS FB3-K, the fluxing action shall be determined using the following procedure:

16.2.1 An AISI 1008 steel coupon shall be used for this test.

16.2.2 Set up an oxyacetylene liquid flux brazing station as follows:

- (1) Use a No. 48 drill size torch tip;⁸
- (2) Set both oxygen and acetylene pressure at 50 kPa [7 psig];
- (3) Place RBCuZn-D on a test specimen that has a blue, oxidized surface; and
- (4) With the torch 125 mm [5 in] above the test specimen, heat to 955°C [1750°F] by moving the flame over the entire coupon until the filler metal sample is fully melted. Air cool to room temperature.

16.3 The results of the tests are acceptable if the surface of the test specimen that was coated with the flux and the filler metal surface are free of high-temperature oxidation as indicated by a lack of discoloration of the sample.

⁸ Drill No. 48 is equivalent to 2 mm [0.076 in].

17. Flow Test

17.1 For all brazing fluxes except AWS FB3-K, the extent of filler metal flow shall be determined using the following procedure:

17.1.1 Apply 1.4 g [0.05 oz] of flux as a uniform coating to one surface of the test specimen (see Figure 1) of a base metal specified in Table 3. Place the prefluxed filler metal sample (see 11.1 through 11.3 and Table 3) on the test specimen.

17.1.2 With the test specimen in a horizontal position, heat it in an air atmosphere furnace preheated to the test temperature provided in Table 3. Then, hold it at the furnace temperature for five minutes, and air cool it to room temperature.

17.2 For flux AWS FB3-K, the extent of filler metal flow shall be determined using the following procedure:

17.2.1 An AISI 1008 steel coupon shall be used for this test.

17.2.2 Set up an oxyacetylene, liquid flux brazing station as follows:

- (1) Use a No. 48 drill size torch tip;⁸
- (2) Set both oxygen and acetylene pressure at 50 kPa [7 psig];
- (3) Place the filler metal (as specified in Table 3) on a test specimen (see Figure 1); and
- (4) With the torch tip positioned 125 mm [5 in] above the test specimen, heat to 955°C [1750°F] and air cool it to room temperature.

17.3 Clean the test specimen by soaking it in hot water.

17.4 The results of the test are acceptable if the filler metal flow area is equal to or greater than the flow area shown in Table 3. The wetting of the base metal by the filler metal is required for fluxes AWS FB1-C, AWS FB2-A, AWS FB3-E, and AWS FB3-K, but there are no specific flow area requirements.

18. Life Test

18.1 The ability of the flux to protect the surface of the base metal at high temperatures shall be determined using the following procedure:

18.1.1 Apply 1.4 g [0.05 oz] of flux as a uniform coating to one surface of the test specimen (see Figure 1) of a base metal specified in Table 3.

18.1.2 With the test specimen in a horizontal position, heat it in the furnace preheated to the test temperature provided in Table 3. Then, hold it at that furnace test temperature for 10 minutes.

18.1.3 Place the unfluxed filler metal (see 11.1 through 11.3 and Table 3) on the test specimen in the furnace.

18.1.4 Continue to heat the test specimen until the furnace returns to the test temperature. Hold the furnace for one minute at that temperature, then remove the test specimen and air cool it to room temperature.

18.1.5 Clean the test specimen by soaking in hot water.

18.2 The results of the test are acceptable if the filler metal has wet the test specimen. There is no specific flow area requirement.

19. Viscosity Test

19.1 The test method used to measure viscosity of dispensable paste fluxes shall be as agreed upon by the manufacturer and the user.

19.2 The viscosity of dispensable paste fluxes shall be as agreed upon by the manufacturer and the user.

20. Method of Manufacture

The brazing fluxes classified according to this specification may be manufactured by any method that will produce a brazing flux that meets the requirement of this specification. Chemicals of technical grade or better shall be used.⁹

21. Forms

21.1 The standard forms for brazing fluxes shall be powder, paste, slurry, dispensable paste, or liquid, as shown in Table 1.

21.2 A flux in paste form shall meet the requirements of 12.2.

21.3 A flux in slurry form shall be suitable for use with automatic flux spraying dispensing equipment and shall meet the requirements of 12.3.

