AWS STANDARD WELDING PROCEDURE SPECIFICATION LICENSE

IMPORTANT—READ CAREFULLY BEFORE PROCEEDING

THE ENTITY OR INDIVIDUAL PURCHASING THIS AWS STANDARD WELDING PROCEDURE SPECIFICATION AGREES TO BE BOUND BY THE TERMS OF THIS LICENSE. IF YOU DO NOT AGREE TO THE TERMS OF THIS LICENSE, DO NOT USE THE STANDARD AND PROMPTLY RETURN THE PACKAGE UNOPENED, AND THE LICENSE PRICE WILL BE REFUNDED.

The enclosed **AWS STANDARD WELDING PROCEDURE SPECIFICATION ("SWPS")** is provided to the End User by the **American Welding Society ("AWS")** for use only under the terms of this License. AWS reserves any right not expressly granted to the End User.

1. Ownership: The SWPS is proprietary to AWS and is protected by United States and foreign copyright laws. AWS retains the title to, and ownership of, the SWPS, which is licensed, not sold, to the End User.

2. Acceptance of responsibility: Prior to use of an SWPS, the employer shall signify acceptance of responsibility for the production application of the procedure by signing and dating the SWPS on the appropriate page.

3. Definitions:

Authorized User shall mean an employee or contractor of the End User.

End User shall mean the purchaser of the SWPS.

4. License: The End User is granted a limited, non-exclusive license to the SWPS for internal business purposes by Authorized Users.

5. Sublicensing: The End User may not sublicense, assign, or otherwise transfer this License to End User employees or contractors who are not Authorized Users.

6. Modifications: The End User may not modify, translate, sell, or make derivative works of, the SWPS.

7. Protection and Security: The End User shall use its best efforts and take all reasonable steps to safeguard the SWPS to ensure that no unauthorized person shall have access thereto and that no unauthorized copy, publication, disclosure or distribution shall be made. The End User shall notify AWS immediately should the End User discover any unauthorized access or copying.

8. Termination: This License will terminate immediately without notice from AWS if the End User fails to comply with any of its provisions.

9. DISCLAIMER OF WARRANTY: THE SWPS IS PROVIDED "AS IS." AWS DISCLAIMS ALL WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE END-USER ASSUMES ALL RISK AS TO THE SUITABILITY OF THE SWPS. IN NO EVENT WILL AWS, OR ITS DIRECTORS, OFFICERS, EMPLOYEES OR AFFILIATES, BE LIABLE TO THE END USER FOR ANY CONSEQUENTIAL, INCIDENTAL, INDIRECT, SPECIAL OR EXEMPLARY DAMAGES. THE LIABILITY (IF ANY) OF AWS TO THE END USER FOR ACTUAL DIRECT DAMAGES FOR ANY CAUSE WHATSOEVER, AND REGARDLESS OF THE FORM OF THE ACTION, WILL BE LIMITED TO, AND IN NO EVENT SHALL EXCEED, THE AMOUNT ORIGINALLY PAID TO AWS FOR THIS LICENSE BY THE END USER.

10. Miscellaneous: This License is governed by and construed in accordance with the laws of the State of Florida and shall inure to the benefit of AWS and End User and their respective successors and legal representatives. If any provision of this License is held by a court of competent jurisdiction to be invalid or unenforceable, that provision will be enforced to the maximum extent permissible, and the remaining provisions of this License will remain in full force and effect. This Agreement constitutes the entire agreement between the parties with respect to the subject matter hereof. This Agreement may not be changed or amended except by a written instrument executed by a duly authorized officer of Licensor. The exclusive forum for resolution of legal disputes shall be State or federal court in or for Miami, Florida.

AWS B2.1-1-235:2020-AMD1
An American National Standard

Standard Welding Procedure Specification (SWPS) for 98% Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 inch [3 mm] through 1-1/2 inch [38 mm] Thick, ER70S-3, in the As-Welded or PWHT Condition, Primarily Pipe Applications

Site License

American Welding Society®

Approved American National Standard ANSI

second printing, May 2022

AWS B2.1-1-235:2020-AMD1
An American National Standard

Approved by the
American National Standards Institute
July 31, 2019
Amendment: February 17, 2022

Standard Welding Procedure Specification (SWPS) for 98% Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 inch [3 mm] through 1-1/2 inch [38 mm] Thick, ER70S-3, in the As-Welded or PWHT Condition, Primarily Pipe Applications

2nd Edition

Revises AWS B2.1-1-235:2020

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 standard contains the essential welding variables for carbon steel in the thickness range of 1/8 inch [3 mm] through 1-1/2 inch [38 mm], using 98% argon plus 2% oxygen shielded gas metal arc welding (spray transfer mode). It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for groove and fillet welds. This SWPS was developed primarily for pipe applications.

