

ANSI/AWS A5.31-92R
An American National Standard

Specification for Fluxes for Brazing and Braze Welding



American Welding Society

Key Words—Brazing, braze welding, brazing fluxes, braze welding fluxes, silver brazing fluxes, aluminum brazing fluxes, nickel brazing fluxes, magnesium brazing fluxes, copper brazing fluxes

ANSI/AWS A5.31-92R
An American National Standard

Approved by
American National Standards Institute
April 24, 1992

Specification for Fluxes for Brazing and Braze Welding

Initiated by
AWS Committee on Brazing and Soldering

Prepared by
AWS A5 Committee on Filler Metal

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

Fifteen fluxes for brazing and braze welding are classified according to the filler metal, form, and activity temperature range. Classification is in accordance with a new 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. The Appendix suggests some general application guidelines.



American Welding Society

550 N.W. LeJeune Road, Miami, Florida 33126

Statement on Use of AWS American National Standards

All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society (AWS) are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute (ANSI). When AWS standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute. In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations. In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties.

International Standard Book Number: 0-87171-384-5

American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126

© 1992 by American Welding Society. All rights reserved

Printed in the United States of America

Reaffirmed: February 4, 2003

AWS American National Standards are developed through a consensus standards development process that brings together volunteers representing varied viewpoints and interests to achieve consensus. While AWS administers the process and establishes rules to promote fairness in the development of consensus, it does not independently test, evaluate, or verify the accuracy of any information or the soundness of any judgments contained in its standards.

AWS disclaims liability for any injury to persons or to property, or other damages of any nature whatsoever, whether special, indirect, consequential or compensatory, directly or indirectly resulting from the publication, use of, or reliance on this standard. AWS also makes no guaranty or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this standard available, AWS is not undertaking to render professional or other services for or on behalf of any person or entity. Nor is AWS undertaking to perform any duty owed by any person or entity to someone else. Anyone using these documents should rely on his or her own independent judgment or, as appropriate, seek the advice of a competent professional in determining the exercise of reasonable care in any given circumstances.

This standard may be superseded by the issuance of new editions. Users should ensure that they have the latest edition.

Publication of this standard does not authorize infringement of any patent. AWS disclaims liability for the infringement of any patent resulting from the use or reliance on this standard.

Finally, AWS does not monitor, police, or enforce compliance with this standard, nor does it have the power to do so.

On occasion, text, tables, or figures are printed incorrectly, constituting errata. Such errata, when discovered, are posted on the AWS web page (www.aws.org).

Official interpretations of any of the technical requirements of this standard may be obtained by sending a request, in writing, to the Managing Director, Technical Services Division, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126 (see Annex A). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. However, such opinions represent only the personal opinions of the particular individuals giving them. These individuals do not speak on behalf of AWS, nor do these oral opinions constitute official or unofficial opinions or interpretations of AWS. In addition, oral opinions are informal and should not be used as a substitute for an official interpretation.

This standard is subject to revision at any time by the AWS A5 Committee on Filler Metal. It must be reviewed every five years, and if not revised, it must be either reapproved or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are required and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS A5 Committee on Filler Metal and the author of the comments will be informed of the Committee's response to the comments. Guests are invited to attend all meetings of the AWS A5 Committee on Filler Metal to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

Photocopy Rights

Authorization to photocopy items for internal, personal, or educational classroom use only, or the internal, personal, or educational classroom use only of specific clients, is granted by the American Welding Society (AWS) provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: 978-750-8400; online: <http://www.copyright.com>.

