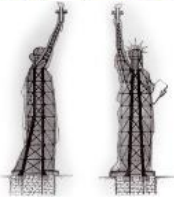


# INTERNATIONAL WELDING CENTER GROUP



**WELDING QUALIFICATIONS**



**American Welding Society**  
EDUCATIONAL INSTITUTION MEMBER  
IWC-AWS N° 2036904



# ASME IX GUIDE BOOK

**SECOND EDITION A1-2016**

**EDITED BY BACCARI TAREK**

AN INTERNATIONAL TRAINING COURSE ACCORDING TO

# AMERICAN WELDING SOCIETY AWS - Code

## WQH T1.2

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# TABLE OF CONTENTS

CHAPTER 01- FUNDAMENTAL OF WELDING QUALIFICATION

CHAPTER 02- STANDARD WELDING PROCEDURE SPECIFICATIONS (SWPSS)

CHAPTER 03- PROCEDURE QUALIFICATION RECORD (PQR)

CHAPTER 04- TYPES AND PURPOSES OF TESTS AND EXAMINATIONS

CHAPTER 05- WELDING PERFORMANCE QUALIFICATIONS (WPQ)

CHAPTER 06- WELDING PROCEDURE SPECIFICATIONS (WPS)

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## CHAPTER 01

# FUNDAMENTAL OF WELDING QUALIFICATION

Prepared by the  
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Training Committee.

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AWS CWI  
IWC SENIOR INSTRUCTOR

### REFERENCED CODE

ASME IX 2015 EDITION

AWS B2.1

### CONTENT

- 1- Welding qualification standards
- 2- ASME IX welding terminology and definition
- 3- Organizational responsibility



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## CHAPTER 01

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# FUNDAMENTAL OF WELDING QUALIFICATION

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## INTRODUCTION

To ensure that manufacturing processes and professionals render quality products and services, many local, state, and federal codes and regulations require the qualification and certification of fabrication procedures, inspection personnel, and engineering professionals.

An example of one such regulation is the Occupational Safety and Health Administration's (OSHA) Process Safety Management, 29 CFR 1910.119, which requires that employers provide documentation of the qualifications of personnel in industries having recognized certification programs.

Though this particular code is geared toward the chemical industry, it exemplifies the manner in which the federal government is becoming increasingly involved in qualification and certification.

On the whole, government codes and regulations provide assurance that individuals are technically competent to perform work and provide inspection services in their industries.

In the field of welding, qualification and certification programs are offered by organizations such as the American Welding Society (AWS) and the American Society for Nondestructive Testing (ASNT).

In addition to their respective welding and welding-related qualification and certification programs, AWS and ASNT have embarked on a joint initiative to offer a certification program for inspection personnel. In the field of inspection, certification programs are offered by organizations such as AWS, ANST, and the National Board of Boiler and Pressure Vessel Inspectors.

For example, the latter certifies Authorized Inspectors (AIS) in the local, state, and federal jurisdictions where the National Board Inspection Code has been adopted as law. These authorized inspectors provide assurance that boilers and pressure vessels have been built, modified, or repaired in accordance with the requirements established by the National Board of Boiler and Pressure Vessel Inspectors and the American Society of Mechanical Engineers (ASME).

Qualification and certification programs such as these have one main goal-to ensure that design practices, manufacturing processes, fabrication techniques, and inspection activities are performed by personnel who are qualified in accordance with good engineering practices and standards.

The qualification of welding procedures applies to all joining processes covered by a code or specification.

These processes include arc welding (shielded metal arc welding [SMAW], gas tungsten arc welding [GTAW], and gas metal arc welding [GMAW]), oxyfuel gas welding (OFW), and other processes such as electron beam (EBW) and electro-slag welding (ESW) and brazing (B).

Each manufacturer is required to establish welding procedure specifications (WPSs) and brazing procedure qualifications (BPSs). These procedure specifications are the directions to be followed by the welder and brazer during the welding and brazing manufacturing processes.

The manufacturer then demonstrates that the specification meets the standards required by the manufacturing design and records the results of the testing of the weldment in the procedure qualification record (PQR).

Performance qualifications are normally required of personnel who perform manual, semiautomatic, and mechanized welding in production. Technical societies, trade associations, and government agencies have defined qualification requirements for welded fabrications in standards generally tailored for specific applications, such as buildings, bridges, cranes, piping, boilers, and pressure vessels.

Most fabricating codes and standards require the qualification and certification of welding and brazing procedures and of the welders, brazers, and operators who perform welding and brazing operations in accordance with the procedures.

Standards or contractual documents may also require that weldments or brazements be evaluated for acceptance by a qualified inspector. This evaluation may entail visual inspection or nondestructive examination of the weldments, or both.

These activities are performed by qualified nondestructive examination personnel using the specified standardized testing procedures.

As the objectives of qualification are nearly the same in all codes and regulations, a welding procedure qualification performed in compliance with one standard may qualify the procedure for implementation under another standard provided the qualification test results meet the requirements of the latter.

Moreover, some standards permit the acceptance of previous performance qualification by welders, brazers, and welding operators who present properly documented evidence of their certification.

The detailed document that specifies the required welding conditions for a specific application is referred to as a welding procedure specification (WPS).

The standard according to which the product is manufactured typically identifies which of the variables indicated in the welding procedure specification are qualification variable.

Should the qualification variables be modified beyond the specified limits, the welding procedure must be requalified. After requalification, a revised or new welding procedure specification is prepared.

Variables other than the qualification variables can be changed in the welding procedure specification without affecting the procedure's qualification status. However, all procedural changes require a revision of the welding procedure specification prior to the implementation of the revised procedure in production.

The welding procedure specification is normally qualified by demonstrating that the welded joints produced by means of the procedure meet the prescribed requirements.

The welding conditions used to produce an acceptable test joint and the results of the qualification test are recorded on a form known as the procedure qualification record (PQR).

Welders, brazers, and welding and brazing operators are normally required to demonstrate their ability to produce joints that meet the prescribed standards. This process is known as performance qualification. The results of weld procedure qualification and welder performance qualification must be certified by an authorized representative of the organization performing the qualification tests. This process is known as certification.

# 1- WELDING QUALIFICATION STANDARDS

## 1-1 API650-2014: Welded Tanks for Oil Storage

### SCOPE

This standard establishes minimum requirements for material, design, fabrication, erection, and inspection for vertical, cylindrical, aboveground, closed- and open-top, welded storage tanks in various sizes and capacities for internal pressures approximating atmospheric.

### SECTION 9—WELDING PROCEDURE AND WELDER QUALIFICATIONS

#### 9.2 Qualification of Welding Procedures

The erection Manufacturer and the fabrication Manufacturer if other than the erection Manufacturer shall prepare welding procedure specifications and shall perform tests documented by procedure qualification records to support the specifications, as required by **Section IX of the ASME Code** and any additional provisions of this standard.

If the Manufacturer is part of an organization that has, to the Purchaser's satisfaction, established effective operational control of the qualification of welding procedures and of welder performance for two or more companies of different names, then separate welding procedure qualifications are not required, provided all other requirements of 9.2, 9.3, and **Section IX of the ASME Code** are met.

Welding procedures for ladder and platform assemblies, handrails, stairways, and other miscellaneous assemblies, but not their attachments to the tank, shall comply with either AWS D1.1, AWS D1.6, or **Section IX of the ASME Code**, including the use of standard WPSs.

#### 9.3 Qualification of Welders

**9.3.1** The erection Manufacturer and the fabrication Manufacturer, if other than the erection Manufacturer, shall conduct tests for all welders assigned to manual and semiautomatic welding and all welding operators assigned to machine and automatic welding to demonstrate the welders' and welding operators' ability to make acceptable welds.

Tests conducted by one Manufacturer shall not qualify a welder or welding operator to do work for another Manufacturer.

**9.3.2** The welders and welding operators who weld pressure parts and join non-pressure parts, such as all permanent and temporary clips and lugs, to pressure parts shall be qualified in accordance with **Section IX of the ASME Code**.

**9.3.3** The records of the tests for qualifying welders and welding operators shall include the following.

### Welded Tanks for Oil Storage

API STANDARD 650  
TWELFTH EDITION, MARCH 2013

ADDENDUM 1, SEPTEMBER 2014  
ERRATA 1, JULY 2013  
ERRATA 2, DECEMBER 2014



- a) Each welder or welding operator shall be assigned an identifying number, letter, or symbol by the fabrication or erection Manufacturer.
- b) The fabrication or erection Manufacturer shall maintain a record of the welders or welding operators employed that shows the date and results of the tests for each welder or operator and the identifying mark assigned to each welder or operator. This record shall be certified by the fabrication or erection Manufacturer and shall be accessible to the inspector.

## 1-2 ASME VIII DIV 1 -2010 Rules for Construction of Pressure Vessels

### UW-28 QUALIFICATION OF WELDING PROCEDURE

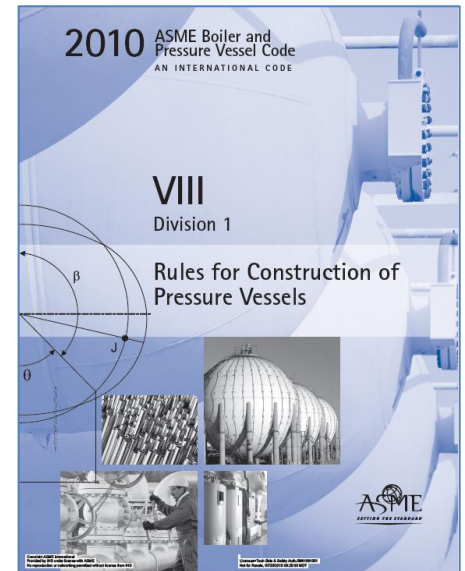
- (a) Each procedure of welding that is to be followed in construction shall be recorded in detail by the manufacturer.
- (b) The procedure used in welding pressure parts and in joining load-carrying non-pressure parts, such as all permanent or temporary clips and lugs, to pressure parts shall be qualified in accordance with **Section IX**.
- (c) The procedure used in welding non-pressure-bearing attachments which have essentially no load-carrying function (such as extended heat transfer surfaces, insulation support pins, etc.), to pressure parts shall meet the following requirements.

(1) When the welding process is manual, machine, or semiautomatic, procedure qualification is required in accordance with **Section IX**.

