

**Standard
Welding Procedure
Specification (WPS) for**

**Gas Tungsten Arc Welding
of Austenitic Stainless Steel
(M-8/P-8/S-8, Group 1),
1/8 through 1-1/2 inch Thick,
As-Welded Condition**



American Welding Society

Key Words — Welding Procedure Specification,
base metal, allowable joint designs,
filler metal, austenitic stainless
steel, manual gas tungsten arc
welding

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An American National Standard

Approved by
American National Standards Institute
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Prepared by
AWS Committee on Welding Qualification

Under the Direction of the
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for austenitic stainless steel in the thickness range of 1/8 through 1-1/2 inch, using manual gas tungsten arc welding. It cites the base metals and operating conditions necessary to make the weldment, the filler metal specifications, and the allowable joint designs for fillet and groove welds. This WPS was developed primarily for plate and structural applications.



American Welding Society

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

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**Advisor*

***Retired*

****Deceased*

Foreword

(This Foreword is not a part of the ANSI/AWS B2.1-8-024-94, *Standard Welding Procedure Specification*, but is included for information purposes only.)

The American Welding Society and the Welding Research Council have joined in a cooperative effort to generate standard welding procedures for industry. 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 specification 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 Welding Procedure Specification is an outgrowth of the coordinated work of the Welding Procedures Committee of WRC and the Committee on Welding Qualification of the AWS. The Welding Procedures Committee has provided the test data documented on Procedure Qualification Records, which are available from the Welding Research Council.

The welding terms used in this specification shall be interpreted in accordance with the definitions given in the latest edition of ANSI/AWS A3.0, *Standard Welding Terms and Definitions*. Welding symbols shall be those shown in the latest edition of ANSI/AWS A2.4, *Standard Symbols for Welding, Brazing, and Nondestructive Examination*.

The AWS Committee on Welding 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, *Standard for Welding Procedure and Performance Qualification*. This document established the foundation and framework for Standard Welding Procedure Specifications.

Comments on this publication are most welcome. They should be addressed to: Secretary, AWS Committee on Welding Qualification, American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126.

Standard Welding Procedure Specification (WPS)

Gas Tungsten Arc Welding of Austenitic Stainless Steel (M-8/P-8/S-8, Group 1), 1/8 through 1-1/2 inch Thick, As-Welded Condition

Welding Research Council¹—Supporting PQR Numbers:
001031, 001032, 003049, 007018, 007019, 103023, 103024, 200005, 200623, 200720, 200721, 200723, 500227, 500228, 500229, 500230, 500231, 500258, 500263, 500264, 500265, 500266, 084A, 085A, 089A, 090A, 091A

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 or PWHT applications.

WELDING PROCESSES

Welding Processes: GTAW (Gas Tungsten Arc Welding)
Method of Application: Manual

BASE METALS

Base Metal:² Austenitic Stainless Steel, M-8, P-8, or S-8, Group 1 to M-8, P-8, or S-8, Group 1 (See Table 1)
Thickness Range: 1/8 in. through 1-1/2 in. for groove welds,
1/8 in. minimum for fillet welds
Diameter: All diameters

FILLER METALS

Filler Metal Specification:² ANSI/AWS A5.9 or ASME SFA 5.9
A Number 8, F Number 6
Classification: See Table 1 for allowable classifications
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 Designs: See Figure 1
Backing: When required by Figure 1
Backing Material:² Stainless Steel, M-8, P-8, or S-8, Group 1. Nonmetallic or nonfusing metal retainers are not permitted

POSITIONS

Permitted Positions: All
Vertical Progression: Uphill

PREHEAT AND INTERPASS TEMPERATURES

Preheat Temperature: 50°F Minimum
Interpass Temperature: 50°F Minimum, 350°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.

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GAS

Shielding Gas: Welding Grade Argon
Flow Rate: 15 to 30 ft³/h
Trailing Shield: Not Required
Backing Gas: Argon; backing gas shall remain in place until the joint is completed or at least 3/16 in. weld metal has been deposited. Backing gas is not required for fillet welds or when backing or back gouging is used.
Flow Rate: A typical flow rate of 5 to 15 ft³/h may be varied depending on component configuration
Shielding Gas Nozzle Size: 1/4 to 3/4 in. I.D.