21.4 A flux in liquid form shall be suitable for use with flux spraying equipment and meet the requirements of 12.4.

22. Packaging

22.1 Brazing fluxes shall be suitably packaged to protect them from damage during shipment and storage under normal conditions.

22.2 Flux containers and closures shall be made of materials that do not noticeably react with the flux during storage for a minimum period of 12 months after packaging.

22.3 Sealing shall be adequate to prevent the loss or contamination of the flux components under normal handling conditions.

22.4 Standard package weights shall be as agreed between the purchaser and the supplier.

23. Marking of Packages

23.1 Unless otherwise agreed upon by the manufacturer and the purchaser, the following product information (as a minimum) shall be legibly marked on the outside of each unit package:

- (1) AWS specification and classification designation (year of issue may be excluded)
- (2) Supplier's name and trade designation
- (3) Volume or net weight
- (4) Lot, control, or batch number
- (5) Date of manufacture

23.2 The appropriate precautionary information¹⁰ as given in ANSI Z49.1 (as a minimum) or its equivalent shall be prominently displayed in legible print on all packages of brazing fluxes, including individual unit packages enclosed within a larger package.

⁹For further description of the classification of grades of chemicals, refer to the American Chemistry Council, 1300 Wilson Boulevard, Arlington VA 22209, www.americanchemistry.com.

¹⁰Typical examples of "warning labels" for some common or specific consumables used with certain processes are shown in the figures illustrated in ANSI Z49.1. Figure B.1 illustrates an example of a cautionary label for flux.

Annex A (Informative)

Informative References

This annex is not part of AWS A5.31M/A5.31:2012, *Specification for Fluxes for Brazing and Braze Welding*, but is included for informational purposes only.

AWS A1.1, *Metric Practice Guide for the Welding Industry*, American Welding Society.

AWS A5.8M/A5.8, *Specification for Filler Metals for Brazing and Braze Welding*, American Welding Society.

AWS, 2007, *Brazing Handbook*, 5th ed., Miami: American Welding Society.

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Annex B (Informative)

Guide to AWS A5.31M/A5.31:2012, *Specification for Fluxes for Brazing and Braze Welding*

This annex is not part of AWS A5.31M/A5.31:2012, *Specification for Fluxes for Brazing and Braze Welding*, but is included for informational purposes only.

B1. Introduction

The purpose of this guide is to correlate the flux classifications with their intended applications so that the specification can be used effectively. Appropriate base metals, filler metals, and brazing processes are referred to whenever that can be done and when it would be helpful. Such references are intended only as examples rather than complete listings of the materials and processes for which each brazing flux is suitable.

B2. Classification System

B2.1 The system for identifying the flux classifications in this specification is based on three factors: form, applicable filler metal, and activity temperature range. The letters “FB” at the beginning of each classification designation stand for “Flux for Brazing or Braze Welding.” The third character is a number that stands for a group of applicable filler metals. The fourth character, a letter, designates a change in form and attendant composition within the broader base metal classification.

B2.2 Request for Flux Classification

(1) When a brazing flux cannot be classified according to a classification given in this specification, the manufacturer may request that a classification be established for that brazing flux. The manufacturer can do this by following the procedure below.

(2) A request to establish a new brazing flux classification must be a written request, and it must provide sufficient detail to permit the Committee on Filler Metals and Allied Materials or the Subcommittee on Filler Metals and Fluxes for Brazing to determine whether the new classification or the modification of an existing classification is more appropriate, and whether either is necessary to satisfy the need. The request must state the variables and their limits for such a classification or modification. The request should contain some indication of the time by which the completion of a new classification or modification is needed. In particular, the request needs to include:

- (a) All classification requirements as given for existing classifications, such as chemical composition ranges and usability test requirements;
 - (b) Any conditions for conducting the tests used to demonstrate that the product meets the classification requirements (it would be sufficient, for example, to state that brazing conditions are the same as for other classifications); and
 - (c) A description that parallels the type of information contained for the existing classifications found in Annex Clause B7 (Description and Intended Use of Brazing Fluxes).
- (d) A request for a new classification without the above information will be considered incomplete. The Secretary will return the request to the requestor for further information.