(2) When the welding is any automatic welding process performed in accordance with a Welding Procedure Specification (in compliance with **Section IX** as far as applicable), procedure qualification testing is not required.

(d) Welding of all test coupons shall be conducted by the Manufacturer. Testing of all test coupons shall be the responsibility of the Manufacturer. Alternatively, AWS Standard Welding Procedure Specifications that have been accepted by **Section IX** may be used provided they meet all other requirements of this Division.

Qualification of a welding procedure by one Manufacturer shall not qualify that procedure for any other Manufacturer except as provided in **QW-201 of Section IX**.



### UW-29 TESTS OF WELDERS AND WELDING OPERATORS

(a) The welders and welding operators used in welding pressure parts and in joining load-carrying non-pressure parts (attachments) to pressure parts shall be qualified in accordance with **Section IX**.

(1) The qualification test for welding operators of machine welding equipment shall be performed on a separate test plate prior to the start of welding or on the first workpiece.

(2) When stud welding is used to attach load-carrying studs, a production stud weld test of each welder or welding operator shall be performed on a separate test plate or tube prior to the start of welding on each work shift. This weld test shall consist of five studs, welded and tested by the bend or torque stud weld testing procedure described in **Section IX**.

(b) The welders and welding operators used in welding non-pressure-bearing attachments, which have essentially no load-carrying function (such as extended heat transfer surfaces, insulation support pins, etc.), to pressure parts shall comply with the following:

(1) When the welding process is manual, machine, or semiautomatic, qualification in accordance with **Section IX** is required.

(2) When welding is done by any automatic welding process, performance qualification testing is not required.

(3) When stud welding is used, a production stud weld test, appropriate to the end use application requirements, shall be specified by the Manufacturer and carried out on a separate test plate or tube at the start of each shift.

(c) Each welder and welding operator shall be assigned an identifying number, letter, or symbol by the manufacturer which shall be used to identify the work of that welder or welding operator in accordance with UW-37(f).

(d) The Manufacturer shall maintain a record of the welders and welding operators showing the date and result of tests and the identification mark assigned to each. These records shall be maintained in accordance with **Section IX**.

(e) Welding of all test coupons shall be conducted by the Manufacturer. Testing of all test coupons shall be the responsibility of the Manufacturer. A performance qualification test conducted by one Manufacturer shall not qualify a welder or welding operator to do work for any other Manufacturer except as provided in **QW-300 of Section IX**.

### 1-3 AWS D1.1/D1.1M:2010: Structural Welding Code— Steel

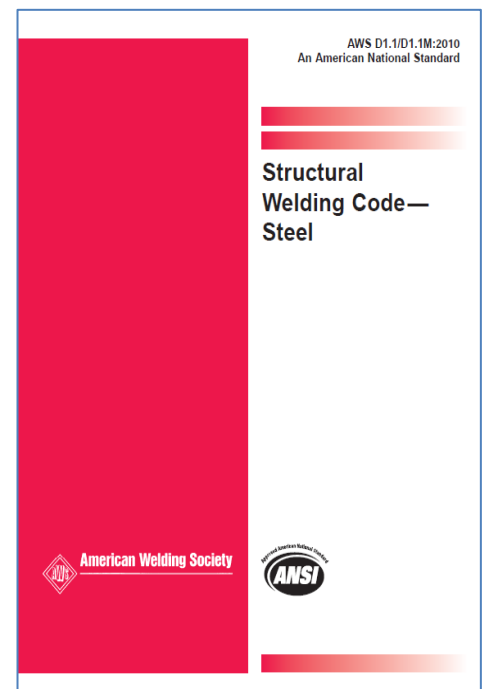
This code contains the requirements for fabricating and erecting welded steel structures. When this code is stipulated in contract documents, conformance with all provisions of the code shall be required, except for those provisions that the Engineer or contract documents specifically modifies or exempts. The following is a summary of the code sections:

**3. Prequalification.** This section contains the requirements for exempting a WPS (Welding Procedure Specification) from the qualification requirements of this code.

Prequalification of WPSs (Welding Procedure Specifications) shall be defined as exemption from the WPS qualification testing required in Section 4. All prequalified WPSs shall be written. In order for a WPS to be prequalified, conformance with all of the applicable requirements of Section 3 shall be required.

WPSs that do not conform to the requirements of **Section 3** may be qualified by tests in conformance with **Section 4**.

For convenience, **Annex H** lists provisions to be included in a prequalified WPS, and which should be addressed in the fabricators or Contractor's welding program.



Welders, welding operators and tack welders that use prequalified WPSs shall be qualified in conformance with **Section 4, Part C**.

**4. Qualification.** This section contains the qualification requirements for WPSs and welding personnel (welders, welding operators and tack welders) necessary to perform code work.

The requirements for qualification testing of welding procedure specifications (WPSs) and welding personnel are described as follows:

**Part A—General Requirements.** This part covers general requirements of both WPS and welding personnel performance requirements.

**Part B—Welding Procedure Specification (WPS).** This part covers the qualification of a WPS that is not classified as prequalified in conformance with **Section 3**.

**Part C—Performance Qualification.** This part covers the performance qualification tests required by the code to determine a welder's, welding operator's, or tack welder's ability to produce sound welds.

## 1-4 PD 5500:2000 Specification for Unfired fusion welded pressure vessels

### 5.2 Approval testing of fusion welding procedures

**5.2.1** Approval testing of welding procedures shall be conducted, recorded and reported in accordance with **BS EN 288-3** or **BS 4870 Part 3**.

**5.2.2** The manufacturer shall supply a list of all the welding procedures required in the fabrication of the vessel, which shall also identify the applicable weld procedure test/approval report or record. Test pieces shall be provided which are representative of the various thicknesses and materials to be used in applying each weld procedure, except that, in cases where the manufacturer can furnish proof of previously authenticated tests and results on the same type of joint and material within the permitted variables of **BS EN 2883** or **BS 4870 : Part 3**, he is not required to perform any further tests.

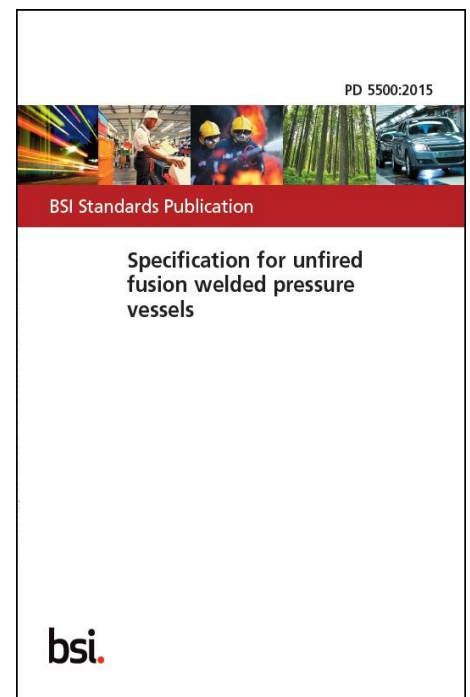
The production and testing of any test pieces shall be witnessed by the purchaser or the Inspecting Authority.

All welding shall be performed in accordance with a welding procedure specification or other work instruction which conforms to **BS EN 288-2**.

### 5.3 Welder and operator approval

**5.3.1** Approval testing of welders and operators shall be conducted, recorded and reported in accordance with **BS EN 287-1**, except as modified by 5.3.5 or with **BS 4871 : Part 3**, as appropriate (see annex T).

**5.3.2** All welders and welding machine operators engaged on the welding of pressure parts of vessels fabricated in accordance with this specification shall pass the welder



approval tests which are designed to demonstrate their competence to make sound welds of the types on which each is to be employed.

## 1-5 EN 13445-4:2002 unfired pressure vessels

### 7.2 Welding procedure specification (WPS)

The manufacturer shall compile welding procedure specifications, in accordance with **EN 288-2:1992** for all welds.

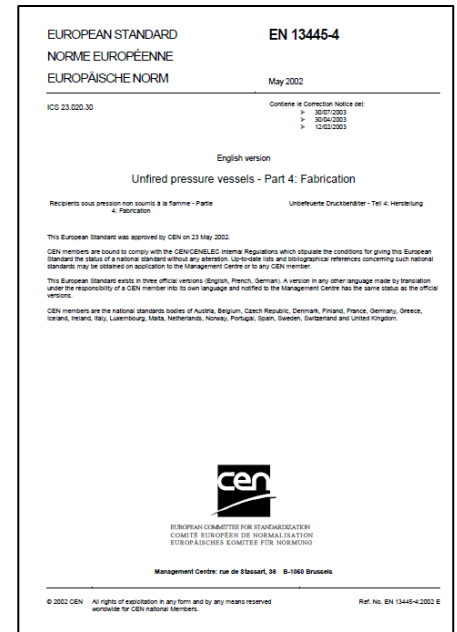
### 7.3 Qualification of welding procedure specifications (WPAR)

Welding procedure specifications to be used in production shall be qualified by reference to an appropriate WPAR.

For the pressure retaining welds of a pressure vessel this shall be achieved by performing welding procedure approval tests in accordance with **EN 288-3:1992** or by preproduction tests in accordance with **EN 288-8:1995**.

### 7.4 Qualification of welders and welding operators

Welders and welding operators shall be approved to **EN 287 1:1992** or **EN 1418:1997** respectively.