POSTWELD HEAT TREATMENT

Postweld Heat Treatment: None (Not qualified for PWHT applications)

TUNGSTEN ELECTRODES

Specification: ANSI/AWS A5.12, or ASME SFA 5.12
Classification: EWTh-2 or EWCe-2
Size: 1/16 through 1/8 in. diameter sharpened to a point

ELECTRICAL CHARACTERISTICS

Filler Metal		Current	
Dia. in.		Amperes*	Polarity
1/16		20-100	DCEN (Straight)
3/32		70-120	DCEN (Straight)
1/8		90-140	DCEN (Straight)

*Values not to exceed capacity of Tungsten Electrodes.

Pulsing Current: Not permitted

TECHNIQUE

Weave or Stringer Bead: Either
Peening: Not required; if used, proceed as directed 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.

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Table 1
Base Metal & Corresponding Filler Metal Classifications*

Base Metal Grade or Type	Corresponding Classification
302, 304, CF8, CF8A	ER308, ER308L, ER309, ER309L
304L, CF3, CF3A	ER308L, ER309L
304H, CF10	ER308H
304N	ER308H
304LN	ER308L
316, CF8M	ER316, ER316L, ER16-8-2
316L, CF3M, CF3MA	ER316L
316H, CF10M	ER316H
316Ti	ER316
316Cb	ER316
316N	ER308H, ER309
316LN	ER316
317	ER317, ER317L
317L	ER317L
321	ER321
347, CF8C	ER347
347H	ER347
348	ER349

Notes:

- When two different base metal grades or types listed above are being joined, a filler metal classification permitted for either base metal grade or type may be used.
- The care and storage of filler metals shall be as recommended by the electrode manufacturer.

*Table 1 is based on room temperature strength and may not ensure high temperature or corrosion resistant properties.

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

Dated _____

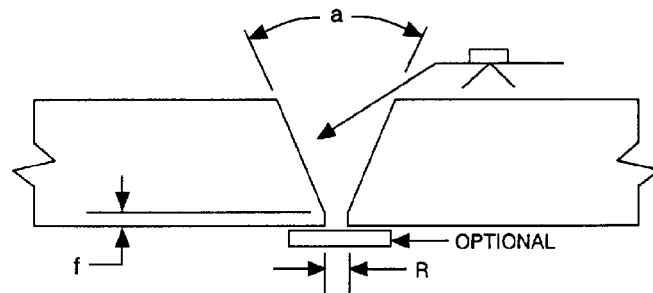
DATE _____ APPROVED BY _____ TITLE _____

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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.

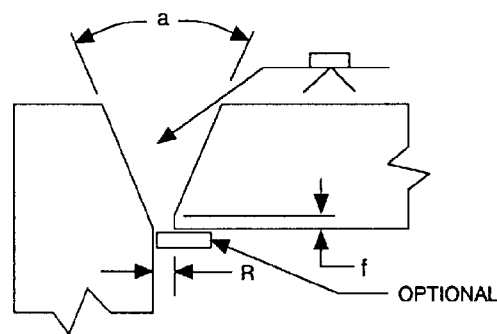
For tubular products, see Joints 1, 2, 6 and 7. In addition, joints having groove designs resulting from end preparations conforming with the latest edition of ANSI/ASME B16.25, *Butt Welding Ends*, are also allowable for application with this WPS.



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

WITHOUT BACKING
 $a = 60^\circ$ MIN.
 $R = 1/8$ in., $+1/16 - 1/16$
 $f = 1/16$ in. MAX.

JOINT 1



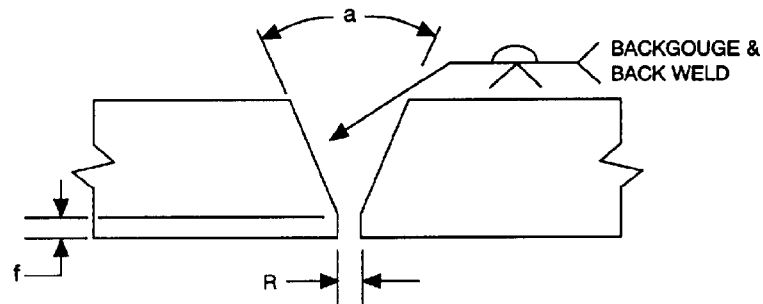
WITH BACKING
 $a = 45^\circ$ MIN.
 $R = 1/4$ in., $+1/4 - 1/16$
 $f = R/2$

WITHOUT BACKING
 $a = 60^\circ$ MIN.
 $R = 1/8$ in., $+1/16 - 1/16$
 $f = 1/16$ in. MAX.