Personnel

AWS A5 Committee on Filler Metal

<i>W. L. Wilcox, Chairman</i>	Consultant
<i>D. J. Kotecki, 1st Vice Chairman</i>	The Lincoln Electric Company
<i>D. F. Betz, 2nd Vice Chairman</i>	Crane Midwest
<i>W. A. Dierschow, Secretary</i>	American Welding Society
<i>Z. Al-Hillal</i>	Liquid Carbonic
<i>D. R. Amos</i>	Westinghouse Turbine Plant
<i>B. E. Anderson</i>	Alcotec
<i>K. E. Banks</i>	Teledyne McKay
<i>J. B. Bolton</i>	Kennametal, Incorporated
<i>R. S. Brown</i>	Carpenter Technology Corporation
<i>J. Caprarola, Jr.</i>	Alloy Rods Corporation
<i>L. J. Christensen*</i>	Consultant
<i>R. J. Christoffel</i>	Consultant
<i>D. A. DelSignore</i>	Westinghouse Electric Company
<i>P. B. Dickerson*</i>	Consultant
<i>H. W. Ebert</i>	Exxon Research and Engineering Company
<i>D. A. Fink</i>	The Lincoln Electric Company
<i>J. Gonzalez</i>	The Lincoln Electric Company
<i>G. Hallstrom, Jr.</i>	USNRC-RII
<i>R. L. Harris*</i>	R. L. Harris Associates
<i>D. C. Helton</i>	Consultant
<i>W. S. Howes</i>	National Electrical Manufacturers Association
<i>J. P. Hunt</i>	Inco Alloys International
<i>R. B. Kadiyala</i>	Techalloy Maryland, Incorporated
<i>P. A. Kammer*</i>	Eutectic Corporation
<i>G. A. Kurisky</i>	Maryland Specialty Wire
<i>R. A. LaFave</i>	Elliott Company
<i>N. E. Larson</i>	Union Carbide, Linde Division
<i>A. S. Laurenson</i>	Consultant
<i>G. H. MacShane</i>	Stoody Deloro Stellite Incorporated
<i>L. M. Malik*</i>	Arctec Canada Limited
<i>W. F. McLaughlin</i>	Chrysler Corporation
<i>M. T. Merlo</i>	Stoody Company
<i>G. E. Metzger</i>	WRDC/MLLS
<i>J. W. Mortimer</i>	Consultant
<i>L. W. Mott</i>	Consultant
<i>C. L. Null</i>	Department of the Navy
<i>Y. Ogata*</i>	Kobe Steel, Limited
<i>J. Payne</i>	Schneider Services International
<i>R. L. Peaslee</i>	Wall Colmonoy Corporation
<i>E. W. Pickering</i>	Consultant
<i>S. D. Reynolds, Jr.*</i>	Westinghouse GTSD
<i>L. F. Roberts</i>	Canadian Welding Bureau

*Advisor

AWS A5 Committee on Filler Metal (Continued)

<i>D. Rozet</i>	Consultant
<i>P. K. Salvesen</i>	American Bureau of Shipping
<i>H. S. Sayre*</i>	Consultant
<i>O. W. Seth</i>	Chicago Bridge and Iron Company
<i>R. W. Straiton</i>	Bechtel Group, Incorporated
<i>R. D. Sutton</i>	L-Tec Welding and Cutting Systems
<i>R. A. Swain</i>	Thyssen Welding Products
<i>J. W. Tackett</i>	Haynes International, Incorporated
<i>R. D. Thomas, Jr.</i>	R. D. Thomas and Company
<i>R. Timerman*</i>	CONARCO, S. A.
<i>R. T. Webster</i>	Teledyne Wah Chang
<i>A. E. Wiehe*</i>	Consultant
<i>W. A. Wiehe**</i>	Arcos Alloys
<i>F. J. Winsor</i>	Consultant
<i>K. G. Wold</i>	Consultant
<i>T. J. Wonder</i>	VSE Corporation

AWS A5 Subcommittee on Filler Metals and Fluxes for Brazing

<i>R. L. Peaslee, Chairman</i>	Wall Colmonoy Corporation
<i>W. A. Dierschow, Secretary</i>	American Welding Society
<i>G. A. Andreano*</i>	Consultant
<i>R. E. Ballentine*</i>	Consultant
<i>T. S. Bannos</i>	Engelhard Corporation
<i>Y. Baskin</i>	Superior Flux and Manufacturing Company
<i>A. S. Cross, Jr.*</i>	Consultant
<i>C. Henschel</i>	Consultant
<i>R. Henson</i>	J. W. Harris Company
<i>W. H. King*</i>	Consultant
<i>M. J. Lucas, Jr.</i>	General Electric Company
<i>M. T. Merlo*</i>	Stoody Company
<i>J. A. Miller*</i>	Consultant
<i>C. W. Philp</i>	Consultant
<i>H. S. Sayre*</i>	Consultant
<i>J. L. Schuster</i>	Consultant

*Advisor

**Deceased

Foreword

(This Foreword is not a part of ANSI/AWS A5.31-92, *Specification for Fluxes for Brazing and Braze Welding*, but is included for information purposes only.)

This document represents the first national specification for fluxes for brazing and braze welding. The first edition of the *Brazing Manual*, published in 1955, included a numerical list of fluxes. The next two revisions published, at approximately 10 year intervals, made numerous changes in the initial listings. The *Brazing Manual* list, in some respects, was used without any of the testing and restrictions normally incorporated in a specification. The *Brazing Manual* was revised again in 1991 and published as the *Brazing Handbook*.