(3) The request should be sent to the Secretary of the Committee on Filler Metals and Allied Materials at AWS Headquarters. Upon receipt of the request, the Secretary will:

- (a) Assign an identifying number to the request. This number will include the date the request was received;
 - (b) Confirm receipt of the request and give the identification number to the person who made the request;
 - (c) Send a copy of the request to the Chair of the Committee on Filler Metals and Allied Materials and the Chair of the Subcommittee on Filler Metals and Fluxes for Brazing;
 - (d) File the original request; and
 - (e) Add the request to the log of outstanding requests.
- (4) All necessary action on each request will be completed as soon as possible. If more than 12 months lapse, the Secretary shall inform the requestor of the status of the request, with copies to the Chairs of the committee and subcommittee. Requests that are still outstanding after 18 months shall be considered to not have been answered in a “timely manner” and the Secretary shall report these to the Chair of the Committee on Filler Metals and Allied Materials for action.
- (5) The Secretary shall include a copy of the log of all requests pending and those completed during the preceding year with the agenda for each Committee on Filler Metals and Allied Materials meeting. Any other publication of requests that have been completed will be at the option of the American Welding Society, as deemed appropriate.

B3. Acceptance

The acceptance of all brazing fluxes classified under this specification is in accordance with the tests and requirements of this specification. Any testing a purchaser requires of the supplier, for fluxes shipped in accordance with this specification, shall be clearly stated in the purchase order. In the absence of any such statement in the purchase order, the supplier may ship the fluxes with whatever testing the supplier normally conducts on fluxes of that classification. In such cases, the acceptance of the material shipped will be in accordance with those requirements.

B4. Certification

The act of placing the AWS specification and classification designations on the packaging enclosing the product, or the classification on the product itself, constitutes the supplier’s (manufacturer’s) certification that the product meets all the requirements of the specification. The only testing requirement implicit in this *certification* is that the manufacturer has actually conducted the tests required by the specification on material that is representative of that being shipped and that the material has met the requirements of the specification. *Certification* is not to be construed to mean that tests of any kind were necessarily conducted on samples of the specific material shipped. Tests on such material may or may not have been conducted. The basis for the *certification* required by the specification is the classification test of *representative material* cited above, and the Manufacturer’s Quality Assurance Program in AWS A5.01M/A5.01 (ISO 14344:2002 MOD).

B5. Ventilation During Brazing

B5.1 Five major factors govern the quantity of fumes to which brazers and brazing operators can be exposed during brazing. They are:

- (1) Dimensions of the space in which brazing is performed (with special regard to the height of the ceiling);
- (2) Number of brazers and brazing operators working in that space;
- (3) Rate of evolution of fumes, gases, or dust, according to the materials and processes used;
- (4) The proximity of the brazer or brazing operators to the fumes, as these fumes issue from the brazing zone and to the gases and dusts in the space in which they are working; and
- (5) The ventilation provided to the space in which the brazing is performed.

B5.2 American National Standard ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes* (published by the American Welding Society), discusses the ventilation that is required during brazing and braze welding, and should be referred for details. Attention is drawn particularly to the Clause on Ventilation in that document. Further information concerning ventilation during brazing can be found in AWS F3.2, *Ventilation Guide for Weld Fume*.

B5.3 Local, state, and federal requirements for air quality need to be reviewed and met.

B6. Brazing Considerations

B6.1 Successful brazing requires that the surfaces of each detail part and the filler metal be free of oxide, tarnish, or other foreign matter at the time the brazing filler metal flows into the joint.

Proper prebrazing cleaning is an initial step in any brazing process; however, additional protection and cleaning is required to maintain this condition throughout the brazing procedure. Fluxes are used to maintain cleanliness and protection from oxidation. Controlled atmospheres, including vacuum and active deoxidizing elements, are alternate methods of providing the necessary surface cleanliness during brazing.

B6.2 Brazing fluxes are mixtures of chemical compounds that may include inorganic salts and mild acids selected for their ability to provide chemical cleaning or protection of the faying surfaces and the filler metal during brazing. Fluxes must perform the protective, cleaning, and fluxing action with the specific filler metals being used in conjunction with the other brazing variables such as the base metal, the brazing process, the mass of the assembly, and the method of flux application. For further information, refer to the AWS *Brazing Handbook*.