## 1-6 EN 287 Qualification test of welders

- **EN 287 Part 1:** Steels
- **EN 287 Part 2:** Aluminum and aluminum alloys

## 1-7 EN 288 Specification and approval of welding procedures for metallic materials

- **EN 288 Part 1:** General rules for fusion welding.
- **EN 288 Part 2:** Welding procedure specification for arc welding.
- **EN 288 Part 3:** Welding procedure tests for the arc welding of steels
- **EN 288 Part 4:** Welding procedure tests for the arc welding of aluminum and its alloys
- **EN 288 Part 5:** Approval by using approved welding consumables for arc welding
- **EN 288 Part 6:** Approval related to previous experience
- **EN 288 Part 7:** Approval by a standard welding procedure for arc welding
- **EN 288 Part 8:** Approval by a pre-production welding test
- **EN 288 Part 9:** Welding procedure test for pipeline

## **1-8 ISO 15609: Specification and qualification of welding procedures for metallic materials - Welding procedure specification**

- **ISO 15609 Part 1:** Arc welding (This document replaces EN 288-2)
- **ISO 15609 Part 2:** Gas welding
- **ISO 15609 Part 3:** Electron beam welding
- **ISO 15609 Part 4:** Laser beam welding
- **ISO 15609 Part 5:** Resistance welding

## **1-9 ISO 15614: Specification and qualification of welding procedures for metallic materials — Welding procedure test**

- **ISO 15614 Part 1:** Arc and gas welding of steels and arc welding of nickel and nickel alloys (This document replaces EN 288-3)
- **ISO 15614 Part 2:** Arc welding of aluminum and its alloys (This document replaces EN 288-4)
- **ISO 15614 Part 4:** Finishing welding of aluminum castings
- **ISO 15614 Part 5:** Arc welding of titanium, zirconium and their alloys
- **ISO 15614 Part 6:** Arc welding of copper and its alloys
- **ISO 15614 Part 8:** Welding of tubes to tube-plate joints
- **ISO 15614 Part 11:** Electron and laser beam welding
- **ISO 15614 Part 12:** Spot, seam and projection welding
- **ISO 15614 Part 13:** Resistance butt and flash welding

## 2- ASME IX WELDING TERMINOLOGY AND DEFINITION

### 2-1 WELDING PROCEDURE SPECIFICATION WPS QG101

A procedure specification is a **written document** providing direction to the person applying the material joining process.

When a procedure specification is prepared by the organization, it shall address, as a minimum, the specific **essential** and **nonessential variables** that are applicable to the material joining process to be used in production.

When the **referencing Code**, standard, or specification requires **toughness qualification** of the material joining procedure, the applicable **supplementary essential** variables shall also be addressed in the procedure specification.

### 2-2 PROCEDURE QUALIFICATION RECORD PQR QG102

The purpose of qualifying the procedure specification is to demonstrate that the joining process proposed for construction is capable of producing joints having the required mechanical properties for the intended application.

Qualification of the procedure specification demonstrates the mechanical properties of the joint made using a joining process, **and not the skill of the person** using the joining process.

The procedure qualification record (PQR) **documents** what occurred during the production of a procedure qualification test coupon and the results of testing that coupon.

**As a minimum**, the PQR shall document the **essential** procedure qualification test **variables** applied during production of the test joint, and the **results of the required tests**.

When toughness testing is required for qualification of the procedure specification, the applicable **supplementary essential variables** shall be recorded for each process.

The organization shall certify the PQR by a signature or other means as described in the organization's Quality Control System.

The PQR shall be accessible to the Authorized Inspector. A procedure specification may be supported by one or more PQR(s), and one PQR may be used to support one or more procedure specification(s).

### 2-3 QG-103 PERFORMANCE QUALIFICATION QG103

The purpose of qualifying the person who will use a joining process is to demonstrate that person's ability to produce a sound joint when using a procedure specification.

## 2-4 PERFORMANCE QUALIFICATION RECORD WPQR QG104

The performance qualification record **documents** what occurred during the production of a test coupon by a person using one or more joining processes following an organization's procedure specification.

As a minimum, the record shall document **the essential variables** for each process used to produce the test coupon, the **ranges of variables qualified**, and the **results** of the required testing and/or nondestructive examinations.

The organization shall certify a performance qualification record by a signature or other means as described in the organization's Quality Control System.

## 3- ORGANIZATIONAL RESPONSIBILITY QG106

### 3-1 PROCEDURE QUALIFICATIONS. QG106-1

Each organization **is responsible for conducting the tests required** by this Section to qualify the procedures that are used in the construction of components under the rules of the Codes, standards, and specifications that reference this Section.

(a) The personnel who produce test joints for procedure qualification shall be under the **full supervision and control** of the **qualifying organization** during the production of these test joints.

\*\*\*\*\*

In the 2011 and prior editions of Section IX, the requirement that the welding of procedure and performance qualification test coupons be **supervised and controlled by the manufacturer or contractor who will have responsible operational control of welding and brazing was quite explicit**. In the 2013, this requirement was unintentionally made less explicit. As a result, the committee clarified its position with the following inquiry:

**Question:** Is it the intent of QG-106.1(a) and QG-106.2(a) that personnel who produce test joints for procedure or performance qualification shall produce those joints under the full supervision and control of the qualifying organization using those procedures or personnel?

**Reply:** Yes

Because this was an "intent" inquiry, ASME's ANSI-accredited procedures required that parallel Code changes be made at the same time, so the first sentences of QG- 106.1(a) and QG-106.2(a) were revised to say that personnel who produce test joints for procedure or performance qualification shall be under the **full supervision and control of the qualifying organization** during the production of qualification test joints.

**Organizations** are defined **as a manufacturer, contractor, assembler, installer, or some other single or combined entity having responsibility for operational control of the material-joining methods**.

The organization that will give the welder the WPS to follow and tell him what to weld each day is the organization that has "operational control" over welding, and that is the organization that has to supervise the welding of any procedure and performance qualification test coupons.

**Sources:** Changes to ASME Section IX, 2015 Edition - As published in the Welding Journal, July, 2015 - Prepared by Walter J. Sperko, P.E. Sperko Engineering Services, Inc 4803 Archwood Drive Greensboro, NC 27406 USA Voice: 336-674-0600 FAX: 336-674-0202 e-mail:sperko@asme.org www.sperkoengineering.com

\*\*\*\*\*

(b) Production of qualification test joints under the supervision and control of another organization is not permitted. However, it is permitted to subcontract any or all of the work necessary for preparing the materials to be joined, the subsequent work for preparing test specimens from the completed test joint, and the performance of nondestructive examination and mechanical tests, provided the organization accepts full responsibility for any such work.

### 3-2 PERFORMANCE QUALIFICATIONS. QG106-2

Each organization is responsible for the supervision and control of material joining performed by persons for whom they have operational responsibility and control.

The organization shall conduct the tests required by this Section to qualify the performance of those persons with each joining process they will use for the construction of components under the rules of the Codes, standards, and specifications that reference this Section.

This requirement ensures that the **qualifying organization** has determined that the personnel using its procedures are capable of achieving the minimum requirements specified for an acceptable joint. This responsibility cannot be delegated to another organization.

(a) The personnel who produce test joints for performance qualification shall be tested under the **full supervision and control of the qualifying organization**.

(b) The performance qualification test shall be performed following either a **qualified procedure specification** or a **standard procedure specification** acceptable under the rules of the applicable Part for the joining process.

The Part addressing any specific joining process may exempt a portion of the procedure specification from being followed during production of the performance qualification test coupon.

(c) Production of test joints under the supervision and control of another organization is not permitted. It is permitted to subcontract any or all of the work necessary for preparing the materials to be joined in the test joint, and the subsequent work for preparing test specimens from the completed test joint, and the performance of nondestructive examination and mechanical tests, provided the organization accepts full responsibility for any such work.

(d) The performance qualification test may be terminated at any stage, whenever it becomes apparent to the supervisor conducting the tests that the person being tested does not have the required skill to produce satisfactory results.

(e) When a procedure qualification test coupon has been tested and found acceptable, the person who prepared the test coupon is also qualified for the joining process used, within the ranges specified for performance qualification for the applicable process (es).

(f) Persons who are successfully qualified shall be assigned an identifying number, letter, or symbol by the organization, which shall be used to identify their work.

## CHAPTER 02

# STANDARD WELDING PROCEDURE SPECIFICATIONS (SWPSS)

Prepared by the  
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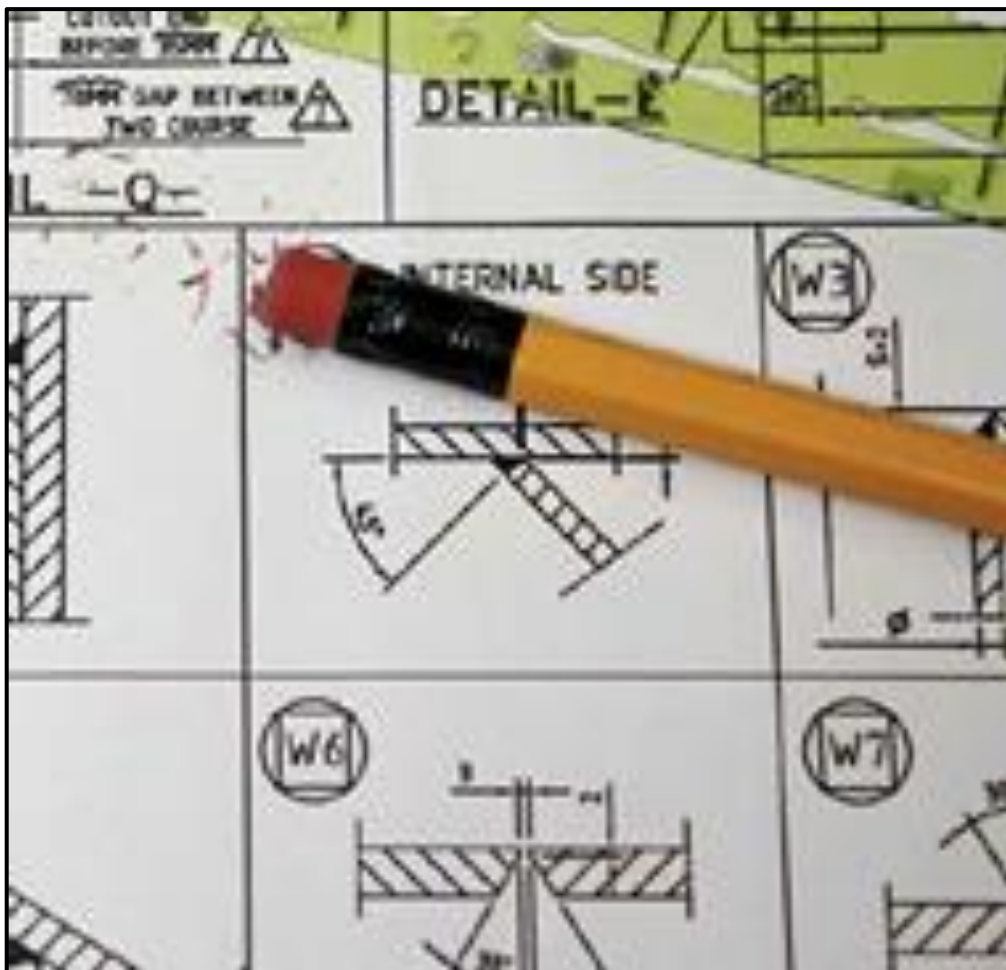
### REFERENCED CODE

ASME IX 2015 EDITION

AWS B2.1

### CONTENT

- 1- Standard Welding Procedure Specification History
- 2- ADOPTION OF SWPSS
- 3- USE OF SWPSS WITHOUT DISCRETE DEMONSTRATION
- 4- FORMS
- 5- PRODUCTION USE OF SWPSS
- 6- PERMITTED SWPSS



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## CHAPTER 02

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# STANDARD WELDING PROCEDURE SPECIFICATIONS (SWPSS)

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### DEFINITION **QG109-2**

**Standard Welding Procedure Specification (SWPS):** a welding procedure specification, published by the American Welding Society, that is made available for production welding by companies or individuals without further qualification, and that may be used in Code applications in accordance with the restrictions and limitations of Article V.