JOINT 2

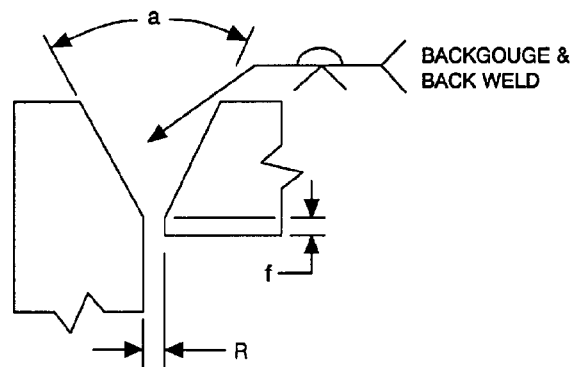
Figure 1—Allowable Joint Designs

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$a = 60^\circ \text{ MIN.}$
 $R = 1/8 \text{ in., } +1/16-1/8$
 $f = \text{NOT LIMITED}$

JOINT 3

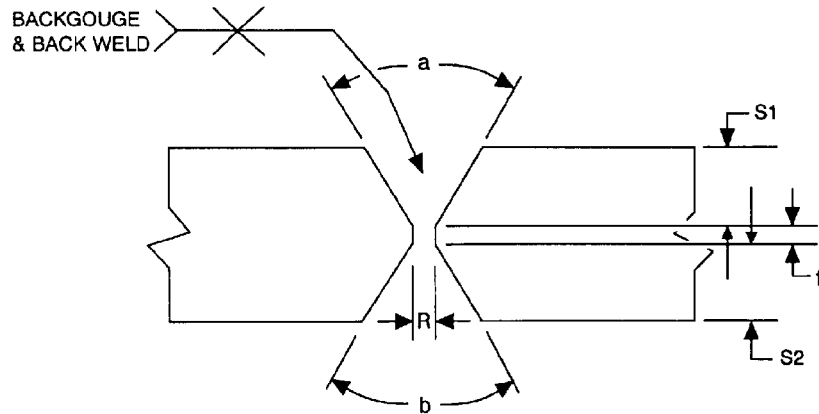


$a = 60^\circ \text{ MIN.}$
 $R = 1/8 \text{ in., } +1/16-1/8$
 $f = \text{NOT LIMITED}$

JOINT 4

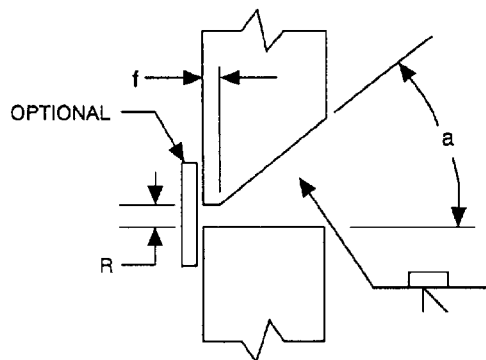
Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)



