

**AWS B2.2/B2.2M:2010
An American National Standard**

**Approved by the
American National Standards Institute
July 7, 2009**

Specification for Brazing Procedure and Performance Qualification

3rd Edition

Supersedes ANSI/AWS B2.2-91

Prepared by the
American Welding Society (AWS) B2 Committee on Procedure and Performance Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by the
AWS Board of Directors

Abstract

This specification provides the requirements for qualification of brazing procedure specifications, brazers, and brazing operators for manual, mechanized, and automatic brazing. The brazing processes included are torch brazing, furnace brazing, diffusion brazing, resistance brazing, dip brazing, infrared brazing, and induction brazing. Base metals, brazing filler metals, brazing fluxes, brazing atmospheres, and brazing joint clearances are also included.



American Welding Society

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

International Standard Book Number: 978-0-87171-762-7
American Welding Society
550 N.W. LeJeune Road, Miami, FL 33126
© 2009 by American Welding Society
All rights reserved
Printed in the United States of America
Amended: April 22, 2010

Photocopy Rights. No portion of this standard may be reproduced, stored in a retrieval system, or transmitted in any form, including mechanical, photocopying, recording, or otherwise, without the prior written permission of the copyright owner.

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 provided that the appropriate fee is paid to the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, tel: (978) 750-8400; Internet: <www.copyright.com>.

Statement on the Use of American Welding Society 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 American National 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.

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 the 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 guarantee or warranty as to the accuracy or completeness of any information published herein.

In issuing and making this standard available, AWS is neither 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. It is assumed that the use of this standard and its provisions are entrusted to appropriately qualified and competent personnel.

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 or trade name. Users of this standard accept any and all liabilities for infringement of any patent or trade name items. AWS disclaims liability for the infringement of any patent or product trade name resulting from the use of this standard.

Finally, the 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 only be obtained by sending a request, in writing, to the appropriate technical committee. Such requests should be addressed to the American Welding Society, Attention: Managing Director, Technical Services Division, 550 N.W. LeJeune Road, Miami, FL 33126 (see Annex G). With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. These opinions are offered solely as a convenience to users of this standard, and they do not constitute professional advice. 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 B2 Committee on Procedure and Performance Qualification. It must be reviewed every five years, and if not revised, it must be either reaffirmed 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 B2 Committee on Procedure and Performance Qualification 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 B2 Committee on Procedure and Performance Qualification 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.

This page is intentionally blank.

Personnel

AWS B2 Committee on Procedure and Performance Qualification

J. J. Fluckiger, Chair	<i>Idaho National Laboratory</i>
J. L. Cooley, 1st Vice Chair	<i>J. C. & Associates, Incorporated</i>
E. W. Beckman, 2nd Vice Chair	<i>International Training Institute</i>
S. Morales, Secretary	<i>American Welding Society</i>
L. P. Connor	<i>Consultant</i>
W. D. Doty	<i>Doty and Associates, Incorporated</i>
E. H. Gray	<i>U.S. Nuclear Regulatory Commission</i>
B. J. Hable	<i>Ford Motor Company</i>
M. Herrle	<i>Arise, Incorporated</i>
R. A. LaFave	<i>Elliott Company, Incorporated</i>
K.Y. Lee	<i>The Lincoln Electric Company</i>
K. M. McTague	<i>Factory Mutual</i>
A. S. Olivares	<i>HSB Global Standards</i>
J. F. Pike	<i>NASA Langley Research Center</i>
W. M. Ruof	<i>Bechtel Plant Machinery, Incorporated</i>
J. J. Sekely	<i>Welding Services, Incorporated</i>
M. R. Stone	<i>Canadian Welding Bureau</i>
G. M. Wisbrock, Jr.	<i>Lockheed Martin Missiles & Fire Control (Retired)</i>
R. K. Wiswesser	<i>Welder Training and Testing Institute</i>

Advisors to the AWS B2 Committee on Procedure and Performance Qualification

W. L. Ballis	<i>Consultant</i>
J. D. Duncan	<i>Consultant</i>
N. K. Kanaya	<i>BEAR Testing Laboratory</i>
B. B. MacDonald	<i>Consultant</i>
A. W. Sindel	<i>Alstom Power, Incorporated</i>
C. E. Spaeder, Jr.	<i>Aristech Chemical Corporation</i>
W. J. Sperko	<i>Sperko Engineering Services</i>
R. F. Waite	<i>Consultant</i>