B7. Description and Intended Use of Brazing Fluxes

B7.1 AWS FB1-A is a brazing flux in powder form intended for the torch and furnace brazing of aluminum and its brazable alloys. It consists of fluorides and/or chlorides of some of the alkali metals. Water or alcohol may be used for thinning.

B7.2 AWS FB1-B is a brazing flux in powder form intended for the furnace brazing of aluminum and its brazable alloys. The lower end of its activity temperature range is slightly lower than that of the AWS FB1-A classification. It consists primarily of fluorides and/or chlorides of some of the alkali metals. Water or alcohol may be used for thinning.

B7.3 AWS FB1-C is a brazing flux in powder form intended for the salt-bath dip brazing of aluminum and its brazable alloys. The lower end of its activity temperature range is much lower than that of the AWS FB1-A and AWS FB1-B classifications. It consists primarily of fluorides and/or chlorides of some of the alkali metals. Water should be avoided in the flux or removed prior to the immersion of the brazement in the salt bath.

B7.4 AWS FB2-A is a brazing flux in powder form intended for the salt-bath dip brazing of magnesium alloys whose designators start with "AZ." It consists primarily of fluorides and chlorides of some of the alkali metals. Water should be avoided in the flux or removed prior to the immersion of the brazement in the salt bath.

B7.5 AWS FB3-A is a general purpose brazing flux in paste form intended for use with most brazing processes in the brazing of steels, copper, copper alloys, nickel, and nickel alloys. It is not suitable for aluminum bronze or other base metals containing alloying elements (e.g., aluminum) that form refractory oxides. It consists primarily of boric acid, borates, and fluorides. Water is used for thinning.

B7.6 AWS FB3-C is a brazing flux in paste form similar to AWS FB3-A, except that the activity temperature range extends to a higher temperature, and AWS FB3-C contains elemental boron. Water is used for thinning. A typical pH range is 7.0 to 10.0.

B7.7 AWS FB3-D is a brazing flux in paste form intended for the torch, furnace, and induction brazing of steels, nickel and its alloys, and carbides using high-temperature filler metals. It consists primarily of boric acid, borates, and fluorides. It may contain elemental boron. Water is used for thinning.

B7.8 AWS FB3-E is a low-activity liquid flux used in the torch brazing of jewelry or to augment borderline furnace brazing atmospheric conditions. Flux is usually applied by dipping or by the use of semi or fully automatic spray dispensing equipment. The flux constituents are similar to those in AWS FB3-D fluxes.

B7.9 AWS FB3-F is somewhat similar to the AWS FB3-A flux, except that no vehicle is added to the powder during manufacture. In application, water may be used as a thinning vehicle.

B7.10 AWS FB3-G is a brazing flux in slurry form for use with automatic spray dispensing equipment. The general areas of application are similar to those of AWS FB3-A flux. Water may be used as the thinning vehicle.

B7.11 AWS FB3-H is a brazing flux in slurry form for use with automatic spray dispensing equipment. The general areas of application are similar to those of the AWS FB3-C flux. The flux typically contains borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

B7.12 AWS FB3-I is a brazing flux in slurry form for use with automatic spray dispensing equipment. The general areas of application are similar to those of the AWS FB3-D flux. The flux typically contains borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

B7.13 AWS FB3-J is a brazing flux in powder form for areas of application similar to those of the AWS FB3-D flux. The flux typically contains borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

B7.14 AWS FB3-K is a liquid flux used exclusively in flame brazing. The fuel gas is passed through the container of liquid flux entraining flux in the fuel gas. The flux is applied by the flame where needed on base metals such as carbon steels, low-alloy steels, cast iron, copper and copper alloys, nickel and nickel alloys, and precious metals. The flux consists primarily of liquid borates.

B7.15 *AWS FB3-L is a general purpose brazing flux in the form of a dispensable paste intended for use with automated dispensing equipment. It can be used with most brazing processes in the brazing of steels, coppers, copper alloys, nickels and nickel alloys. Viscosity requirements shall be as agreed upon by the customer and the manufacturer to meet the intended dispensing requirements. It consists primarily of borate and fluoride compounds.*

B7.16 *AWS FB3-M is similar to AWS FB3-L in composition except that the activity temperature range extends to a higher temperature due to the inclusion of elemental boron.*

B7.17 *AWS FB3-N is a brazing flux in dispensable paste form intended for the torch, furnace, and induction brazing of steels, nickel and its alloys, and carbides using high-temperature filler metals. It consists primarily of boric acid, borates, and fluorides. It may contain elemental boron. Viscosity requirements shall be as agreed upon by the customer and the manufacturer to meet the intended dispensing requirements.*

B7.18 AWS FB4-A is a brazing flux in paste form intended for the brazing of copper alloys and other base metals containing up to 9% aluminum, such as aluminum bronze. It may also be suitable for base metals containing up to 3% titanium or other metals that form refractory oxides. It consists primarily of borates, fluorides, and chlorides. Water is used for thinning. A typical pH range is 3.0 to 7.5.