**QW500** These SWPSSs are not permitted for construction where impact testing of the WPS is required by the Construction Code.

## 1. Standard Welding Procedure Specification History

Standard Welding Procedures have been available for many years. Initially they were called “Pre-qualified Welding Procedure Specifications (WPS).” The Certified Pipe Welding Bureau, the American Welding Society (AWS) Structural Code and other codes and standards have used them.

These Pre-qualified WPS were developed by consensus committee action based upon the experience of each of the above groups. Some codes and standards would not accept the concept of pre-qualified WPS, as they wanted each Code user to qualify their own WPS.

The AWS was asked to develop Standard Welding procedure Specifications, SWPS. AWS entered into an agreement with the Welding Research Council (WRC) and formed a WRC Welding Procedure Committee (WRC/WPC).

Representatives of most industry groups that used welding were invited to participate in the development of SWPSSs. The WRC/WPC wanted to prepare SWPSSs based upon extensive testing.

The WRC/WPC intended to conduct extensive testing of each SWPS in nationally recognized laboratories, under the observation of nationally recognized inspection agencies. The cost of the initial WPS testing was beyond the means of AWS and WRC.

A decision was made to solicit industry for copies of their Procedure Qualification Records (PQR), which would support the SWPSSs prepared by the WRC/WPC.

Industry responded and today the AWS has thousands of these PQRs solicited from industry, which support the SWPSs. Industries and societies quickly adopted the SWPSs, but others were reluctant to do so.

In the 1998 edition, the National Board of Boiler and Pressure Vessel Inspectors (National Board) adopted a few of the SWPSs into their National Board Inspection Code (NBIC). The NBIC is used for repairs to pressure retaining items (boilers, pressure vessels, piping, etc.).

In 1991 the ASME Boiler and Pressure Vessel Code Main Committee formed a Task Group to review the SWPSs published by AWS, for applicability to boiler and pressure vessel new construction.

The Task Group was to determine if the procedures had adequate technical support for use in ASME boiler and pressure vessel construction. ASME had always required the manufacturer to qualify its own procedures, and now, ASME was going to allow the manufacturer to use welding procedure specifications essentially qualified by someone else.

ASME wanted to insure that these SWPSs produce the mechanical properties needed for ASME Code work. Another objective of the Task Group was to determine if there were any administrative procedures that would have to be changed in order for the Boiler Codes to adopt SWPSs.

The Task Group was directed to review and recommend for adoption a limited number of basic SWPSs for boiler and pressure vessel construction. The Task Group recommended several SWPSs appropriate for use in the boiler and pressure vessel industry.

ASME Subcommittee IX (SCIX) was directed to determine how SWPSs could be adopted into Section IX for ASME Code Construction. SCIX determined that while the SWPSs were supported with technical data, there might not be any assurance that the Code user would know how to use these SWPSs.

Subcommittee IX added Article V to Section IX, which specifies the requirements with which the Code user must comply before using SWPSs in ASME Code construction. The major addition to Section IX is the requirement to demonstrate the Code users' ability to use the specific SWPS.

Besides the demonstration, other requirements include documentation and restrictions in production use of SWPSs.

The 2000 Addenda to ASME Section IX permits the use of SWPSs, provided the Code user complies with the additional requirements of Section IX, and the referencing ASME construction Code, and all other requirements of the ASME Boiler and Pressure Vessel Codes.

ASME authorized seventeen SWPSs in the ASME Section IX, 2000 addenda.

## 2. ADOPTION OF SWPSS QW510

SWPS SHALL COMPLY with the following:

- (a) Enter the name of the organization on the SWPS.
- (b) An employee of that organization shall sign and date the SWPS.
- (c) The applicable Code Section(s) (Section VIII, B31.1, etc.) and/or any other fabrication document (contract, specification, etc.) that must be followed during welding shall be listed on the SWPS.
- (d) The organization shall weld and test one groove weld test coupon following that SWPS.

The following information shall be recorded:

- (1) The specification, type, and grade of the base metal welded.
- (2) Groove design.
- (3) Initial cleaning method.
- (4) Presence or absence of backing.
- (5) The ASME or AWS specification and AWS classification of electrode or filler metal used and manufacturer's trade name.
- (6) Size and classification of tungsten electrode for GTAW.
- (7) Size of consumable electrode or filler metal.
- (8) Shielding gas and flow rate for GTAW and GMAW.
- (9) Preheat temperature.
- (10) Position of the groove weld and, if applicable, the progression.
- (11) If more than one process or electrode type is used, the approximate weld metal deposit thickness for each process or electrode type
- (12) Maximum interpass temperature
- (13) Post weld heat treatment used, including holding time and temperature range
- (14) Visual inspection and mechanical testing results
- (15) The results of volumetric examination when permitted as an alternative to mechanical testing by QW-304

**(e)** The coupon shall be visually examined in accordance with QW-302.4 and mechanically tested in accordance with QW-302.1 or volumetrically examined in accordance with QW-302.2.

If visual examination, volumetric examination, or any test specimen fails to meet the required acceptance criteria, the test coupon shall be considered as failed and a new test coupon shall be welded before the organization may use the SWPS.

### **3. USE OF SWPSS WITHOUT DISCRETE DEMONSTRATION QW520**

Once an SWPS has been demonstrated, additional SWPSs that are similar to the SWPS that was demonstrated may be used without further demonstration.

Such additional SWPSs shall be compared to the SWPS that was used for the demonstration, and the following limitations shall not be exceeded:

**(a)** A change in the welding process.

**(b)** A change in the P- Number.

**(c)** A change from the as- welded condition to the heat treated condition. This limitation also applies for SWPSs that allow use in both conditions (e.g., SWPS B2.1- 021 allows production welding with or without heat treatment; if the demonstration was performed without heat treatment, production welding with heat treatment is not permitted).

Once heat treatment has been demonstrated for any SWPS, this limitation no longer applies.

**(d)** A change from a gas- shielded flux- cored wire or solid wire to a self-shielded flux-cored wire or vice versa.

**(e)** A change from globular, spray or pulsed spray transfer welding to short circuiting transfer welding or vice versa.

**(f)** A change in the F- Number of the welding electrode.

**(g)** The addition of preheat above ambient temperature.

**(h)** A change from an SWPS that is identified as for sheet metal to one that is not and vice versa.

## 4. FORMS QW530 – QW485

| FORM QW-485 SUGGESTED FORMAT FOR DEMONSTRATION OF STANDARD WELDING<br>PROCEDURE SPECIFICATIONS (SWPS)<br>(See Article V)                                                                                                    |        |      |        |      |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|------|--------|------|--------|
| Identification of Standard Welding Procedure Specification Demonstrated _____                                                                                                                                               |        |      |        |      |        |
| Demonstration Welding Variables                                                                                                                                                                                             |        |      |        |      |        |
| Specification and type/grade or UNS Number of Base Metal(s) _____<br>to Specification and type/grade or UNS Number of Base Metal(s) _____                                                                                   |        |      |        |      |        |
| Base Metal P-Number _____ to Base Metal P-Number _____ Thickness _____                                                                                                                                                      |        |      |        |      |        |
| Welding Process(es) used _____                                                                                                                                                                                              |        |      |        |      |        |
| <input type="checkbox"/> Plate <input type="checkbox"/> Pipe (Enter Diameter of Pipe or Tube) _____                                                                                                                         |        |      |        |      |        |
| Groove Design (Single V, Double V, Single U, etc.) _____                                                                                                                                                                    |        |      |        |      |        |
| Initial Cleaning Method _____                                                                                                                                                                                               |        |      |        |      |        |
| Backing (with/without) _____                                                                                                                                                                                                |        |      |        |      |        |
| Filler Metal Specification _____                                                                                                                                                                                            |        |      |        |      |        |
| Filler Metal or Electrode Classification _____                                                                                                                                                                              |        |      |        |      |        |
| Filler Metal or Electrode Trade Name _____                                                                                                                                                                                  |        |      |        |      |        |
| Size of Consumable Electrode or Filler Metal _____                                                                                                                                                                          |        |      |        |      |        |
| Tungsten Electrode Classification and Size for GTAW _____                                                                                                                                                                   |        |      |        |      |        |
| Consumable Insert Class and Size for GTAW _____                                                                                                                                                                             |        |      |        |      |        |
| Shielding Gas Composition and Flow Rate for GTAW or GMAW (FCAW) _____                                                                                                                                                       |        |      |        |      |        |
| Preheat Temperature _____                                                                                                                                                                                                   |        |      |        |      |        |
| Position(s) _____                                                                                                                                                                                                           |        |      |        |      |        |
| Progression (Uphill or Downhill) _____                                                                                                                                                                                      |        |      |        |      |        |
| Interpass Cleaning Method _____                                                                                                                                                                                             |        |      |        |      |        |
| Measured Maximum Interpass Temperature _____                                                                                                                                                                                |        |      |        |      |        |
| Approximate Deposit Thickness for Each Process or Electrode Type _____                                                                                                                                                      |        |      |        |      |        |
| Current Type/Polarity (AC, DCEP, DCEN) _____                                                                                                                                                                                |        |      |        |      |        |
| Postweld Heat Treatment Time and Temperature _____                                                                                                                                                                          |        |      |        |      |        |
| Visual Examination of Completed Weld (QW-302.4) _____ Date of Test _____                                                                                                                                                    |        |      |        |      |        |
| Bend Test (QW-302.1) <input type="checkbox"/> Transverse Face and Root (QW-462.3(a)) <input type="checkbox"/> Side (QW-462.2)                                                                                               |        |      |        |      |        |
| Type                                                                                                                                                                                                                        | Result | Type | Result | Type | Result |
|                                                                                                                                                                                                                             |        |      |        |      |        |
|                                                                                                                                                                                                                             |        |      |        |      |        |
| Alternative Radiographic Examination Results (QW-302.2) _____                                                                                                                                                               |        |      |        |      |        |
| Specimens Evaluated By _____ Title _____ Company _____                                                                                                                                                                      |        |      |        |      |        |
| Welding Supervised By _____ Title _____ Company _____                                                                                                                                                                       |        |      |        |      |        |
| Welder's Name _____ Stamp No. _____                                                                                                                                                                                         |        |      |        |      |        |
| We certify that the statements in this record are correct and that the weld described above was prepared, welded, and tested in accordance with the requirements of Section IX of the ASME BOILER AND PRESSURE VESSEL CODE. |        |      |        |      |        |
| Organization _____                                                                                                                                                                                                          |        |      |        |      |        |
| Signature _____ Date _____ Demonstration Number _____                                                                                                                                                                       |        |      |        |      |        |
| (07/15)                                                                                                                                                                                                                     |        |      |        |      |        |

## 5. PRODUCTION USE OF SWPSS QW540

As with any WPS, welding that is done following an SWPS shall be done in strict accordance with the SWPS.