About 1978, the AWS Brazing and Soldering Committee recognized the need for a specification. About two years later, the project was transferred to the Filler Metal Committee and the Subcommittee on Fluxes and Filler Metals for Brazing for preparation of the specification. It was at that point, that the magnitude of the problem of writing a specification in an industry built on a foundation of proprietary products became apparent. ANSI/AWS A5.31-92 represents more than a decade of activity by a dedicated group of brazing specialists.

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

Official interpretations of any of the technical requirements of this standard may be obtained by sending a request, in writing, to the Managing Director, Technical Services, American Welding Society. A formal reply will be issued after it has been reviewed by the appropriate personnel following established procedures.

.....

Table of Contents

	Page No.
<i>Personnel</i>	iii
<i>Foreword</i>	v
<i>List of Tables</i>	viii
<i>List of Figures</i>	viii
1. Scope	1
<i>Part A — General Requirements</i>	
2. Classification	1
3. Acceptance	1
4. Certification	1
5. Units of Measure and Rounding-Off Procedure	1
<i>Part B — Tests, Procedures, and Requirements</i>	
6. Summary of Tests	1
7. Retests	3
8. Test Specimen	3
9. Flux Sample	4
10. Filler Metal	4
11. Water Content Test	4
12. Particle Test	4
13. Adherence Test	4
14. Sodium Glare Test	5
15. Fluidity Test (for all fluxes except FB3-E and FB3-K)	5
16. Fluxing Action Test	5
17. Flow Test	6
18. Life Test	6
<i>Part C — Manufacture, Identification, and Packaging</i>	
19. Method of Manufacture	6
20. Forms	6
21. Packaging	7
22. Marking of Packages	7
<i>Appendix — Guide to AWS Specification for Fluxes for Brazing and Braze Welding</i>	
A1. Introduction	9
A2. Classification System	9
A3. Certification	9
A4. Ventilation During Brazing	9
A5. Brazing Considerations	10
A6. Description and Intended Use of Brazing Fluxes	10
<i>AWS Filler Metal Specifications and Related Documents</i>	13

List of Tables

Table		Page No.
1	Classification of Brazing Fluxes with Brazing or Braze Welding Filler Materials	2
2	Required Tests	2
3	Conditions for Fluxing Action, Flow and Life Tests	3

List of Figures

Figure		Page No.
1	Test Specimen Approximately 0.040 in. Thick	4

Specification for Fluxes for Brazing and Braze Welding

1. Scope

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

Part A *General Requirements*

2. Classification

2.1 The brazing fluxes covered by this specification are classified according to the filler metal, form, and activity temperature range for which they are applicable as specified in Table 1.

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

3. Acceptance

Acceptance of the material shall be based on meeting the requirements of this specification.

4. Certification

By affixing the AWS specification and classification to the unit package, the manufacturer certifies that the flux meets the requirements of this specification. (See Section A3.)

5. Units of Measure and Rounding-Off Procedure

5.1 U.S. customary units are the standard units of measure in this specification except where SI units are noted for flux sample weights. The SI units are given as equivalent values to the U.S. customary units. The standard sizes and dimensions in the two systems are not identical and for this reason conversion from a standard size or dimension in one system will not always coincide with a standard size or dimension in the other. Suitable conversions encompassing standard sizes of both can be made, however, if appropriate tolerances are applied in each case.

5.2 For purposes of determining conformance with this specification, 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 value for other quantities in accordance with the rounding-off method given in ASTM E29, *Recommended Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications*.¹

Part B **Tests, Procedures, and Requirements**

6. Summary of Tests

6.1 The tests required for each flux classification are specified in Table 2. These tests include tests for the water content, maximum particle size, adherence to a

1. ASTM standards can be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

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

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

*Flux 3B in the Brazing Manual, 3rd Edition, 1976 has been discontinued. Type 3B has been divided into types FB3-C and FB3-D.

Notes:

- 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 Section A6 and the latest issue of the Brazing Handbook for further assistance.
- See 11.2 and 11.3 for the difference between paste flux and slurry flux.