American Welding Society®

ISBN Print: 978-1-64322-080-2
ISBN PDF: 978-1-64322-081-9
© 2019 by American Welding Society
All rights reserved
Printed in the United States of America
Amendment: 2nd Printing, February 17, 2022

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 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 revised, 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). Users should ensure that they have the appropriate 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, Standards Development (see Annex A). 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.

Personnel (Amendment)

AWS B2 Committee on Procedure and Performance Qualification

T. Anderson, Chair	*ITW Welding North America*
J. M. Rosario, Secretary	*American Welding Society*
J. Alston	*Jefferson Lab*
M. E. Barrett	*Westinghouse*
J. P. Bell	*Yates Construction*
K. L. Bingham	*Los Alamos National Laboratory*
D. T. Braun	*Southside Virginia Community College*
M. W. Bumgarner	*Bumgarner Consulting, LLC*
J. L. Cooley	*YMC Mechanical*
M. C. Cook	*Mid-America Carpenters Regional Council Apprentice & Training Programs*
T. A. Davenport	*Arcos Industries, LLC*
J. D. Farren	*Naval Surface Warfare Center*
J. J. Fluckiger	*Idaho National Laboratory*
M. F. Herrle	*Arise*
T. A. Mihalik	*International Training Institute*
S. D. Mobley	*Oak Ridge National Laboratory*
T. C. Mueller	*Motion Engineering Ltd*
J. L. Pasqua	*Salco Products*
A. B. Rigato	*Pacific Northwest National Laboratory*
W. M. Ruof	*Bechtel Plant Machinery, Incorporated*
J. J. Sekely	*Welding Services, Incorporated*
M. L. Thomas	*Rocky Mountain Testing, LLC*
R. K. Wiswesser	*Welder Training & Testing Institute*

Advisors to the AWS B2 Committee on Procedure and Performance Qualification

E. W. Beckman	*Consultant*
M. Bernasek	*C-SPEC*
H. R. Castner	*Edison Welding Institute (retired)*
B. J. Hable	*Ford Motor Company*
K. Y. Lee	*DNV*
B. B. MacDonald	*Consultant*
C. D. Morell	*U.S. Nuclear Regulatory Commission (retired)*
J. F. Pike	*Acoustical Sheetmetal*
F. A. Schweighardt	*Airgas*
A. W. Sindel	*TRC Solutions*
C. E. Spaeder, Jr.	*Consultant*
W. J. Sperko	*Sperko Engineering Services, Incorporated*
R. F. Waite	*Robert F. Waite, PE PC*
G. M. Wisbrock, Jr.	*Consultant*

AWS B2D Subcommittee on Standard Welding Procedure Specifications

J. J. Sekely, Chair	*Welding Services, Incorporated*
J. M. Rosario, Secretary	*American Welding Society*
J. Alston	*Jefferson Lab*
T. Anderson	*ITW Welding North America*
M. E. Barrett	*Westinghouse*
E. W. Beckman	*Consultant*
J. P. Bell	*Yates Construction*
K. L. Bingham	*Los Alamos National Laboratory*
D. T. Braun	*Southside Virginia Community College*
M. W. Bumgarner	*Bumgarner Consulting, LLC*
J. L. Cooley	*YMC Mechanical*
T. A. Davenport	*Arcos Industries, LLC*
J. D. Farren	*Naval Surface Warfare Center*
J. J. Fluckiger	*Idaho National Laboratory*
G. L. Franke	*Consultant*
T. A. Mihalik	*International Training Institute*
T. C. Mueller	*Motion Engineering Ltd*
J. L. Pasqua	*Salco Products*
A. B. Rigato	*Pacific Northwest National Laboratory*
W. M. Ruof	*Bechtel Plant Machinery, Incorporated*

Advisors to the AWS B2D Subcommittee on Standard Welding Procedure Specifications

M. Bernasek	*C-SPEC*
H. R. Castner	*Edison Welding Institute (retired)*
K. Y. Lee	*DNV*
C. D. Morell	*U.S. Nuclear Regulatory Commission (retired)*
F. A. Schweighardt	*Airgas*
T. J. White	*Consultant*
G. M. Wisbrock, Jr.	*Consultant*

