

**AWS B2.2/B2.2M:2016**  
**An American National Standard**

# **Specification for Brazing Procedure and Performance Qualification**



**AWS B2.2/B2.2M:2016  
An American National Standard**

**Approved by the  
American National Standards Institute  
August 5, 2016**

# **Specification for Brazing Procedure and Performance Qualification**

**4th Edition**

**Supersedes AWS B2.2/B2.2M:2010**

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.



ISBN: 978-0-87171-893-8  
© 2016 by American Welding Society  
All rights reserved  
Printed in the United States of America

**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](http://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 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 is entrusted to appropriately qualified and competent personnel.

This standard may be superseded by new editions. This standard may also be corrected through publication of amendments or errata, or supplemented by publication of addenda. Information on the latest editions of AWS standards including amendments, errata, and addenda is posted on the AWS web page ([www.aws.org](http://www.aws.org)). Users should ensure that they have the latest edition, amendments, errata, and addenda.

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.

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

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, 8669 NW 36 St, # 130, Miami, FL 33166 (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 requested 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, 8669 NW 36 St, # 130, Miami, FL 33166.

This page is intentionally blank.

## Personnel

### AWS B2 Committee on Procedure and Performance Qualification

J. L. Cooley, Chair	<i>J. C. &amp; Associates, Incorporated</i>
H. R. Castner, 1st Vice Chair	<i>Edison Welding Institute</i>
E. W. Beckman, 2nd Vice Chair	<i>Consultant</i>
J. M. Rosario, Secretary	<i>American Welding Society</i>
D. M. Allbritten	<i>Consultant</i>
J. Alston	<i>Jefferson Lab</i>
M. Bernasek	<i>C-SPEC</i>
K. L. Bingham	<i>Los Alamos National Laboratory</i>
M. W. Bumgarner	<i>Bumgarner Welding &amp; Inspection, Incorporated</i>
M. C. Cook	<i>St. Louis Carpenters Apprenticeship Program</i>
T. A. Davenport	<i>PRL Industries, Incorporated</i>
J. J. Fluckiger	<i>Idaho National Laboratory</i>
E. H. Gray	<i>U.S. Nuclear Regulatory Commission</i>
M. F. Herrle	<i>Arise</i>
K. G. Kofford	<i>Idaho National Laboratory</i>
G. S. Michels	<i>Summit Design and Engineering Services</i>
S. D. Mobley	<i>Oak Ridge National Laboratory</i>
C. D. Morell	<i>U.S. Nuclear Regulatory Commission</i>
T. C. Mueller	<i>TransCanada Pipelines</i>
W. M. Ruof	<i>Bechtel Plant Machinery, Incorporated</i>
J. J. Sekely	<i>Welding Services, Incorporated</i>
M. L. Thomas	<i>Rocky Mountain Testing, LLC</i>
G. M. Wisbrock, Jr.	<i>Consultant</i>
R. K. Wiswesser	<i>Welder Training &amp; Testing Institute</i>

### Advisors to the AWS B2 Committee on Procedure and Performance Qualification

L. P. Connor	<i>Consultant</i>
B. J. Hable	<i>Ford Motor Company</i>
K. Y. Lee	<i>U.S. Department of Transportation</i>
B. B. MacDonald	<i>Consultant</i>
J. F. Pike	<i>NASA Langley Research Center</i>
F. A. Schweighardt	<i>Air Liquide Industrial U.S. LP</i>
A. W. Sindel	<i>GE Power, Steam Power Systems</i>
C. E. Spaeder, Jr.	<i>Consultant</i>
W. J. Sperko	<i>Sperko Engineering Services, Incorporated</i>
R. F. Waite	<i>Consultant</i>

### AWS B2A Subcommittee on Brazing Qualification

E. W. Beckman, Chair	<i>Consultant</i>
J. M. Rosario, Secretary	<i>American Welding Society</i>
K. L. Bingham	<i>Los Alamos National Laboratory</i>
J. L. Cooley	<i>J. C. &amp; Associates, Incorporated</i>

**AWS B2A Subcommittee on Brazing Qualification (Continued)**

J. J. Fluckiger	<i>Idaho National Laboratory</i>
C. D. Morell	<i>U.S. Nuclear Regulatory Commission</i>
W. J. Sperko	<i>Sperko Engineering Services, Incorporated</i>
M. L. Thomas	<i>Rocky Mountain Testing, LLC</i>
G. M. Wisbrock, Jr.	<i>Consultant</i>
R. K. Wiswesser	<i>Welder Training &amp; Testing Institute</i>

**Advisors to the AWS B2A Subcommittee on Brazing Qualification**

R. M. Henson	<i>Harris Products Group</i>
D. J. Jossick	<i>Lucas-Milhaupt, Incorporated</i>
R. A. LaFave	<i>LaFave Consulting Incorporated, LLC</i>
J. J. Sekely	<i>Welding Services, Incorporated</i>
C. E. Spaeder, Jr.	<i>Consultant</i>
K. P. Thornberry	<i>Care Medical, Incorporated</i>

## Foreword

This foreword is not part of this standard but is included for informational purposes only.