B8. General Safety Considerations

B8.1 Safety and health issues and concerns are beyond the scope of this standard and, therefore, are not fully addressed herein. Some safety and health information can be found in annex clause B5. Safety and health information is available from other sources, including, but not limited to the Safety and Health Fact Sheets listed in B8.2, ANSI Z49.1 *Safety in Welding, Cutting and Allied Processes*,¹¹ and applicable federal and state regulations.

B8.2 Safety and Health Fact Sheets. The Safety and Health Fact Sheets listed below are published by the American Welding Society (AWS). They may be downloaded and printed directly from the AWS web site at <http://www.aws.org>. The Safety and Health Fact Sheets are revised and additional sheets are added periodically.

No.	Title
1	<i>Fumes and Gases</i>
2	<i>Radiation</i>
3	<i>Noise</i>
4	<i>Chromium and Nickel in Welding Fume</i>
5	<i>Electrical Hazards</i>
6	<i>Fire and Explosion Prevention</i>
7	<i>Burn Protection</i>
8	<i>Mechanical Hazards</i>
9	<i>Tripping and Falling</i>
10	<i>Falling Objects</i>
11	<i>Confined Spaces</i>
12	<i>Contact Lens Wear</i>
13	<i>Ergonomics in the Welding Environment</i>
14	<i>Graphic Symbols for Precautionary Labels</i>
15	<i>Style Guidelines for Safety and Health Documents</i>
16	<i>Pacemakers and Welding</i>
17	<i>Electric and Magnetic Fields (EMF)</i>
18	<i>Lockout/Tagout</i>
19	<i>Laser Welding and Cutting Safety</i>
20	<i>Thermal Spraying Safety</i>
21	<i>Resistance Spot Welding</i>
22	<i>Cadmium Exposure from Welding and Allied Processes</i>
23	<i>California Proposition 65</i>
24	<i>Fluxes for Arc Welding and Brazing: Safe Handling and Use</i>
25	<i>Metal Fume Fever</i>
26	<i>Arc Viewing Distance</i>
27	<i>Thoriated Tungsten Electrodes</i>
28	<i>Oxyfuel Safety: Check Valves and Flashback Arrestors</i>
29	<i>Grounding of Portable and Vehicle Mounted Welding Generators</i>
30	<i>Cylinders: Safe Storage, Handling, and Use</i>
31	<i>Eye and Face Protection for Welding and Cutting Operations</i>
33	<i>Personal Protective Equipment (PPE) for Welding & Cutting</i>
34	<i>Coated Steels: Welding and Cutting Safety Concerns</i>
36	<i>Ventilation for Welding & Cutting</i>
37	<i>Selecting Gloves for Welding & Cutting</i>

¹¹ ANSI Z49.1 is published by the American Welding Society, 550 LeJeune Road, Miami, FL 33126.

B9 General Label Information

An example of the minimum appropriate precautionary information as given in ANSI Z49.1:2005 is shown in Figure B.1.

WARNING:

PROTECT yourself and others. Read and understand this information.

FUMES AND GASES CAN BE HAZARDOUS TO YOUR HEALTH. BURNS EYES AND SKIN ON CONTACT. CAN BE FATAL IF SWALLOWED.

- Before use, read and understand the manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices.
- Keep your head out of the fume.
- Use enough ventilation or exhaust, or both, to keep fumes and gases from your breathing zone and the general area.
- Avoid contact of flux with eyes and skin.
- Do not take internally.
- Keep away from children when using.
- See American National Standard ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, published by the American Welding Society, 550 N.W. LeJeune Rd., Miami, Florida 33126; OSHA *Safety and Health Standards* are published by the U.S. Government Printing Office, 732 North Capitol Street NW, Washington DC 20401.