AWS B2A Subcommittee on Brazing Qualification

J. L. Cooley, Chair	<i>J. C. & Associates, Incorporated</i>
S. Morales, Secretary	<i>American Welding Society</i>
J. J. Fluckiger	<i>Idaho National Laboratory</i>
L. Guimaraes	<i>National Automotive Corporation</i>
R. A. LaFave	<i>Elliott Company, Incorporated</i>
*R. L. Peaslee	<i>Wall Colmonoy Corporation</i>
W. J. Sperko	<i>Sperko Engineering Services</i>
K. P. Thornberry	<i>Care Medical, Incorporated</i>
G. M. Wisbrock, Jr.	<i>Lockheed Martin Missiles and Fire Control (Retired)</i>
R. K. Wiswesser	<i>Welder Training and Testing Institute</i>

*Deceased

Advisors to the AWS B2A Subcommittee on Brazing Qualification

W. D. Rupert	<i>Wolverine Joining Technologies</i>
J. J. Sekely	<i>Welding Services, Incorporated</i>
C. E. Spaeder, Jr.	<i>Aristech Chemical Corporation</i>

Foreword

This foreword is not part of AWS B2.2/B2.2M:2010, *Specification for Brazing Procedure and Performance Qualification*, but is included for informational purposes only.

The AWS B2 Committee on Procedure and Performance Qualification was formed in 1979. The first edition of B2.1, *Standard for Welding Procedure and Performance Qualification*, was published in 1984. This standard introduced the concept of Standard Welding Procedure Specifications (SWPSs) in addition to a set of rules for qualifying welding procedures, welders, and welding operators. The following edition, renamed B2.1:1998, *Specification for Welding Procedure and Performance Qualification*, was an extensive revision of B2.1-84. The Committee has published sixty-two Standard Welding Procedure Specifications; B2.2, *Specification for Brazing Procedure and Performance Qualification*; B2.3, *Specification for Soldering Procedure and Performance Qualification*; and B2.4, *Specification for Welding Procedure and Performance Qualification for Thermoplastics*.

This is the third edition of AWS B2.2, *Specification for Brazing Procedure and Performance Qualification*. AWS B2.2 was first published in 1985. AWS B2.2-85, *Standard for Brazing Procedure and Performance Qualification*, was first revised in 1991. This edition supersedes B2.2-91 and has renamed the standard. Also incorporated into this standard are four amendments correcting 4.3.11.2 to require a minimum overlap, standardizing the magnification requirements for macroetch tests in 4.2.5.1 and 5.3.3.2, and clarifying verbiage for visual examination in 5.2.1. Underlined text in clauses, tables, or figures indicates an editorial or technical change from the 1991 edition. A vertical line in the margin also indicates a revision from the 1991 edition.

This standard originated in the B2A Subcommittee on Brazing Qualification. The B2A Subcommittee was formed in the early 1980s in order to explicitly address the unique requirements of brazing procedure and brazing performance qualification outside the spectrum of B2.1, *Specification for Welding Procedure and Performance Qualification*.

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary, AWS B2 Committee on Procedure and Performance Qualification, American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126.

This page is intentionally blank.

Table of Contents

	Page No.
<i>Personnel</i>	v
<i>Foreword</i>	vii
<i>List of Tables</i>	x
<i>List of Figures</i>	x
<i>List of Forms</i>	x
1. Scope	1
1.1 Base Metals	1
1.2 Filler Metals	2
2. Normative References	2
3. Terms and Definitions	3
4. Brazing Procedure Qualification	4
4.1 General	4
4.2 Test Brazements and Acceptance Criteria	5
4.3 Qualification Variables	7
5. Brazing Performance Qualification	14
5.1 General	14
5.2 Qualification by Visual Examination	14
5.3 Qualification by Specimen Testing	15
5.4 Qualification Variables for Brazers	16
5.5 Qualification Variables for Brazing Operators	17
Annex A (Normative)—Brazing Flow Positions, Specimens, Tension Test, Bend Test, and Suggested Forms	23
Annex B (Normative)—Base Metal Groups	37
Annex C (Normative)—Filler Metal Groups	53
Annex D (Informative)—Brazing Fluxes	61
Annex E (Informative)—Brazing Atmospheres	63
Annex F (Informative)—Brazing Joint Design	65
Annex G (Informative)—Guidelines for the Preparation of Technical Inquiries	67
List of AWS Documents on Welding Procedure and Performance Qualification	69