This specification 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/B2.1M, *Specification for Welding Procedure and Performance Qualification*.

This is the fourth edition of AWS B2.2/B2.2M, *Specification for Brazing Procedure and Performance Qualification*. AWS B2.2/B2.2M was first published in 1985. AWS B2.2-85, *Standard for Brazing Procedure and Performance Qualification*, was revised in 1991 and 2010.

The welding terms used in this specification shall be interpreted in accordance with the definitions given in the latest edition of AWS A3.0M/A3.0, *Standard Welding Terms and Definitions, Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting, and Thermal Spraying*. The application of brazing symbols shall conform to the requirements of AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

A vertical line in the margin or underlined text in clauses, tables, or figures indicates an editorial or technical change from the 2010 edition.

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, 8669 NW 36 St, # 130, Miami, FL 33166.



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
<b>1. General Requirements</b> .....	1
1.1 <u>Scope</u> .....	1
1.2 <u>Units of Measure</u> .....	2
1.3 <u>Safety</u> .....	2
<b>2. Normative References</b> .....	2
<b>3. Terms and Definitions</b> .....	3
<b>4. Brazing Procedure Qualification</b> .....	4
4.1 General .....	4
4.2 Test Brazements and Acceptance Criteria .....	4
4.3 Qualification Variables .....	6
<b>5. Brazing Performance Qualification</b> .....	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 .....	16
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 (Normative)—Brazing Atmospheres .....	61
Annex E (Normative)—Brazing Joint Design .....	63
Annex F (Informative)—Brazing Fluxes .....	65
Annex G (Informative)—Requesting an Official Interpretation on an AWS Standard .....	67
<u>Annex H (Informative)—Guidelines for Requesting Adoption of New Materials under the AWS     B2.2 Standard</u> .....	69
List of AWS Documents on Welding Procedure and Performance Qualification .....	71

## List of Tables

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

## List of Figures

Figure	Page No.
4.1 Cutting Plan of Test Brazement for Butt Joints in Plate .....	10
4.2 Cutting Plan of Test Brazement for Lap Joints, Single and Double Spliced Butt Joints, and Rabbet Joints in Plate .....	11
4.3 Cutting Plan of Test Brazement for Lap Joints and Single and Double Spliced Butt Joints in Plate.....	12
4.4 Cutting Plan of Test Brazement for Procedure Qualification Joints in Pipe and Tube of Greater Than 3 in [75 mm] Outside Diameter.....	13
4.5 Typical Workmanship Test Brazements.....	13
5.1 Plate Performance Qualification—Section Testing .....	19
5.2 Plate Performance Qualification—Peel Testing .....	20
5.3 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.
A-1 Brazing Procedure Specification (BPS).....	33
A-2 Brazing Procedure Qualification Record (BPQR).....	34
A-3 Brazing Performance Qualification ( <u>BPQ</u> ).....	36

# Specification for Brazing Procedure and Performance Qualification

## 1. General Requirements

**1.1 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 BPSs meet any additional requirements of the Referencing Document. Each Employer shall maintain the applicable BPSs, Brazing Procedure Qualification Records (BPQRs), and Brazing Performance Qualification (BPQ)s 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 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)

**1.1.1 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.

Base metals are identified by their American Society for Testing and Materials (ASTM), American Bureau of Shipping (ABS), or Unified Numbering System (UNS) designations. Cross reference specifications, listed in the UNS for Metals and Alloys opposite a given UNS No., are included in the same BM No. group as the given UNS No. An American Society of Mechanical Engineers (ASME) designation, is included in the same BM No. group.

Eight categories are included as follows:

- (1) Ferrous metals (BM Nos. 100 through 180)
- (2) Aluminum and aluminum alloys (BM Nos. 200 through 220)
- (3) Copper and copper alloys (BM Nos. 300 through 360)