First Aid: If contact in eyes, flush immediately with water for at least 15 minutes. If swallowed, induce vomiting. Never give anything by mouth to an unconscious person. Call a physician.

DO NOT REMOVE THIS INFORMATION

Source: Adapted from ANSI Z49.1:2005, *Safety in Welding, Cutting, and Allied Processes*, Figure 4, American Welding Society.

Figure B.1—Precautionary Information for Brazing and Welding Fluxes Containing Fluorides

Annex C (Informative)

Guidelines for the Preparation of Technical Inquiries

This annex is not part of AWS A5.31M/A5.31:2012, *Specification for Fluxes for Brazing and Braze Welding*, but is included for informational purposes only.

C1. Introduction

The American Welding Society (AWS) Board of Directors has adopted a policy whereby all official interpretations of AWS standards are handled in a formal manner. Under this policy, all interpretations are made by the committee that is responsible for the standard. Official communication concerning an interpretation is directed through the AWS staff member who works with that committee. The policy requires that all requests for an interpretation be submitted in writing. Such requests will be handled as expeditiously as possible, but due to the complexity of the work and the procedures that must be followed, some interpretations may require considerable time.

C2. Procedure

All inquiries shall be directed to:

Managing Director
Technical Services Division
American Welding Society
550 NW LeJeune Road
Miami, FL 33126

All inquiries shall contain the name, address, and affiliation of the inquirer, and they shall provide enough information for the committee to understand the point of concern in the inquiry. When the point is not clearly defined, the inquiry will be returned for clarification. For efficient handling, all inquiries should be typewritten and in the format specified below.

C2.1 Scope. Each inquiry shall address one single provision of the standard unless the point of the inquiry involves two or more interrelated provisions. The provision(s) shall be identified in the scope of the inquiry along with the edition of the standard that contains the provision(s) the inquirer is addressing.

C2.2 Purpose of the Inquiry. The purpose of the inquiry shall be stated in this portion of the inquiry. The purpose can be to obtain an interpretation of a standard's requirement or to request the revision of a particular provision in the standard.

C2.3 Content of the Inquiry. The inquiry should be concise, yet complete, to enable the committee to understand the point of the inquiry. Sketches should be used whenever appropriate, and all paragraphs, figures, and tables (or annex) that bear on the inquiry shall be cited. If the point of the inquiry is to obtain a revision of the standard, the inquiry shall provide technical justification for that revision.

C2.4 Proposed Reply. The inquirer should, as a proposed reply, state an interpretation of the provision that is the point of the inquiry or provide the wording for a proposed revision, if this is what the inquirer seeks.

C3. Interpretation of Provisions of the Standard

Interpretations of provisions of the standard are made by the relevant AWS technical committee. The secretary of the committee refers all inquiries to the chair of the particular subcommittee that has jurisdiction over the portion of the standard addressed by the inquiry. The subcommittee reviews the inquiry and the proposed reply to determine what the response to the inquiry should be. Following the subcommittee's development of the response, the inquiry and the response are presented to the entire committee for review and approval. Upon approval by the committee, the interpretation is an official interpretation of the Society, and the secretary transmits the response to the inquirer and to the *Welding Journal* for publication.

C4. Publication of Interpretations

All official interpretations will appear in the *Welding Journal* and will be posted on the AWS web site.

C5. Telephone Inquiries

Telephone inquiries to AWS Headquarters concerning AWS standards should be limited to questions of a general nature or to matters directly related to the use of the standard. The AWS *Board Policy Manual* requires that all AWS staff members respond to a telephone request for an official interpretation of any AWS standard with the information that such an interpretation can be obtained only through a written request. Headquarters staff cannot provide consulting services. However, the staff can refer a caller to any of those consultants whose names are on file at AWS Headquarters.

C6. AWS Technical Committees

The activities of AWS technical committees regarding interpretations are limited strictly to the interpretation of provisions of standards prepared by the committees or to consideration of revisions to existing provisions on the basis of new data or technology. Neither AWS staff nor the committees are in a position to offer interpretive or consulting services on (1) specific engineering problems, (2) requirements of standards applied to fabrications outside the scope of the document, or (3) points not specifically covered by the standard. In such cases, the inquirer should seek assistance from a competent engineer experienced in the particular field of interest.