Table 2
Required Tests

AWS Flux Classification	Form	Water Content	Particle Test	Adherence	Sodium Glare	Fluidity	Fluxing Action	Flow	Life
FB1-A	Powder	X				X	X	X	
FB1-B	Powder	X				X	X	X	
FB1-C	Powder	X				X	X	X	
FB2-A	Powder	X				X	X	X	
FB3-A	Paste	X	X	X	X	X	X	X	X
FB3-C	Paste	X	X	X	X	X	X	X	X
FB3-D	Paste	X	X	X	X	X	X	X	X
FB3-E	Liquid	X	X				X	X	
FB3-F	Powder	X			X	X	X	X	X
FB3-G	Slurry	X	X	X	X	X	X	X	X
FB3-H	Slurry	X	X	X	X	X	X	X	X
FB3-I	Slurry	X	X	X	X	X	X	X	X
FB3-J	Powder	X			X	X	X	X	X
FB3-K	Liquid		X				X	X	
FB4-A	Paste	X	X	X	X	X	X	X	X

test specimen, and the presence or absence of sodium glare when heating with a torch flame. They are also used to determine the fluidity at high temperature, fluxing action, 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 used, and the results required are given in Part B, Sections 8 through 18 and Table 3.

6.2 The shelf-life requirement shall be a minimum of six (6) months from date of manufacture when stored in its original unopened container. Alternate minimum storage periods shall be as agreed upon between the supplier and purchaser.

7. Retests

If any test fails to meet its requirement, that test shall be repeated twice. The results of both tests shall meet the requirement. Samples for retest shall be taken from the original test sample or from a new test sample.

8. Test Specimen

8.1 The test specimen, Figure 1, shall be a rectangular sheet, 1.25 in. (30 mm) wide, 2.5 in. (60 mm) long, and approximately 0.040 in. (1 mm) thick, of the base metal given in Table 3.

8.2 Except as noted in 8.3 and 8.4, the surface of the test specimen shall be prepared by degreasing, polishing with a grade 200 abrasive paper or cloth, washing, drying, wiping with a cloth soaked in light petroleum oil, and wiping dry with a clean dry cloth.

8.3 The surface of the aluminum test specimen shall be prepared by degreasing, caustic etching [5% NaOH at 170° F (77° C)], desmuting (50% HNO₃ at room temperature), water rinsing, and drying.

8.4 The surface of the magnesium test specimen shall be prepared by degreasing, immersed for 2 minutes in a ferric nitrate bright pickle solution [1.5 lb (0.68 kg) chromic acid, 5.33 oz (0.15 kg) ferric nitrate, 0.5 oz (0.014 kg) potassium fluoride per gallon of water at 60–100° F (16–38° C)], water rinsing, and drying.

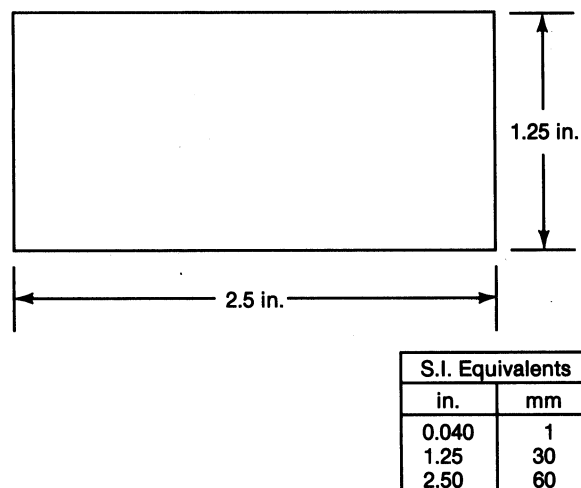
Table 3
Conditions for Fluxing Action, Flow and Life Tests

AWS Flux Classification	AWS Filler Metal Classification	Base Metal		Test Temperature ¹		Flow Area	
		Common Name	UNS Number ²	° F	° C	Sq. in.	Sq. mm
FB1-A	BAISi-4	3003 aluminum	A93003	1135	613	0.2	129
FB1-B	BAISi-4	3003 aluminum	A93003	1135	613	0.2	129
FB1-C	BAISi-4	3003 aluminum	A93003	1135	613	NR ³	NR ³
FB2-A	BMg-1	AZ31B magnesium	M11311	1130	610	NR ³	NR ³
FB3-A	BAG-7	1008 carbon steel	G10080	1300	705	0.25	161
FB3-C	BAG-24	304 stainless steel	S30400	1400	760	0.25	161
FB3-D	RBCuZn-D	304 stainless steel	S30400	1850	1010	0.25	161
	BNi-2	304 stainless steel	S30400	1900	1040	0.25	161
FB3-E	BAG-7	304 stainless steel	S30400	1300	705	NR ³	NR ³
FB3-F	BAG-7	1008 carbon steel	G10080	1300	705	0.25	161
FB3-G	BAG-7	1008 carbon steel	G10080	1300	705	0.25	161
FB3-H	BAG-24	1008 carbon steel	G10080	1400	760	0.25	161
FB3-I	RBCuZn-D	304 stainless steel	S30400	1850	1010	0.25	161
	BNi-2	304 stainless steel	S30400	1900	1040	0.25	161
FB3-J	RBCuZn-D	304 stainless steel	S30400	1850	1010	0.25	161
	BNi-2	304 stainless steel	S30400	1900	1040	0.25	161
FB3-K	RBCuZn-D	1008 carbon steel	G10080	1750	955	NR ³	NR ³
FB4-A	BAG-6	C613 aluminum bronze	C61300	1525	830	0.25	161