Personnel

AWS B2 Committee on Procedure and Performance Qualification

J. L. Cooley, Chair	*YMC Mechanical*
H. R. Castner, 1st Vice Chair	
E. W. Beckman, 2nd Vice Chair	*Consultant*
J. M. Rosario, Secretary	*American Welding Society*
D. M. Allbritten	*Consultant*
J. Alston	*Jefferson Lab*
T. Anderson	*ITW Welding North America*
J. P. Bell	*Yates Construction*
M. Bernasek	*C-SPEC*
K. L. Bingham	*Los Alamos National Laboratory*
M. W. Bumgarner	*Consultant*
M. C. Cook	*St. Louis-Kansas City Carpenters Apprenticeship Program*
T. A. Davenport	*PRL Industries, Incorporated*
J. J. Fluckiger	*Idaho National Laboratory*
M. F. Herrle	*Arise*
K. G. Kofford	*Idaho National Laboratory*
T. A. Mihalik	*International Training Institute*
S. D. Mobley	*Oak Ridge National Laboratory*
T. C. Mueller	*TC Energy*
J. L. Pasqua	*Salco Products*
A. B. Rigato	*U.S. Nuclear Regulatory Commission*
W. M. Ruof	*Bechtel Plant Machinery, Incorporated*
J. J. Sekely	*Welding Services, Incorporated*
M. L. Thomas	*Rocky Mountain Testing, LLC*
P. Villarreal	*Villarreal Inspection*
R. K. Wiswesser	*Welder Training & Testing Institute*

Advisors to the AWS B2 Committee on Procedure and Performance Qualification

B. J. Hable	*Ford Motor Company*
K. Y. Lee	*DNVGL*
B. B. MacDonald	*Consultant*
C. D. Morell	*U.S. Nuclear Regulatory Commission (retired)*
J. F. Pike	*NASA Langley Research Center*
F. A. Schweighardt	*Airgas*
A. W. Sindel	*TRC Solutions*
C. E. Spaeder, Jr.	*Consultant*
W. J. Sperko	*Sperko Engineering Services, Incorporated*
R. F. Waite	*Consultant*
G. M. Wisbrock, Jr.	*Consultant*

AWS B2D Subcommittee on Standard Welding Procedure Specifications

H. R. Castner, Chair	
J. M. Rosario, Secretary	*American Welding Society*
D. M. Allbritten	*Consultant*
J. Alston	*Jefferson Lab*
T. Anderson	*ITW Welding North America*
E. W. Beckman	*Consultant*
J. P. Bell	*Yates Construction*
M. Bernasek	*C-SPEC*
K. L. Bingham	*Los Alamos National Laboratory*
M. W. Bumgarner	*Consultant*
M. C. Cook	*St. Louis-Kansas City Carpenters Apprenticeship Program*
J. L. Cooley	*YMC Mechanical*
T. A. Davenport	*PRL Industries, Incorporated*
J. D. Farren	*Naval Surface Warfare Center*
J. J. Fluckiger	*Idaho National Laboratory*
G. L. Franke	*Consultant*
K. G. Kofford	*Idaho National Laboratory*
T. A. Mihalik	*International Training Institute*
T. C. Mueller	*TC Energy*
J. L. Pasqua	*Salco Products*
W. M. Ruof	*Bechtel Plant Machinery, Incorporated*
J. J. Sekely	*Welding Services, Incorporated*
P. Villarreal	*Villarreal Inspection*
T. J. White	*First Energy*

Advisors to the AWS B2D Subcommittee on Standard Welding Procedure Specifications

K. Y. Lee	*DNVGL*
C. D. Morell	*U.S. Nuclear Regulatory Commission (retired)*
F. A. Schweighardt	*Airgas*
G. M. Wisbrock, Jr.	*Consultant*

Foreword

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

The American Welding Society generates Standard Welding Procedure Specifications (SWPSs) for industry through the cooperative efforts of the AWS B2 Committee on Procedure and Performance Qualification, the AWS B2D Subcommittee on Standard Welding Procedure Specifications, and the AWS B2G Subcommittee on Procedure Qualification Records. The Welding Procedures Committee (WPC) of the Welding Research Council (WRC) originally managed the procedure qualification records in support of AWS Standard Welding Procedure Specifications and was formally transitioned to the AWS B2G Subcommittee on Procedure Qualification Records in 2019.

The need for pretested welding procedures that are supported by adequate test data and that satisfy the technical requirements for the commonly used construction codes and specifications has been expressed by many individuals and organizations. The purpose of a welding procedure qualification is to provide test data for assessing the properties of a weld joint.

This Standard Welding Procedure Specification is an outgrowth of the coordinated work of the AWS B2G Subcommittee on Procedure Qualification Records and the AWS B2 Committee on Procedure and Performance Qualification. The AWS B2G Subcommittee on Procedure Qualification Records has provided the data documented on the Summary of Procedure Qualification Records.

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 AWS designations for welding gases should be those shown in the latest edition of AWS A5.32M/A5.32 (ISO 14175 MOD), *Welding Consumables—Gases and Gas Mixtures for Fusion Welding and Allied Processes.*

The AWS B2 Committee on Procedure and Performance Qualification was formed in 1979 to provide welding standards concerning the subject of qualification. The primary document developed by this committee is AWS B2.1/B2.1M, *Specification for Welding Procedure and Performance Qualification*. This document established the foundation and framework for Standard Welding Procedure Specifications (SWPSs). The first two SWPSs were published in 1990. Since then SWPSs are continuing to be developed and published by the American Welding Society.