AWS Filler Metal Specifications by Material and Welding Process

	OFW	SMAW	GTAW GMAW PAW	FCAW	SAW	ESW	EGW	Brazing
Carbon Steel	A5.2/A5.2M	A5.1/A5.1M	A5.18/A5.18M	A5.20/A5.20M	A5.17/A5.17M	A5.25/A5.25M	A5.26/A5.26M	A5.8M/A5.8 A5.31M/A5.31
Low-Alloy Steel	A5.2/A5.2M	A5.5/A5.5M	A5.28/A5.28M	A5.29/A5.29M	A5.23/A5.23M	A5.25/A5.25M	A5.26/A5.26M	A5.8M/A5.8 A5.31M/A5.31
Stainless Steel		A5.4/A5.4M	A5.9/A5.9M A5.22/A5.22M	A5.22/A5.22M	A5.9/A5.9M	A5.9/A5.9M	A5.9/A5.9M	A5.8M/A5.8 A5.31M/A5.31
Cast Iron	A5.15	A5.15	A5.15	A5.15				A5.8M/A5.8 A5.31M/A5.31
Nickel Alloys		A5.11/A5.11M	A5.14/A5.14M	A5.34/A5.34M	A5.14/A5.14M	A5.14/A5.14M		A5.8M/A5.8 A5.31M/A5.31
Aluminum Alloys		A5.3/A5.3M	A5.10/A5.10M					A5.8M/A5.8 A5.31M/A5.31
Copper Alloys		A5.6/A5.6M	A5.7/A5.7M					A5.8M/A5.8 A5.31M/A5.31
Titanium Alloys			A5.16/A5.16M					A5.8M/A5.8 A5.31M/A5.31
Zirconium Alloys			A5.24/A5.24M					A5.8M/A5.8 A5.31M/A5.31
Magnesium Alloys			A5.19					A5.8M/A5.8 A5.31M/A5.31
Tungsten Electrodes			A5.12M/A5.12 (ISO 6848 MOD)					
Brazing Alloys and Fluxes								A5.8M/A5.8 A5.31M/A5.31
Surfacing Alloys	A5.21/A5.21M	A5.13/A5.13M	A5.21/A5.21M	A5.21/A5.21M	A5.21/A5.21M			
Consumable Inserts			A5.30/A5.30M					
Shielding Gases			A5.32/A5.32M (ISO 14175 MOD)	A5.32/A5.32M (ISO 14175 MOD)			A5.32/A5.32M (ISO 14175 MOD)	