1. Temperature tolerances shall be $\pm 15^{\circ}\text{F}$ ($\pm 8^{\circ}\text{C}$).

2. ASTM/SAE Unified Number System for Metals and Alloys, published by SAE, Inc., 400 Commonwealth Drive, Pittsburgh, Pennsylvania 15096.

3. NR—No flow requirement. Wetting of base metal by the filler metal is all that is required.



**Figure 1 — Test Specimen
Approximately 0.040 in. Thick**

9. Flux Sample

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

10. Filler Metal

10.1 For all flux classifications, except FB3-D, FB3-I and FB3-J when testing with the BNi-2 filler metal, the filler metal shall be a 1/2 in. (13 mm) length of 1/16 in. (1.6 mm) diameter wire of the AWS classification given in Table 3.

10.2 For the flux classifications FB3-D, FB3-I and FB3-J when testing with the BNi-2 filler metal, the filler metal shall be 0.2 gm of powder or rod.

11. Water Content Test

11.1 The water content shall be determined with the following procedure (all weights shall be determined to the nearest 0.01 gm):

- (1) Determine the weight of a dry 50 ml glass beaker.
- (2) Place a 3 gm sample of the flux into the beaker.
- (3) Determine the weight of the wet flux by weighing the flux and beaker, and subtracting the weight of the beaker.
- (4) Place the beaker in a vacuum assist desiccator containing activated silica gel mixed with a small amount of blue gel.
- (5) Cover the desiccator and dry with vacuum assist for 48 hours.

(6) Determine the weight of the dry flux by weighing the flux and beaker, and subtracting the weight of the beaker.

(7) Calculate the water content as follows:

$$\text{Water content (\%)} = \frac{(\text{wet flux wt.} - \text{dry flux wt.}) \times (100)}{\text{wet flux wt.}}$$

11.2 Paste fluxes shall have a water content of 15 to 35 percent.

11.3 Slurry fluxes shall have a water content of 30 to 60 percent.

11.4 Liquid fluxes shall have a water content of 82 to 90 percent.

11.5 Powder fluxes shall have a moisture content of less than or equal to 5 percent.

12. Particle Test

12.1 The particle consistency of a paste flux is acceptable when the entire amount of a 60 gm sample will pass through a U.S.A. Standard Testing Sieve 425 μm (No. 40). The screen shall conform to ASTM E11, *Specification for Wire-Cloth Sieves for Testing Purposes*. Heating at 180° F (82° C) for one hour before testing is permissible.

12.2 The particle consistency of a slurry flux is acceptable when the entire amount of a 60 gm sample will pass through a U.S.A. Standard Testing Sieve 106 μm (No. 140).

12.3 Liquid fluxes shall not exhibit any visible particles when examined without magnification.

13. Adherence Test

The adherence characteristics of the flux shall be determined with the following procedures:

13.1 For temperatures below the activity temperature range the following apply:

13.1.1 Using a brush, apply a layer of flux approximately 1/32 in. (0.8 mm) thick to one surface of a test specimen, see Figure 1, and for base metal see Table 3.

13.1.2 Examination No. 1. Examine the surface for areas of nonwetting.

13.1.3 Allow the flux to dry in air at room temperature with the longitudinal axis of the test specimen inclined at approximately 60° from the horizontal.

13.1.4 Examination No. 2. Examine surface for areas of flux loss or retraction.

13.1.5 With the same test specimen inclined at approximately 60°, heat in an air atmosphere furnace which has been preheated to 100°F (55°C) below the minimum activity temperature of Table 1, hold at temperature for three minutes, and air cool to room temperature.

13.1.6 Examination No. 3. Examine surface for areas of flux loss or retraction.

13.2 The results of the tests are acceptable when each of the three examinations indicates that the flux coating is continuous, i.e., free from areas of nonwetting or areas of flux loss or retraction.