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

JOINT 5



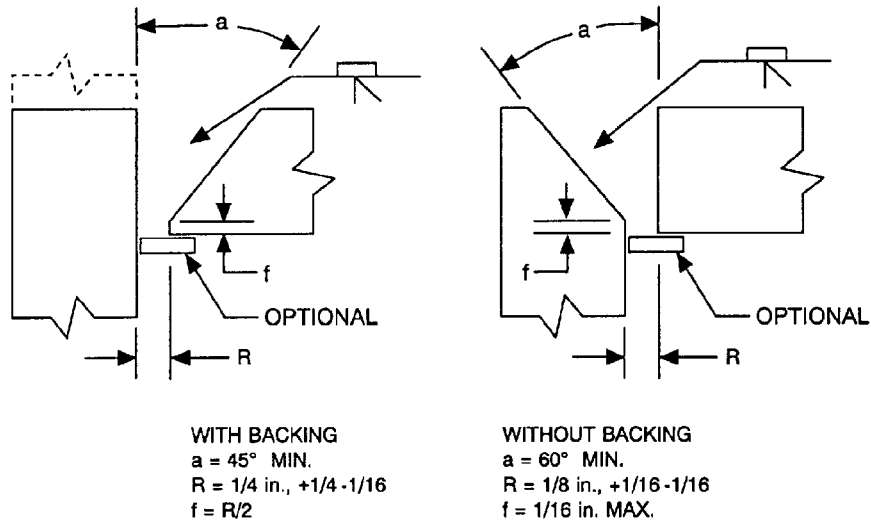
WITH BACKING
 $a = 45^\circ$ MIN.
 $R = 1/4$ in., $+1/4$ - $1/16$
 $f = R/2$

WITHOUT BACKING
 $a = 60^\circ$ MIN.
 $R = 1/8$ in., $+1/16$ - $1/16$
 $f = 1/16$ in. MAX.

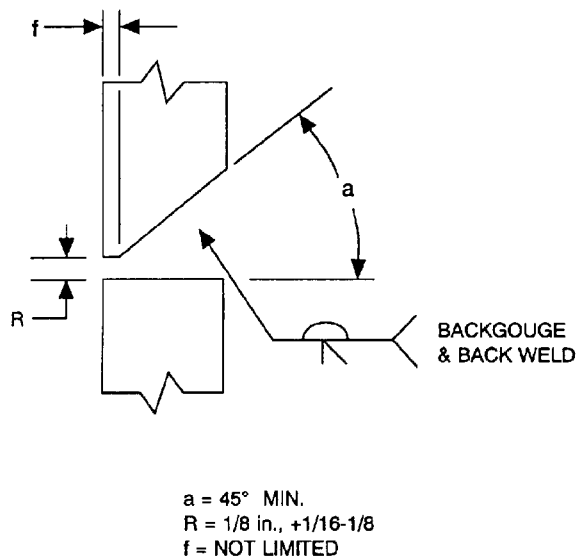
JOINT 6

Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)



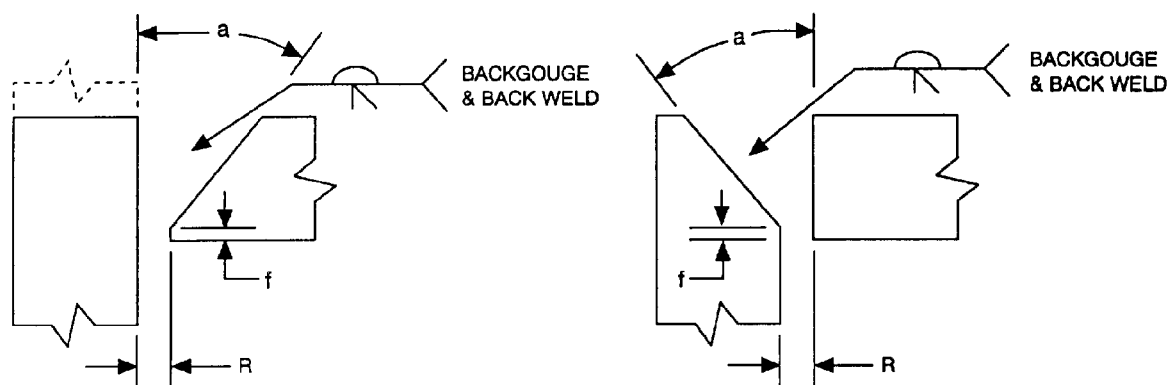
JOINT 7



JOINT 8

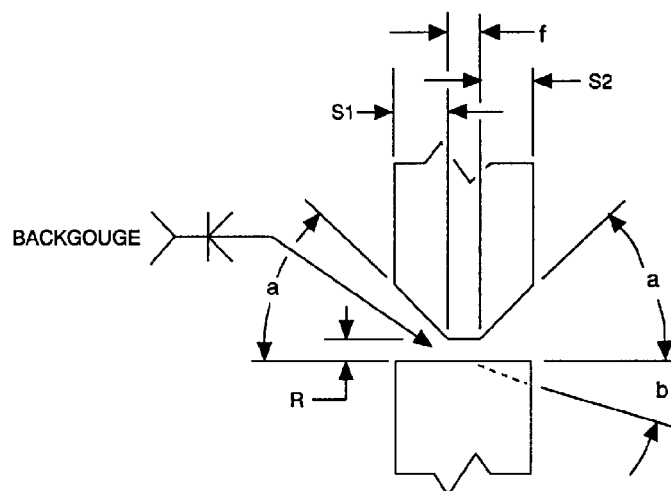
Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)