List of Tables

Table		Page No.
<u>4.1</u>	Procedure Qualification Test Brazement	9
<u>4.2</u>	Thickness Range Qualified for Butt, Scarf, and Lap Joints	9
<u>5.1</u>	Base Metals Qualified	18
<u>5.2</u>	Brazing Test Position Qualified by Position of Test Brazement	18
B.1	Base Metal Groups	39
C.1	Filler Metal Groups	54
D.1	Classification of Brazing Fluxes with Brazing or Braze Welding Filler Materials	61
E.1	Brazing Atmosphere Types	63
F.1	Joint Clearance	65

List of Figures

Figure		Page No.
<u>4.1</u>	Cutting Plan of Test Brazement for Butt Joints in Plate	10
<u>4.2</u>	Cutting Plan of Test Brazement for Lap Joints, Single and Double Spliced Butt Joints, and Rabbet Joints in Plate	11
<u>4.3</u>	Cutting Plan of Test Brazement for Lap Joints and Single and Double Spliced Butt Joints in Plate	12
<u>4.4</u>	Cutting Plan of Test Brazement for Procedure Qualification Joints in Pipe and Tube of Greater Than 3 in [75 mm] Outside Diameter	13
<u>4.5</u>	Typical Workmanship Test Brazements	13
<u>5.1</u>	Plate Performance Qualification—Section Testing	19
<u>5.2</u>	Plate Performance Qualification—Peel Testing	20
<u>5.3</u>	Pipe Performance Qualification	21
A.1A	Brazing Test Positions	25
A.1B	Qualified Production Position(s)	26
A.2A	Tension—Reduced Section for Butt and Scarf Joints—Plate	27
A.2B	Tension—Reduced Section for Butt, Lap, and Scarf—Pipe	28
A.2C	Tension—Reduced Section for Lap and Rabbet Joints—Plate	29
A.2D	Tension—Full Section for Lap, Scarf, and Butt Joints—Small Diameter Pipe	30
A.3A	Bend Specimen for Butt Joints	31
A.3B	Bend Test for Butt Joints	32

List of Forms

Form		Page No.
<u>A-1</u>	Brazing Procedure Specification (BPS)	33
<u>A-2</u>	Brazing Procedure Qualification Record (BPQR)	34
<u>A-3</u>	Brazing Performance Qualification Record	36

Specification for Brazing Procedure and Performance Qualification

1. Scope

This specification provides the requirements for qualification of Brazing Procedure Specifications (BPSs). This specification also provides requirements for the performance qualification of brazers and brazing operators. This specification is intended for use where referenced by a product standard or contract document.

Employers shall be responsible for the brazing done by their organization, including the use of qualified brazing procedures, qualified brazers, and qualified brazing operators. It is the Employer's responsibility to assure that Brazing Procedure Specifications meet any additional requirements of the Referencing Document. Each Employer shall maintain the applicable Brazing Procedure Specifications, Brazing Procedure Qualification Records (BPQRs), and Brazing Performance Qualification Records during the period of their use.

When not otherwise specified by the Referencing Document, the edition of this specification to be used shall be established in accordance with the following: (1) editions may be used at any time after the effective date of issue; (2) the latest edition of this document should be used for new contracts; (3) editions established by contract date may be used during the entire term of the contract, or the provisions of later editions may be used when agreed upon by the contracting parties.

This document is intended primarily for use with the following brazing processes:

- (1) Torch Brazing (TB)
- (2) Furnace Brazing (FB)
- (3) Induction Brazing (IB)
- (4) Resistance Brazing (RB)
- (5) Dip Brazing (DB)
- (6) Infrared Brazing (IRB)
- (7) Diffusion Brazing (DFB)

This standard makes use of both U.S. Customary Units and the International System of Units (SI). The latter are shown within brackets ([]) or in appropriate columns in tables and figures. The measurements may not be exact equivalents; therefore, each system must be used independently.

Safety and health issues and concerns are beyond the scope of this standard and therefore are not fully addressed herein. Safety and health information is available from other sources, including, but not limited to, ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, and applicable federal, state, and local regulations.

1.1 Base Metals. The grouping of base metals by Base Metal Number (BM No.) in Table B.1 has been made on the basis of metallurgical compatibility, chemical composition, and brazeability to decrease the number of required brazing qualifications. The grouping does not imply that base metals may be indiscriminately substituted within the same BM No. without consideration of their applicability. For some materials or combinations of materials, additional tests may be required by the procuring activity, the Referencing Document, or the design engineer.