13.3 Minimum Activity Temperature

13.3.1 Apply 1.4 gm of flux as a uniform coating to one surface of the test specimen, Figure 1, of base metal specified in Table 3, and dry in air at room temperature.

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

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

14. Sodium Glare Test

14.1 One surface of a test specimen, Figure 1 of base metal specified in Table 3, shall be generously coated with flux. It shall then be heated with an oxyacetylene flame, adjusted to a slightly acetylene-rich (reducing) condition, to approximately 100°F (56°C) above the minimum activity temperature of the flux being evaluated, see Table 1.

14.2 The result of the test is acceptable if an orange glare from the flux is not visible during heating. In cases of doubt, the sodium content shall not exceed 0.04 percent, as determined by spectrochemical analysis or an equivalent mutually acceptable process.

15. Fluidity Test (for all fluxes except FB3-E and FB3-K)

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

15.1.1 Place a 10 gm sample of flux in a nonreactive crucible.

15.1.2 Heat the crucible in a preheated furnace with an air atmosphere to the minimum activity temperature of Table 1 and hold at temperature for five minutes.

15.1.3 Remove the crucible and immediately observe the degree of fluidity of the molten flux at that temperature by tilting the crucible.

15.1.4 Heat the crucible in a preheated furnace with an air atmosphere to the maximum activity temperature of Table 1 and 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.

15.1.6 When the furnace thermocouple indicates that the furnace is at the minimum activity temperature, remove the crucible and observe the degree of fluidity at that temperature by again tilting the crucible.

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

16. Fluxing Action Test

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

16.1.1 Apply 1.4 gm of flux as a uniform coating to one surface of the test specimen, Figure 1, of base metal specified in Table 3. Place the prefluxed filler metal sample (see 10.1, 10.2, and Table 3) on the test specimen, and dry in air at room temperature.

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

16.1.3 Clean the test specimen by soaking in warm water.

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

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

- (1) Use a No. 48 drill size torch tip.
- (2) Set both oxygen and acetylene pressure at 7 psig.
- (3) Place filler metal on a test specimen which has a blue oxidized surface
- (4) With the tip 5 in. (127 mm) above the test specimen, heat to 1400°F (760°C), and air cool to room temperature.

16.2.2 Use temperature indicating crayons, or equivalent, to measure temperature.

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

17. Flow Test

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

17.1.1 Apply 1.4 gm of flux as a uniform coating to one surface of the test specimen, Figure 1 of base metal specified in Table 3, and place the prefluxed filler metal on the test specimen. Dry in air at room temperature.

17.1.2 With the test specimen in a horizontal position, heat in air in a furnace preheated to the test temperature shown in Table 3, hold for five minutes at the test temperature, remove the test specimen and air cool to room temperature.

17.1.3 Clean the test specimen by soaking in warm water.

17.2 For FB3-K flux, the extent of filler metal flow shall be determined as follows:

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

- (1) Use a No. 48 drill size torch tip.
- (2) Set both oxygen and acetylene pressure at 7 psig.
- (3) Place the filler metal on the test specimen.
- (4) With the torch tip 5 in. (125 mm) above the test specimen, heat to 1750° F (955° C) and air cool.

17.2.2 Use temperature indicating crayon, or equivalent, to measure temperature.

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

18. Life Test

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

18.1.1 Apply approximately 1.4 gm of flux as a uniform coating to one surface of the test specimen, Figure 1 of base metal specified in Table 3, and dry in air at room temperature.

18.1.2 Heat in the furnace preheated to the test temperature shown in Table 3 with the test specimen in a horizontal position, and hold for ten minutes at the test temperature.

18.1.3 Place the unfluxed filler metal on the test specimen in the furnace.

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

18.1.5 Clean the test specimen by soaking in warm water.

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

Part C **Manufacture, Identification, and Packaging**

19. 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.²

20. Forms

20.1 Standard forms for brazing fluxes shall be powder, paste, slurry, or liquid, as shown in Table 1.

20.2 A flux in paste form shall meet the requirements of 11.2.

20.3 A flux in slurry form shall be suitable for use with automatic flux dispensing equipment and meet the requirements of 11.3.

20.4 A flux in liquid form shall be suitable for use with flux spraying equipment and meet the requirements of 11.4.

20.5 A flux in powder form shall meet the requirements of 11.5.

2. For further description of the classification of grades of chemicals, refer to Manufacturing Chemists Association, 1825 Connecticut Avenue N.W., Washington, DC 20009.