In addition, the following requirements apply to the use of SWPSS:

- (a) The organization may not deviate from the welding conditions specified on the SWPS.
- (b) SWPSSs may not be supplemented with PQRs or revised in any manner except for reference to the applicable Code Section or other fabrication documents as provided by QW-511.

\*\*\*\*\*

QW-511 USE OF DEMONSTRATED SWPSS Code Sections or fabrication documents that are required to be referenced by QW-510(c) may be added or deleted from a demonstrated SWPS without further demonstrations.

QW-510 (c) the applicable Code Section(s) (Section VIII, B31.1, etc.) and/or any other fabrication document (contract, specification, etc.) that must be followed during welding shall be listed on the SWPS.

\*\*\*\*\*

- (c) Only the welding processes shown on an SWPS shall be used in given production joint. When a multi-process SWPS is selected, the processes shown on the SWPS shall be used in the order and manner specified on the SWPS.
- (d) SWPSSs shall not be used in the same production joint together with WPSs qualified by the organization.
- (e) The organization may supplement an SWPS by attaching additional instructions to provide the welder with further direction for making production welds to Code or other requirements. When SWPSSs are supplemented with instructions that address any condition shown on the SWPS, such instructions shall be within the limits of the SWPS. For example, when an SWPS permits use of several electrode sizes, supplemental instructions may direct the welder to use only one electrode size out of those permitted by the SWPS; however, the supplemental instructions may not permit the welder to use a size other than one or more of those permitted by the SWPS.
- (f) SWPSSs may not be used until the demonstration of QW-510 has been satisfactorily welded, tested, and certified.
- (g) The identification number of the Supporting Demonstration shall be noted on each SWPS that it supports prior to using the SWPS.
- (h) The certified Supporting Demonstration Record shall be available for review by Authorized Inspector

## 6. PERMITTED SWPSS **MANDATORY APPENDIX E**

### 6-1 CARBON STEEL SWPS:

#### → Shielded Metal Arc Welding **SMAW**:

##### ⊗ Shielded Metal Arc Welding **SMAW**: **AWS B2.1-1-016-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E7018
- **Condition:** As Welded or PWHT Condition

##### ⊗ Shielded Metal Arc Welding **SMAW**: **AWS B2.1-1-017-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E6010
- **Condition:** As Welded or PWHT Condition

##### ⊗ Shielded Metal Arc Welding **SMAW**: **AWS B2.1-1-022-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E6010 Vertical Uphill + E7018
- **Condition:** As Welded or PWHT Condition

##### ⊗ Shielded Metal Arc Welding **SMAW**: **AWS B2.1-1-026-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E6010 Vertical Downhill + E7018
- **Condition:** As Welded or PWHT Condition

#### → COMBINATION **GTAW** AND **SMAW**: **AWS B2.1-1-021-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** ER70S-2 + E7018
- **Condition:** As Welded or PWHT Condition

#### → FLUX CORED ARC WELDING **FCAW**:

##### ⊗ FLUX CORED ARC WELDING **FCAW**: **AWS B2.1-1-019-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E70T-1 and E71T-1
- **Gas:** CO<sub>2</sub>
- **Condition:** As Welded

⊗ **FLUX CORED ARC WELDING FCAW:** **AWS B2.1-1-020-94 R05**

- **Material:** M-1/P-1/S-1\*\*\*\*\* Group 1 or 2
- **Thickness:** 1/8 through 1.1/2 inch
- **Electrode:** E70T-1 and E71T-1
- **Gas:** 75% Ar + 25% CO<sub>2</sub>
- **Condition:** As Welded or PWHT Condition

## 6-2 CARBON STEEL FOR PRIMARILY PIPE APPLICATIONS SWPS:

|                                                                                                                                                                                                                                                                                                                 |                        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Shielded Metal Arc Welding</b>                                                                                                                                                                                                                                                                               |                        |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E6010 (Vertical Uphill) Followed by E7018 (Vertical Uphill), As- Welded Condition, Primarily Pipe Applications                                          | B2.1-1-201-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E6010 (Vertical Downhill) Followed by E7018 (Vertical Uphill), As- Welded Condition, Primarily Pipe Applications                                        | B2.1-1-202-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E6010 (Vertical Uphill), As-Welded Condition, Primarily Pipe Applications                                                                               | B2.1-1-203-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E6010 (Vertical Downhill Root with the Balance Vertical Uphill), As- Welded Condition, Primarily Pipe Applications                                      | B2.1-1-204-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, E6010 (Vertical Uphill) Followed by E7018 (Vertical Uphill), As- Welded or PWHT Condition, Primarily Pipe Applications                                | B2.1-1-205-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, E6010 (Vertical Downhill) Followed by E7018 (Vertical Uphill), As- Welded or PWHT Condition, Primarily Pipe Applications                              | B2.1-1-206-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, E7018, As-Welded or PWHT Condition, Primarily Pipe Applications                                                                                       | B2.1-1-208-96 (R07)    |
| <b>Gas Tungsten Arc Welding</b>                                                                                                                                                                                                                                                                                 |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Applications                                                                                       | B2.1-1-207-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, INMs-1 and ER70S-2, As-Welded or PWHT Condition, Primarily Pipe Applications                                                | B2.1-1-210: 2001 (R11) |
| <b>Flux Cored Arc Welding</b>                                                                                                                                                                                                                                                                                   |                        |
| Standard Welding Procedure Specification (SWPS) for Argon plus 25% Carbon Dioxide Shielded Flux Cored Arc Welding of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 through 1 1/2 inch Thick, E7XT-X, As-Welded or PWHT Condition, Primarily Pipe Applications                                                 | B2.1-1-234: 2006       |
| <b>Gas Metal Arc Welding — Spray Transfer</b>                                                                                                                                                                                                                                                                   |                        |
| Standard Welding Procedure Specification (SWPS) for Argon plus 2% Oxygen Shielded Gas Metal Arc Welding (Spray Transfer Mode) of Carbon Steel (M-1/P-1/S-1, Groups 1 and 2), 1/8 through 1 1/2 inch Thick, E70S-3, Flat Position Only, As-Welded or PWHT Condition, Primarily Pipe Applications                 | B2.1-1-235: 2006       |
| <b>Combination GTAW and SMAW</b>                                                                                                                                                                                                                                                                                |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, ER70S-2 and E7018, As- Welded or PWHT Condition, Primarily Pipe Applications                                     | B2.1-1-209-96 (R07)    |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, INMs-1, ER70S-2, and E7018, As-Welded or PWHT Condition, Primarily Pipe Applications | B2.1-1-211: 2001 (R11) |

## 6-3 AUSTENITIC STAINLESS STEEL PLATE AND PIPE SWPS:

|                                                                                                                                                                                                                                                                                                               |                        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Shielded Metal Arc Welding</b>                                                                                                                                                                                                                                                                             |                        |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, As-Welded Condition                                                                                                     | B2.1-8-023-94 (R05)    |
| <b>Gas Tungsten Arc Welding</b>                                                                                                                                                                                                                                                                               |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{16}$ through $1\frac{1}{2}$ inch Thick, ER3XX, As-Welded Condition, Primarily Plate and Structural Applications                                                  | B2.1-8-024: 2001 (R11) |
| <b>Combination GTAW and SMAW</b>                                                                                                                                                                                                                                                                              |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, ER3XX and 3XX-XX, As-Welded Condition, Primarily Plate and Structural Applications | B2.1-8-025: 2001 (R11) |

## 6-4 AUSTENITIC STAINLESS FOR PRIMARILY PIPE APPLICATIONS SWPS:

|                                                                                                                                                                                                                                                                                                                                     |                        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------|
| <b>Shielded Metal Arc Welding</b>                                                                                                                                                                                                                                                                                                   |                        |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, E3XX-XX, As-Welded Condition, Primarily Pipe Applications                                                                                     | B2.1-8-213-97 (R11)    |
| <b>Gas Tungsten Arc Welding</b>                                                                                                                                                                                                                                                                                                     |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{16}$ through $1\frac{1}{2}$ inch Thick, ER3XX, As-Welded Condition, Primarily Pipe Applications                                                                                        | B2.1-8-212: 2001 (R11) |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, IN3XX and ER3XX, As-Welded Condition, Primarily Pipe Applications                                                        | B2.1-8-215: 2001 (R11) |
| <b>Combination GTAW and SMAW</b>                                                                                                                                                                                                                                                                                                    |                        |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, ER3XX and E3XX-XX, As-Welded Condition, Primarily Pipe Applications                                      | B2.1-8-214: 2001 (R11) |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root followed by Shielded Metal Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, IN3XX, ER3XXX, and E3XX-XX, As-Welded Condition, Primarily Pipe Applications | B2.1-8-216: 2001 (R11) |