AWS Filler Metal Specifications and Related Documents

Designation	Title
FMC	<i>Filler Metal Comparison Charts</i>
IFS	<i>International Index of Welding Filler Metal Classifications</i>
UGFM	<i>User's Guide to Filler Metals</i>
A4.2M (ISO 8249 MOD)	<i>Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Ferritic-Austenitic Stainless Steel Weld Metal</i>
A4.3	<i>Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding</i>
A4.4M	<i>Standard Procedures for Determination of Moisture Content of Welding Fluxes and Welding Electrode Flux Coverings</i>
A5.01M/A5.01 (ISO 14344 MOD)	<i>Procurement Guidelines for Consumables—Welding and Allied Processes—Flux and Gas Shielded Electrical Welding Processes</i>
A5.02/A5.02M	<i>Specification for Filler Metal Standard Sizes, Packaging, and Physical Attributes</i>
A5.1/A5.1M	<i>Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding</i>
A5.2/A5.2M	<i>Specification for Carbon and Low-Alloy Steel Rods for Oxyfuel Gas Welding</i>
A5.3/A5.3M	<i>Specification for Aluminum and Aluminum-Alloy Electrodes for Shielded Metal Arc Welding</i>
A5.4/A5.4M	<i>Specification for Stainless Steel Electrodes for Shielded Metal Arc Welding</i>
A5.5/A5.5M	<i>Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding</i>
A5.6/A5.6M	<i>Specification for Copper and Copper-Alloy Electrodes for Shielded Metal Arc Welding</i>
A5.7/A5.7M	<i>Specification for Copper and Copper-Alloy Bare Welding Rods and Electrodes</i>
A5.8M/A5.8	<i>Specification for Filler Metals for Brazing and Braze Welding</i>
A5.9/A5.9M	<i>Specification for Bare Stainless Steel Welding Electrodes and Rods</i>
A5.10/A5.10M	<i>Specification for Bare Aluminum and Aluminum-Alloy Welding Electrodes and Rods</i>
A5.11/A5.11M	<i>Specification for Nickel and Nickel-Alloy Welding Electrodes for Shielded Metal Arc Welding</i>
A5.12/A5.12M (ISO 6848 MOD)	<i>Specification for Tungsten and Oxide Dispersed Tungsten Electrodes for Arc Welding and Cutting</i>
A5.13/A5.13M	<i>Specification for Surfacing Electrodes for Shielded Metal Arc Welding</i>
A5.14/A5.14M	<i>Specification for Nickel and Nickel-Alloy Bare Welding Electrodes and Rods</i>
A5.15	<i>Specification for Welding Electrodes and Rods for Cast Iron</i>
A5.16/A5.16M	<i>Specification for Titanium and Titanium-Alloy Welding Electrodes and Rods</i>
A5.17/A5.17M	<i>Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.18/A5.18M	<i>Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.19	<i>Specification for Magnesium Alloy Welding Electrodes and Rods</i>
A5.20/A5.20M	<i>Specification for Carbon Steel Electrodes for Flux Cored Arc Welding</i>
A5.21/A5.21M	<i>Specification for Bare Electrodes and Rods for Surfacing</i>
A5.22/A5.22M	<i>Specification for Stainless Steel Flux Cored and Metal Cored Welding Electrodes and Rods</i>
A5.23/A5.23M	<i>Specification for Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding</i>
A5.24/A5.24M	<i>Specification for Zirconium and Zirconium-Alloy Welding Electrodes and Rods</i>
A5.25/A5.25M	<i>Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding</i>
A5.26/A5.26M	<i>Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding</i>
A5.28/A5.28M	<i>Specification for Low-Alloy Steel Electrodes and Rods for Gas Shielded Arc Welding</i>
A5.29/A5.29M	<i>Specification for Low-Alloy Steel Electrodes for Flux Cored Arc Welding</i>
A5.30/A5.30M	<i>Specification for Consumable Inserts</i>
A5.31M/A5.31	<i>Specification for Fluxes for Brazing and Braze Welding</i>
A5.32M/A5.32 (ISO 14175 MOD)	<i>Welding Consumables—Gases and Gas Mixtures for Fusion Welding and Allied Processes</i>
A5.34/A5.34M	<i>Specification for Nickel-Alloy Electrodes for Flux Cored Arc Welding</i>

List of AWS Documents on Brazing and Soldering

Designation	Title
A2.4	<i>Standard Symbols for Welding, Brazing, and Nondestructive Examination</i>
A3.0M/A3.0	<i>Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying</i>
A5.8M/A5.8	<i>Specification for Filler Metals for Brazing and Braze Welding</i>
A5.31M/A5.31	<i>Specification for Fluxes for Brazing and Braze Welding</i>
B2.2/B2.2M	<i>Specification for Brazing Procedure and Performance Qualification</i>
B2.3/B2.3M	<i>Specification for Soldering Procedure and Performance Qualification</i>
C3.2M/C3.2	<i>Standard Method for Evaluating the Strength of Brazed Joints</i>
C3.3	<i>Recommended Practices for the Design, Manufacture, and Examination of Critical Brazed Components</i>
C3.4M/C3.4	<i>Specification for Torch Brazing</i>
C3.5M/C3.5	<i>Specification for Induction Brazing</i>
C3.6M/C3.6	<i>Specification for Furnace Brazing</i>
C3.7M/C3.7	<i>Specification for Aluminum Brazing</i>
C3.8M/C3.8	<i>Specification for the Ultrasonic Pulse-Echo Examination of Brazed Joints</i>
C3.9M/C3.9	<i>Specification for Resistance Brazing</i>
C3.11M/C3.11	<i>Specification for Torch Soldering</i>
D10.13/D10.13M	<i>Recommended Practices for the Brazing of Copper Tubing and Fittings for Medical Gas Systems</i>
BRH	<i>Brazing Handbook</i>
SHB	<i>Soldering Handbook</i>

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