21. Packaging

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

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

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

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

22. Marking of Packages

22.1 The following product information (as a minimum) shall be legibly marked on the outside of each unit package:

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

22.2 The following precautionary information (as a minimum) shall be prominently displayed in legible print on all applicable packages of flux, including individual applicable unit packages enclosed within a larger package.

WARNING: CONTAINS FLUORIDES. Protect yourself and others. Read and understand this label.

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

- Before use, read, understand, and follow manufacturer's instructions, Material Safety Data Sheets (MSDSs), and your employer's safety practices.
- Keep your head out of the fumes.
- Use enough ventilation, exhaust at the work, 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 out of the reach of children.
- See American National Standard Z49.1, *Safety in Welding and Cutting* published by the American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135; *OSHA Safety and Health Standards, 29 CFR 1910*, available from the U.S. Government Printing Office, Washington, DC 20402.

First Aid: If flux contacts eyes, flush immediately with clean 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 LABEL

Copyright 2003 American Welding Society, Inc.

Appendix

Guide to AWS Specification for Fluxes for Brazing and Braze Welding

(This Appendix is not a part of ANSI/AWS A5.31-92, *Specification for Fluxes for Brazing and Braze Welding*, but is included for information only.)

A1. Introduction

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

A2. Classification System

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

A3. Certification

The act of placing the AWS specification and classification designation on the packaging enclosing the product constitutes the supplier's (manufacturer's) certification that the product meets all of 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 representative material tested met the requirements of the specification. Representative material, in this case, is any production run of that classification using the same formulation and manufacturing procedures. "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 made. The basis for the certification required by the specification is the classification tests of "representative material" cited above.

A4. Ventilation During Brazing

A4.1 Five major factors govern the quantity of fumes in the atmosphere to which brazers, brazing operators, and other personnel are exposed during brazing:

- (1) Dimensions of the space in which brazing is done (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 brazers, brazing operators, and other persons to the fumes as the fumes issue from the brazing zone, and to the gases and dusts in the space in which they are working
- (5) The ventilation provided to the space in which the brazing is done

A4.2 American National Standard Z49.1, *Safety in Welding and Cutting*, published by the American Welding Society, discusses the ventilation that is required during brazing and should be referred to for details. Attention is drawn particularly to the section of that document on Ventilation.

A5. Brazing Considerations

A5.1 Successful brazing requires that the surfaces of the workpieces 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 may be 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.

A5.2 Brazing fluxes are mixtures of chemical compounds which 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 this protective, cleaning, and fluxing action with the specific filler metals being used, in conjunction with the other brazing variables; such as, base metal, brazing process, mass of the workpieces, and method of flux application. For further information, refer to the *Brazing Handbook*, published by the American Welding Society.

A6. Description and Intended Use of Brazing Fluxes

A6.1 FB1-A is a brazing flux in powder form intended for torch and furnace brazing of aluminum and its brazeable alloys. It consists primarily of fluorides and chlorides of some of the alkali metals. Water or alcohol may be used for thinning.

A6.2 FB1-B is a brazing flux in powder form intended for furnace brazing of aluminum and its brazeable alloys. The lower end of its activity temperature range is slightly lower than that of the FB1-A classification. It consists primarily of fluorides and chlorides of some of the alkali metals. Water or alcohol may be used for thinning.

A6.3 FB1-C is a brazing flux in powder form intended for salt-bath dip brazing of aluminum and its brazeable

alloys. The lower end of its activity temperature range is much lower than that of the FB1-A and FB1-B classifications. It consists primarily of fluorides and chlorides of some of the alkali metals. Water should be avoided in the flux or removed prior to immersion of the brazement in the salt bath.

A6.4 FB2-A is a brazing flux in powder form intended for 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 immersion of the brazement in the salt bath.

A6.5 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, such as aluminum, which form refractory oxides. It consists primarily of boric acid, borates, and complex fluorine compounds. Water is used for thinning.

A6.6 FB3-C is a brazing flux in paste form similar to FB3-A, except that the activity temperature range extends to a higher temperature, and it may contain elemental boron. Water is used for thinning.

A6.7 FB3-D is a brazing flux in paste form intended for 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 complex fluorine compounds. It may contain elemental boron. Water is used for thinning.

A6.8 FB3-E is a low-activity liquid brazing flux used in the torch brazing of jewelry or to augment borderline furnace brazing atmospheric conditions. Flux usually is applied by dipping or by the use of semi- or fully-automatic spray dispensing equipment. The flux constituents are similar to those in FB3-D fluxes.