## 6-5 CARBON STEEL TO AUSTENITIC STAINLESS STEEL SWPS:

|                                                                                                                                                                                                                                                                                                                                                                                                         |                                     |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------|
| <b>Gas Tungsten Arc Welding</b>                                                                                                                                                                                                                                                                                                                                                                         |                                     |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding of Carbon Steel to Austenitic Stainless Steel (M-1/P-1/S-1, Groups 1 and 2 Welded to M-8/P-8/S-8, Group 1), $\frac{1}{16}$ through $1\frac{1}{2}$ inch Thick, ER309(L), As-Welded Condition, Primarily Pipe Applications                                                                                                   | B2.1-1/8-227: 2002 (R13)            |
| <b>Gas Tungsten Arc Welding</b>                                                                                                                                                                                                                                                                                                                                                                         |                                     |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root of Carbon Steel to Austenitic Stainless Steel (M-1/P-1/S-1, Groups 1 and 2 Welded to M-8/P-8/S-8, Group 1), $\frac{1}{16}$ through $1\frac{1}{2}$ inch Thick, IN309 and R309(L), As-Welded Condition, Primarily Pipe Applications                                                              | (Cont'd)<br>B2.1-1/8-230 2002 (R13) |
| <b>Shielded Metal Arc Welding</b>                                                                                                                                                                                                                                                                                                                                                                       |                                     |
| Standard Welding Procedure Specification (SWPS) for Shielded Metal Arc Welding of Carbon Steel to Austenitic Stainless Steel (M-1/P-1/S-1, Groups 1 and 2 Welded to M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, E309(L)-15, -16, or -17, As-Welded Condition, Primarily Pipe Applications                                                                                   | B2.1-1/8-228 2002 (R13)             |
| <b>Combination GTAW and SMAW</b>                                                                                                                                                                                                                                                                                                                                                                        |                                     |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding Followed by Shielded Metal Arc Welding of Carbon Steel to Austenitic Stainless Steel (M-1/P-1/S-1 Groups 1 and 2 Welded to M-8/P-8/S-8, Group 1), $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, ER309(L) and E309(L)-15, -16, or -17, As-Welded Condition, Primarily Pipe Applications                                  | B2.1-1/8-229 2002 (R13)             |
| Standard Welding Procedure Specification (SWPS) for Gas Tungsten Arc Welding with Consumable Insert Root, Followed by Shielded Metal Arc Welding of Carbon Steel to Austenitic Stainless Steel (M-1/P-1/S-1 Groups 1 and 2 Welded to M-8/P-8/S-8, Group 1) $\frac{1}{8}$ through $1\frac{1}{2}$ inch Thick, IN309, ER309(L), and E309(L)-15, -16, -17, As-Welded Condition, Primarily Pipe Applications | B2.1-1/8-231 2002                   |

Standard Welding Procedure  
Specification (WPS) for

**Shielded Metal Arc  
Welding of Carbon  
Steel (M-1/P-1/S-1,  
Group 1 or 2), 1/8  
through 1-1/2 inch  
Thick, E7018,  
As-Welded or  
PWHT Condition**

Site License



**American Welding Society**



## Standard Welding Procedure Specification (WPS)

### Shielded Metal Arc Welding of Carbon Steel (M-1/P-1/S-1, Group 1 or 2), 1/8 through 1-1/2 inch Thick, E7018, As-Welded or PWHT Condition

**Welding Research Council<sup>1</sup>—Supporting PQR Numbers:**  
001021, 001022, 008001, 106004, 106005, 200116, 200117, 200118, 200119,  
200120, 200121, 200122, 200123, 200124, 200125, 200126, 200516, 200702,  
500006, 500007, 500008, 500023, 500024, 500029, 001A, 002A

#### Requirements for Application of Standard WPSs

**Scope.** The data to support this Standard Welding Procedure Specification (WPS) have been derived from the above listed Procedure Qualification Records (PQRs) which were reviewed and validated under the auspices of the Welding Research Council. This Standard WPS is not valid using conditions and variables outside the ranges listed. The American Welding Society considers that this Standard WPS 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 Standard Welding Procedure Specification.

**Application.** This Standard WPS is to be used only as permitted by the applicable fabrication document [such as code, specification, or contract document(s)]. The fabrication document 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 Standard WPS does not replace or substitute for fabrication codes, specifica-

tions, contract requirements, or capability and judgment on the part of the user. A Standard WPS 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 Standard WPS with appropriate performance qualification tests and sound engineering judgement. The user is responsible for the quality and performance of the final product in accordance with the provisions of the fabrication document.

**Supplementary Instructions.** To adapt this Standard WPS 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. These instructions shall not be less restrictive than provided in the Standard WPS.

**Safety.** Safety precautions shall conform to the latest edition of ANSI/ASC Z49.1, *Safety in Welding and Cutting*, published by the American Welding Society.

This specification may involve hazardous materials, operations, and equipment. The specification does not purport to address all of the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices. The user should determine the applicability of any regulatory limitations prior to use.

1. Welding Research Council, 345 East 47th Street, New York, NY 10017.

## Standard Welding Procedure Specification (WPS)

### LIMITATIONS

This procedure is not qualified for Notch Toughness applications.

### WELDING PROCESSES

**Welding Processes:** SMAW (Shielded Metal Arc Welding)  
**Method of Application:** Manual

### BASE METALS

**Base Metal:**<sup>2</sup> Carbon Steel, M-1, P-1, or S-1, Group 1 or 2 to M-1, P-1, or S-1, Group 1 or 2  
**Thickness Range:** 1/8 in. through 1-1/2 in. for groove welds,  
1/8 in. minimum for fillet welds  
**Diameter:** Groove Welds: 1 in. minimum  
Fillet Welds: all diameters

### FILLER METALS

**Filler Metal Specification:**<sup>2</sup> ANSI/AWS A5.1 or ASME SFA 5.1  
A Number 1, F Number 4  
**Classification:** E7018  
**Deposit Thickness Range:** 1-1/2 in. maximum plus reinforcement for groove welds,  
1/8 in. through 1-1/2 in. fillet weld size for fillet welds

### JOINT DESIGNS

**Joint Design:** See Figure 1  
**Backing:** When required by Figure 1  
**Backing Material:**<sup>2</sup> Carbon Steel, M-1, P-1, or S-1, Group 1, 2, or 3. Nonmetallic or nonfusing metal retainers are not permitted

### POSITIONS

**Permitted Positions:** All  
**Vertical Progression:** Uphill

### PREHEAT AND INTERPASS TEMPERATURES

**Preheat Temperature:**<sup>3</sup> 50°F Minimum  
**Interpass Temperature:**<sup>3</sup> 50°F Minimum, 500°F Maximum  
**Preheat Maintenance:** Continuous or special heating not required

2. M, P, and S numbers for base metal and F and A numbers for filler metal and weld metal respectively, are as detailed in AWS B2.1 or ASME *Boiler and Pressure Vessel Code*, Section IX.

3. Preheat and interpass temperatures must be sufficient to prevent crack formation. Temperatures above the minimum shown may be required for highly restrained welds or to meet the requirements of the fabrication document(s).

## Standard Welding Procedure Specification (WPS)

### POSTWELD HEAT TREATMENT

**Postweld Heat Treatment:** Welds may either be as-welded or postweld heat treated at 1100 to 1200°F. If heat treated, the heat treatment time shall be 1 hour per inch of thickness (15 minutes minimum) unless otherwise noted in the fabrication document.

### ELECTRICAL CHARACTERISTICS

| Electrode <sup>1</sup> |                       | Current |                |
|------------------------|-----------------------|---------|----------------|
| Classification         | Dia. <sup>2</sup> in. | Amperes | Polarity       |
| E7018                  | 3/32                  | 70-110  | DCEP (Reverse) |
| E7018                  | 1/8                   | 90-150  | DCEP (Reverse) |
| E7018                  | 5/32                  | 120-190 | DCEP (Reverse) |
| E7018                  | 3/16                  | 170-280 | DCEP (Reverse) |

- The care and storage of electrodes shall be as recommended by the electrode manufacturer.
- 3/16 in. diameter shall not be used for tack or root pass welding nor for welding in the vertical or overhead positions.

**Pulsing Current:** Not permitted

### TECHNIQUE

**Weave or Stringer Bead:** Either  
**Peening:** Not required; if used, proceed as permitted by the fabrication document  
**Initial Cleaning:** Chemical or mechanical; joint shall be dry prior to welding  
**Interpass Cleaning:** Mechanical only  
**Backgouging:** Mechanical or thermal when required by Figure 1  
**Gouging:** Mechanical or thermal  
**Single or Multiple Passes:** Either  
**Maximum Bead Thickness:** 1/4 in.

COMPANY NAME \_\_\_\_\_

In the name of the Company stated above, I accept full responsibility for the application of this Standard WPS for use with:

\_\_\_\_\_  
 Fabrication Document(s): such as Code, Specification or Contract Document

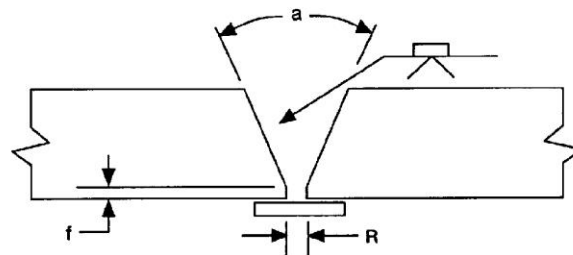
DATE \_\_\_\_\_ APPROVED BY \_\_\_\_\_ TITLE \_\_\_\_\_

## Standard Welding Procedure Specification (WPS)

**FILLET WELDS:** All Joints

**GROOVE WELDS:** See Joints 1 through 17. Joints having prequalified joint details permitted by the latest edition of ANSI/AWS D1.1, *Structural Welding Code—Steel* are also permitted.

For tubular products, see Joints 1, 2, 6 and 7. In addition, joints having groove designs resulting from end preparations conforming with the latest edition of ANSI/ASME B16.25, *Butt Welding Ends*, are also allowable for application with this WPS.



**STRUCTURAL PRODUCTS**

$a = 45^\circ$  MIN.

$R = 1/4$  in.,  $+1/4$  -  $1/16$

$f = R/2$  MAX.

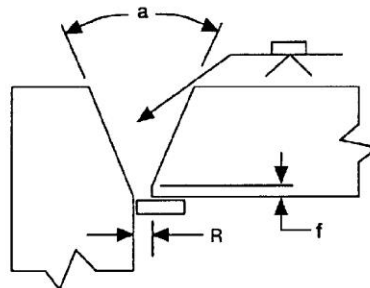
**TUBULAR PRODUCTS**

$a = 60^\circ$  MIN.