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

JOINT 9

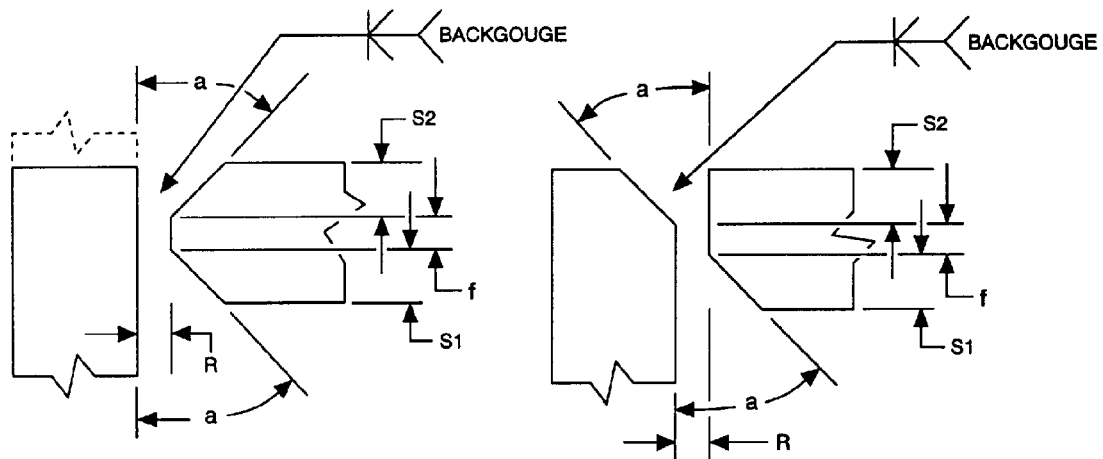


$a = 45^\circ \text{ MIN.}$
 $b = 15^\circ \text{ MAX.}$
 $R = 1/8 \text{ in., } +1/16-1/16$
 $f = \text{NOT LIMITED}$
 $S1 = \text{NOT LIMITED}$
 $S2 = \text{NOT LIMITED}$

JOINT 10

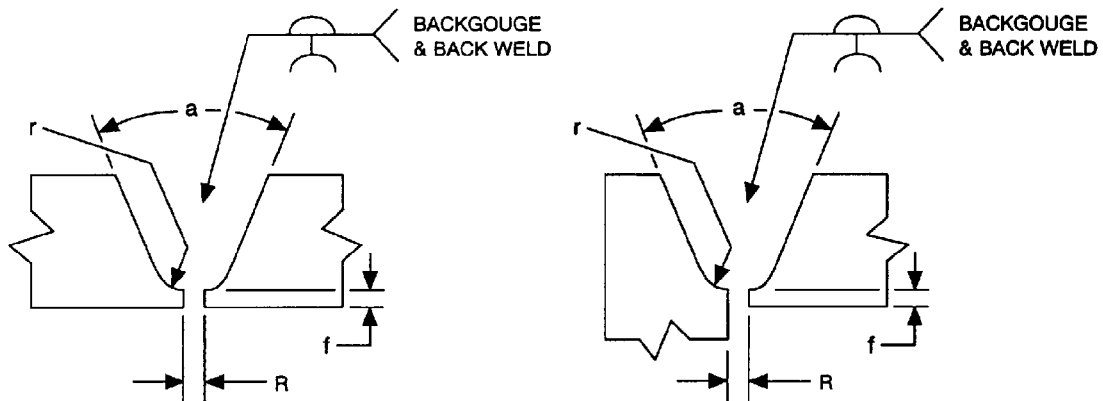
Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)