The following changes are included in this revision of the previous edition:

Headings were updated, ASME S numbers were deleted, the metric table was deleted, conversions were updated and added to the text and joint details, existing footnotes were updated and new footnotes were added, the welding symbols were deleted, supplementary powder and backing gas were deleted, and an annex on requesting an official interpretation was included.

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

Comments and suggestions for the improvement of this standard are welcome. They should be sent to the Secretary of the AWS B2 Committee on Welding Procedure and Performance Qualification, American Welding Society, 8669 NW 36 St., # 130, Miami, FL, 33166.

AWS Amendment Notice

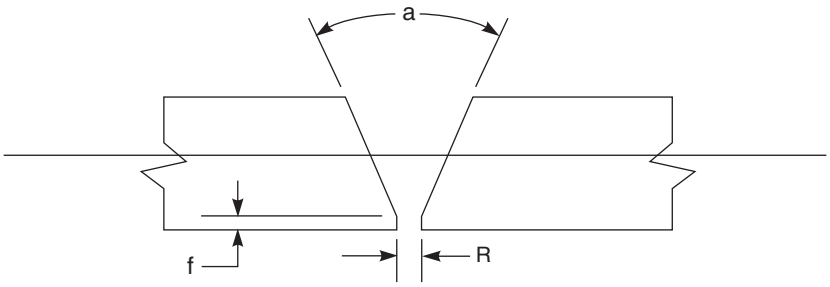
The following Amendments have been identified and are incorporated in this reprint.

AWS Standard: B2.1-1-235:2020, *Standard Welding Procedure Specification (SWPS) for 98% Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 inch [3 mm] through 1-1/2 inch [38 mm] Thick, ER70S-3, in the As-Welded or PWHT Condition, Primarily Pipe Applications*

2nd Printing: May 2022

AWS Standard: B2.1-1-235:2020
Amendment Number: 1
Subject: Joints

Page 5 – Delete Joint 2



~~a = 60° MIN~~
~~R = 1/8 in [3 mm] +1/16 in [1.5 mm] –1/8 [3.0 mm]~~
~~f = NOT LIMITED~~

~~**Joint 2**~~

Standard Welding Procedure Specification (SWPS)

98% Argon Plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1, Group 1 or 2), 1/8 inch [3 mm] through 1-1/2 inch [38 mm] Thick, ER70S-3, in the As-Welded or PWHT Condition, Primarily Pipe Applications

Supporting PQR Numbers: 200853, 200854, 200864, 200865

Requirements for Application of SWPSs

Scope. The data to support this Standard Welding Procedure Specification (SWPS) have been derived from the above listed Procedure Qualification Records (PQRs), which were reviewed and validated under the auspices of the AWS B2G Subcommittee on Procedure Qualification Records. This SWPS is not valid using conditions and variables outside the ranges listed. The American Welding Society considers that this SWPS presents information for producing an acceptable weld using the conditions and variables listed. The user needs a significant knowledge of welding and accepts full responsibility for the performance of the weld and for providing the engineering capability, qualified personnel, and proper equipment to implement this SWPS.

Application. This SWPS is to be used only as permitted by AWS B2.1/B2.1M, *Specification for Welding Procedure and Performance Qualification*, and the applicable fabrication document(s) [such as code, specification, or contract document(s)]. The fabrication document(s) should specify the engineering requirements such as design, need for heat treatment, fabricating tolerances, quality control, and examination and tests applicable to the end product.

User's Responsibility. A SWPS does not replace or substitute for fabrication codes, specifications, contract requirements, or capability and judgment on the part of the user. A SWPS is to be used only as permitted by the applicable fabrication code, specification, or contract document. The ability to produce production welds having properties suitable for the application depends upon supplementing the SWPS with appropriate performance qualification tests and sound engineering judgment. The user is responsible for the quality and performance of the final product in accordance with the provisions of the fabrication document(s).

Supplementary Instructions. To adapt this SWPS to a specific application, a user may issue supplementary instructions. Such instructions may consist of tighter fit-up tolerances, higher minimum preheat temperature or any other instructions necessary to produce a weldment that meets the requirements of the fabrication document(s). These instructions shall not be less restrictive than provided in the SWPS.

Standard Units of Measure. 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. Safety and health issues and concerns are beyond the scope of this standard and therefore are not addressed herein. Safety and health information is available from the following sources:

Permission to reproduce for intra-company use only is granted by the American Welding Society