$R = 3/16$  in.,  $+1/4$  -  $1/16$

$f = R/2$  MAX.

**JOINT 1**



**STRUCTURAL PRODUCTS**

$a = 45^\circ$  MIN.

$R = 1/4$  in.,  $+1/4$  -  $1/16$

$f = R/2$  MAX.

**TUBULAR PRODUCTS**

$a = 60^\circ$  MIN.

$R = 3/16$  in.,  $+1/4$  -  $1/16$

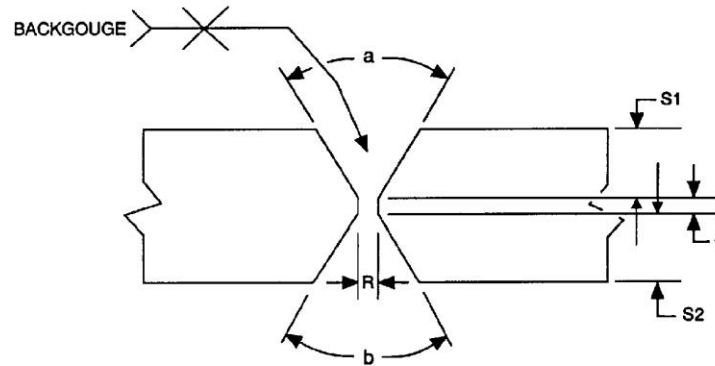
$f = R/2$  MAX.

**JOINT 2**

**Figure 1—Allowable Joint Designs**

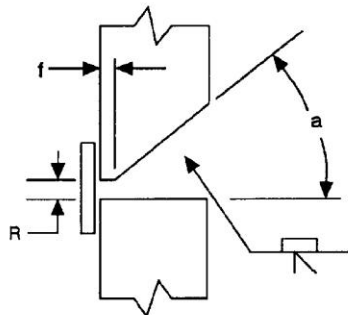


## Standard Welding Procedure Specification (WPS)



a AND b = 60° MIN.  
R = 1/8 in., +1/16-1/8  
f = NOT LIMITED  
S1 = NOT LIMITED  
S2 = NOT LIMITED

JOINT 5



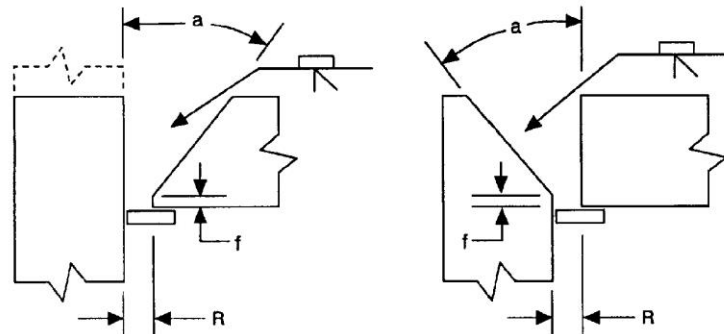
STRUCTURAL PRODUCTS  
a = 45° MIN.  
R = 1/4 in., +1/4 -1/16  
f = R/2 MAX.

TUBULAR PRODUCTS  
a = 60° MIN.  
R = 3/16 in., +1/4 -1/16  
f = R/2 MAX.

JOINT 6

Figure 1 (continued)—Allowable Joint Designs

## Standard Welding Procedure Specification (WPS)



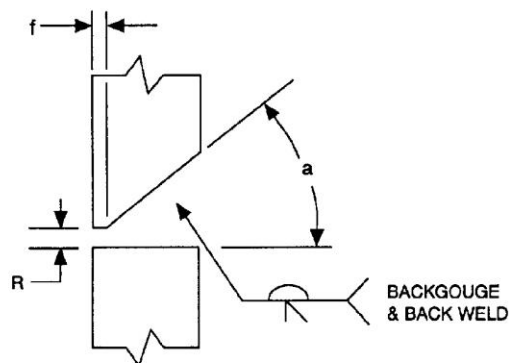
### STRUCTURAL PRODUCTS

$a = 45^\circ$  MIN.  
 $R = 1/4$  in.,  $+1/4 -1/16$   
 $f = R/2$  MAX.

### TUBULAR PRODUCTS

$a = 60^\circ$  MIN.  
 $R = 3/16$  in.,  $+1/4 -1/16$   
 $f = R/2$  MAX.