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

JOINT 11



$a = 45^\circ \text{ MIN.}$
 $R = 1/8 \text{ in., } +1/16-1/8$
 $f = \text{NOT LIMITED}$
 $r = 1/4 \text{ in., } +1/8-0$

JOINT 12

Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)

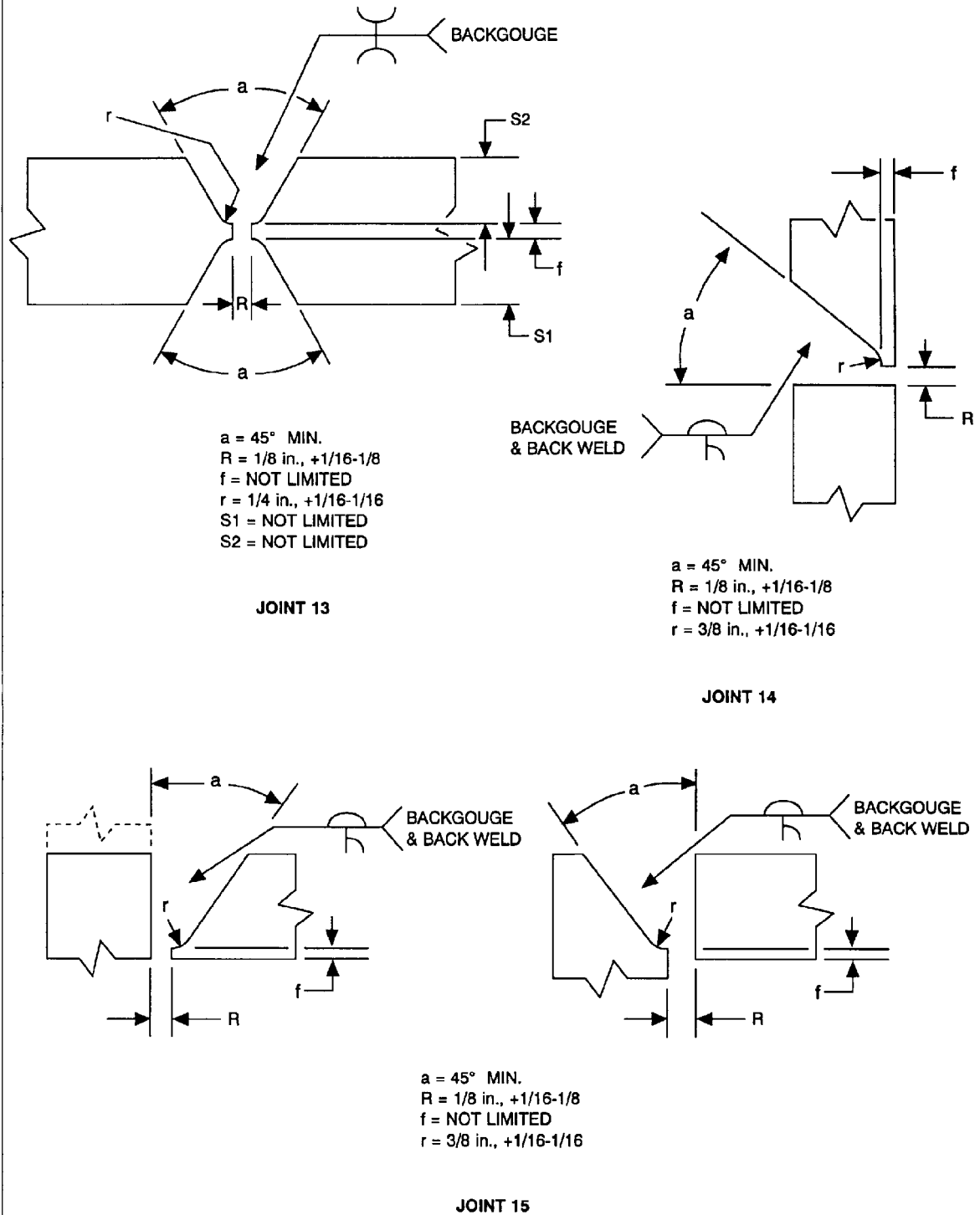


Figure 1 (continued)—Allowable Joint Designs

Standard Welding Procedure Specification (WPS)