A6.9 FB3-F is a brazing flux somewhat similar to the FB3-A flux, except that no vehicle is added to the powder during manufacture. In application, water may be used as a thinning vehicle.

A6.10 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 FB3-A flux. Water may be used as the thinning vehicle.

A6.11 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 FB3-C flux. The flux typically contains complex borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

A6.12 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 FB3-D flux. The flux typically contains complex borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

A6.13 FB3-J is a brazing flux in powder form for areas of application similar to those of the FB3-D flux. The flux typically contains complex borates and fluoride compounds plus powdered boron. Water may be used as the thinning vehicle.

A6.14 FB3-K is a liquid flux used almost exclusively in torch brazing. The fuel gas is passed through the con-

tainer 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.

A6.15 FB4-A is a brazing flux in paste form intended for brazing of copper alloys and other base metals containing up to 9 percent aluminum, e.g., 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, complex fluorine compounds, and complex chlorine compounds. Water is used for thinning.

AWS Filler Metal Specifications and Related Documents

AWS Designation	Title
FMC	Filler Metal Comparison Charts
A4.2	Standard Procedures for Calibrating Magnetic Instruments to Measure the Delta Ferrite Content of Austenitic and Duplex Austenitic-Ferritic Stainless Steel Weld Metal
A4.3	Standard Methods for Determination of the Diffusible Hydrogen Content of Martensitic, Bainitic, and Ferritic Steel Weld Metal Produced by Arc Welding
A5.01	Filler Metal Procurement Guidelines
A5.1	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
A5.2	Specification for Carbon and Low Alloy Steel Rods for Oxyfuel Gas Welding
A5.3	Specification for Aluminum and Aluminum Alloy Electrodes for Shielded Metal Arc Welding
A5.4	Specification for Stainless Steel Welding Electrodes for Shielded Metal Arc Welding
A5.5	Specification for Low Alloy Steel Covered Arc Welding Electrodes
A5.6	Specification for Covered Copper and Copper Alloy Arc Welding Electrodes
A5.7	Specification for Copper and Copper Alloy Bare Welding Rods and Electrodes
A5.8	Specification for Filler Metals for Brazing and Braze Welding
A5.9	Specification for Bare Stainless Steel Welding Electrodes and Rods
A5.10	Specification for Bare Aluminum and Aluminum Alloy Welding Electrodes and Rods
A5.11	Specification for Nickel and Nickel Alloy Welding Electrodes for Shielded Metal Arc Welding
A5.12	Specification for Tungsten and Tungsten Alloy Electrodes for Arc Welding and Cutting
A5.13	Specification for Solid Surfacing Welding Rods and Electrodes
A5.14	Specification for Nickel and Nickel Alloy Bare Welding Electrodes and Rods
A5.15	Specification for Welding Electrodes and Rods for Cast Iron
A5.16	Specification for Titanium and Titanium Alloy Welding Electrodes and Rods
A5.17	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
A5.18	Specification for Carbon Steel Filler Metals for Gas Shielded Arc Welding
A5.19	Specification for Magnesium Alloy Welding Rods and Bare Electrodes
A5.20	Specification for Carbon Steel Electrodes for Flux Cored Arc Welding
A5.21	Specification for Composite Surfacing Welding Rods and Electrodes
A5.22	Specification for Flux Cored Corrosion-Resisting Chromium and Chromium-Nickel Steel Electrodes
A5.23	Specification for Low Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
A5.24	Specification for Zirconium and Zirconium Alloy Welding Electrodes and Rods
A5.25	Specification for Carbon and Low Alloy Steel Electrodes and Fluxes for Electroslag Welding
A5.26	Specification for Carbon and Low Alloy Steel Electrodes for Electrogas Welding
A5.27	Specification for Copper and Copper Alloy Rods for Oxyfuel Gas Welding
A5.28	Specification for Low Alloy Steel Filler Metals for Gas Shielded Arc Welding
A5.29	Specification for Low Alloy Steel Electrodes for Flux Cored Arc Welding
A5.30	Specification for Consumable Inserts
A5.31	Specification for Fluxes for Brazing and Braze Welding

For ordering information, contact Global Engineering Documents, an Information Services Handling (IHS) Group company, 15 Inverness Way East, Englewood, Colorado 80112-5776; telephones (800) 854-7179, (303) 397-7956; fax (303) 397-2740; Internet: www.global.ihs.com.

2003-03-09 10:00:00