JOINT 7

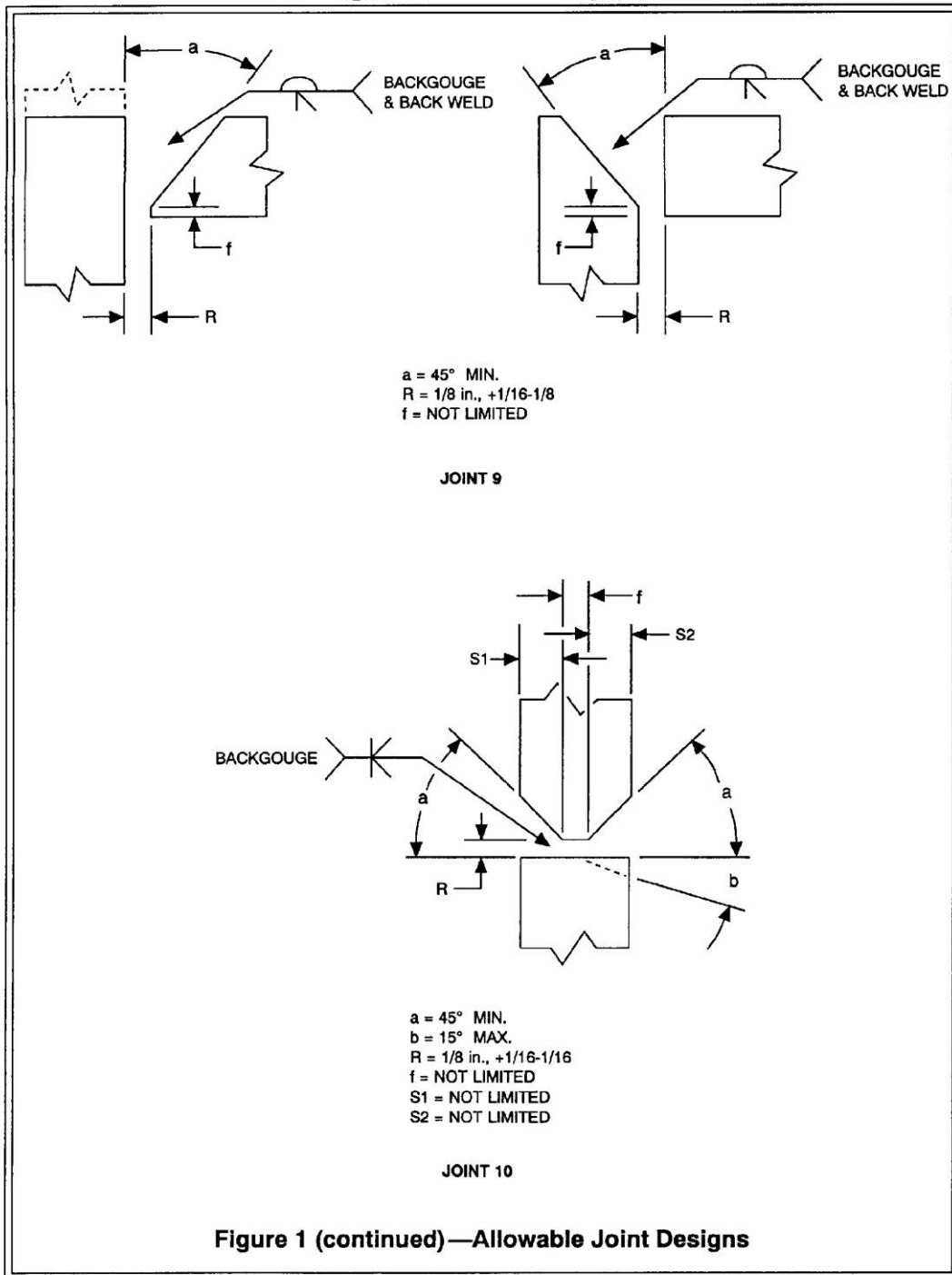


$a = 45^\circ$  MIN.  
 $R = 1/8$  in.,  $+1/16 -1/8$   
 $f =$  NOT LIMITED

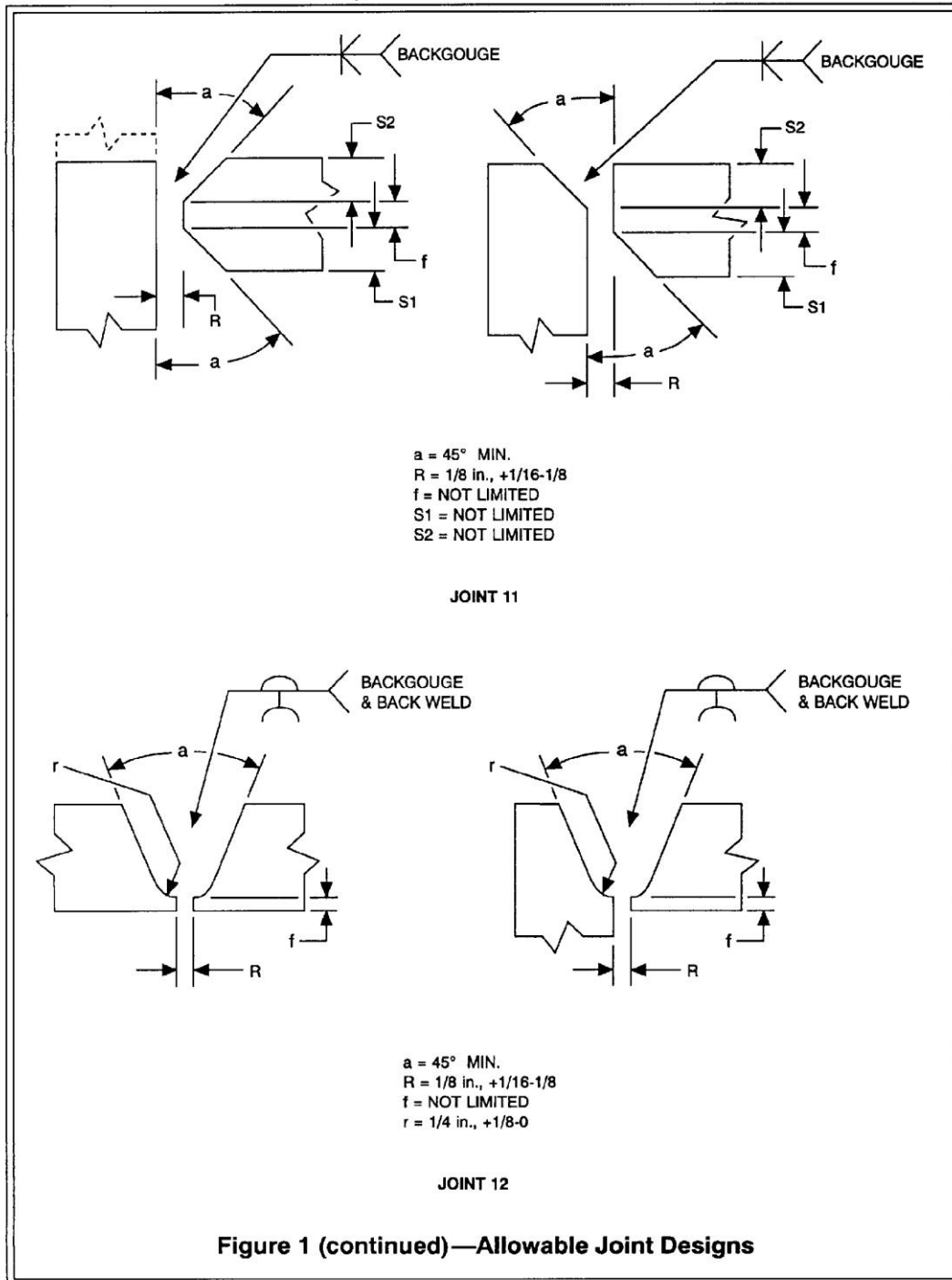
JOINT 8

**Figure 1 (continued)—Allowable Joint Designs**

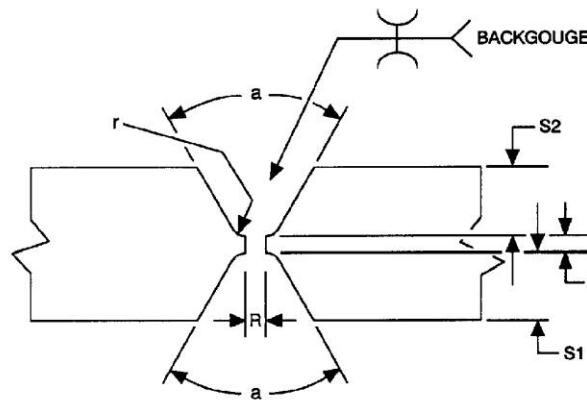
## Standard Welding Procedure Specification (WPS)



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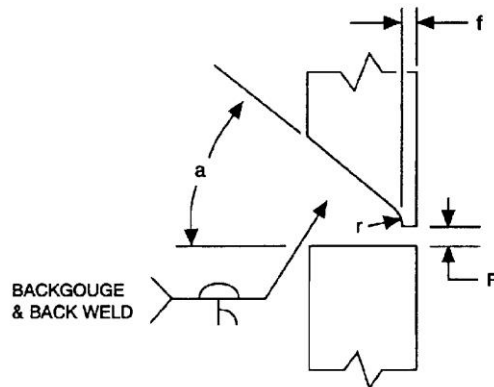


## Standard Welding Procedure Specification (WPS)



$a = 45^\circ$  MIN.  
 $R = 1/8$  in.,  $+1/16-1/8$   
 $f =$  NOT LIMITED  
 $r = 1/4$  in.,  $+1/16-1/16$   
 $S1 =$  NOT LIMITED  
 $S2 =$  NOT LIMITED

JOINT 13

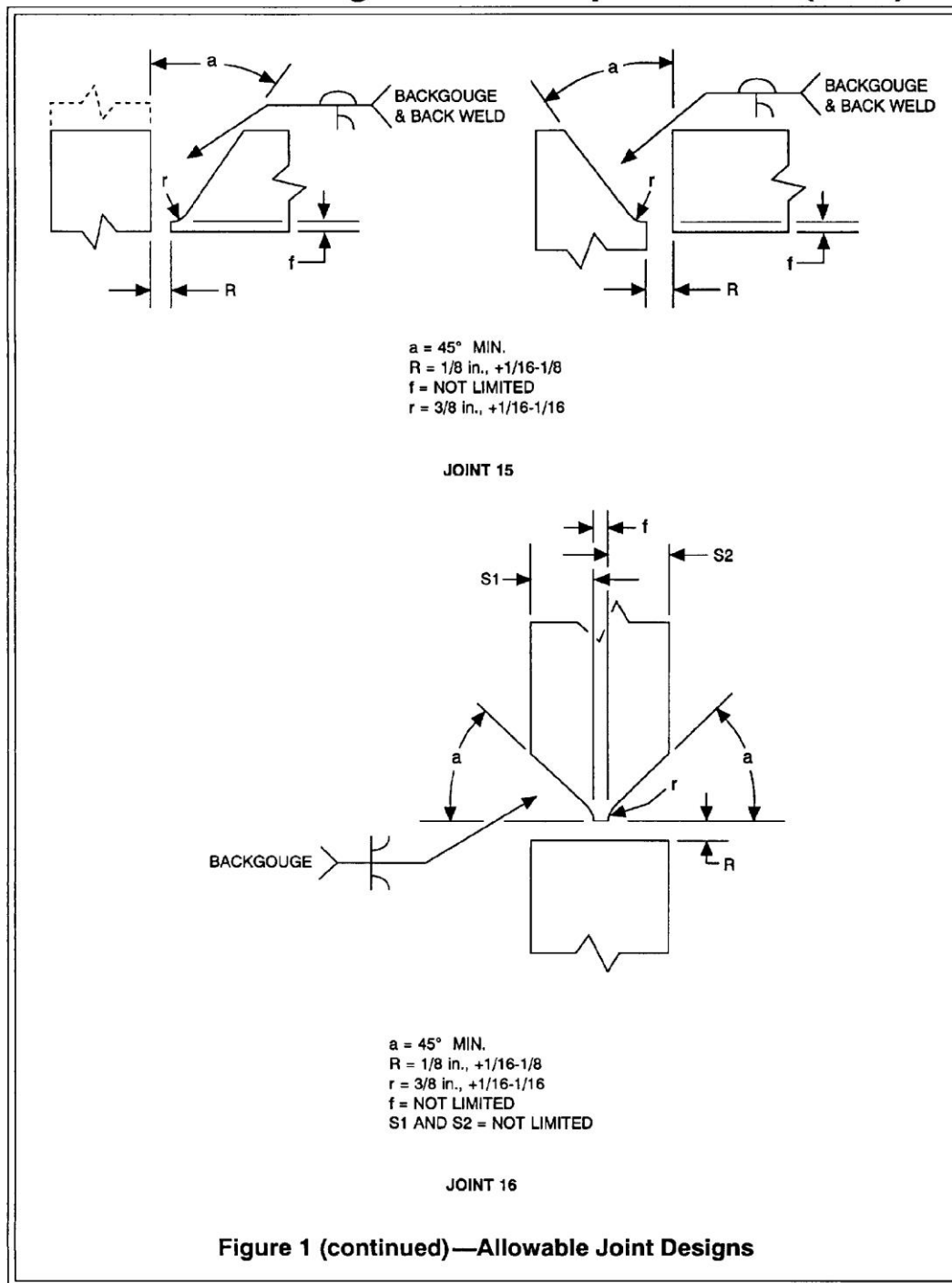


$a = 45^\circ$  MIN.  
 $R = 1/8$  in.,  $+1/16-1/8$   
 $f =$  NOT LIMITED  
 $r = 3/8$  in.,  $+1/16-1/16$

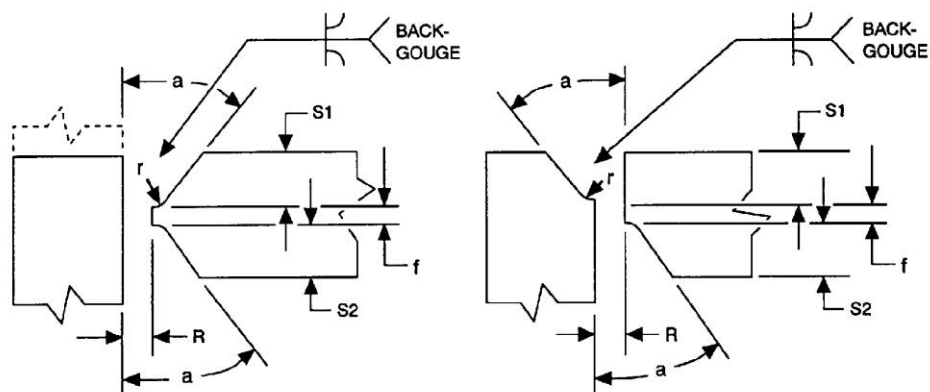
JOINT 14

Figure 1 (continued)—Allowable Joint Designs

## Standard Welding Procedure Specification (WPS)



## Standard Welding Procedure Specification (WPS)



$a = 45^\circ \text{ MIN.}$   
 $R = 1/8 \text{ in., } +1/16-1/8$   
 $r = 3/8 \text{ in., } +1/16-1/16$

$f = \text{NOT LIMITED}$   
 $S1 = \text{NOT LIMITED}$   
 $S2 = \text{NOT LIMITED}$

JOINT 17

Figure 1 (continued)—Allowable Joint Designs

### Metric Conversions

| in.   | mm  | °F   | °C  |
|-------|-----|------|-----|
| 1/16  | 1.6 | 50   | 10  |
| 3/32  | 2.4 | 500  | 260 |
| 1/8   | 3.2 | 1100 | 590 |
| 5/32  | 4.0 | 1200 | 650 |
| 3/16  | 4.8 |      |     |
| 1/4   | 6.4 |      |     |
| 3/8   | 10  |      |     |
| 1     | 25  |      |     |
| 1-1/2 | 38  |      |     |