

ANSI/AWS B2.1.004-90
An American National Standard

**Standard
Welding Procedure
Specification (WPS) for
Gas Metal Arc
Welding of Carbon Steel (M-1, Group 1),
10 through 18 Gage,
in the As-Welded Condition,
With or Without Backing**



American Welding Society

Keywords—Welding procedure specification, base metal, allowable joint designs, filler metal, carbon steel, semiautomatic, gas metal arc welding

ANSI/AWS B2.1.004-90
An American National Standard

Approved by
American National Standards Institute
November 27, 1989

Standard Welding Procedure
Specification (WPS)
Gas Metal Arc Welding of Carbon Steel
(M-1, Group 1),
10 through 18 Gage, in the As-Welded Condition,
With or Without Backing

Prepared by
AWS Committee on Welding Qualification

Under the Direction of
AWS Technical Activities Committee

Approved by
AWS Board of Directors

Abstract

This standard contains the essential welding variables for carbon steel in the thickness range of 10 through 18 gage, using semiautomatic gas metal 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.



American Welding Society

550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135

Statement on Use of AWS Standards

All standards (codes, specifications, recommended practices, methods, classifications, and guides) of the American Welding Society are voluntary consensus standards that have been developed in accordance with the rules of the American National Standards Institute. When AWS standards are either incorporated in, or made part of, documents that are included in federal or state laws and regulations, or the regulations of other governmental bodies, their provisions carry the full legal authority of the statute. In such cases, any changes in those AWS standards must be approved by the governmental body having statutory jurisdiction before they can become a part of those laws and regulations. In all cases, these standards carry the full legal authority of the contract or other document that invokes the AWS standards. Where this contractual relationship exists, changes in or deviations from requirements of an AWS standard must be by agreement between the contracting parties.

International Standard Book Number: 0-87171-333-0

American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135

© 1990 by American Welding Society. All rights reserved
Printed in the United States of America

Note: The primary purpose of AWS is to serve and benefit its members. To this end, AWS provides a forum for the exchange, consideration, and discussion of ideas and proposals that are relevant to the welding industry and the consensus of which forms the basis for these standards. By providing such a forum, AWS does not assume any duties to which a user of these standards may be required to adhere. By publishing this standard, the American Welding Society does not insure anyone using the information it contains against any liability arising from that use. Publication of a standard by the American Welding Society does not carry with it any right to make, use, or sell any patented items. Users of the information in this standard should make an independent investigation of the validity of that information for their particular use and the patent status of any item referred to herein.

This standard is subject to revision at any time by the AWS Committee on Welding Qualification. It must be reviewed every five years and if not revised, it must be either reapproved or withdrawn. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are requested and should be addressed to AWS Headquarters. Such comments will receive careful considerations by the AWS Committee on Welding Qualification and the author of the comments will be informed of the committee's response to the comments. Guests are invited to attend all meetings of the AWS Committee on Welding Qualification to express their comments verbally. Procedures for appeal of an adverse decision concerning all such comments are provided in the Rules of Operation of the Technical Activities Committee. A copy of these Rules can be obtained from the American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.

Personnel

AWS Committee on Welding Qualification

<i>T. J. Anderson, Chairman</i>	Bechtel Group, Incorporated
<i>D. L. Sprow, Vice Chairman</i>	McDermott Incorporated
<i>M. J. Houle, Vice Chairman</i>	Welding Engineering Services
<i>D. R. Papenfuss, Vice Chairman</i>	The Boeing Company
<i>F. X. Neary, Secretary</i>	American Welding Society
<i>W. L. Ballis</i>	Columbia Gas Distribution Companies
<i>H. B. Cary</i>	Hobart Brothers Company
<i>P. B. Dickerson**</i>	Aluminum Company of America
<i>W. D. Doty</i>	Doty and Associates
<i>R. A. Dunn</i>	StepSan Limited Consultants
<i>J. J. Falco*</i>	Army Materials and Mechanics Research Center
<i>E. H. Gray*</i>	U.S. Nuclear Regulatory Commission
<i>J. E. Hinkel</i>	Lincoln Electric Company
<i>R. W. Jackson</i>	Consultant
<i>J. W. McGrew</i>	Babcock and Wilcox
<i>G. E. Metzger</i>	Wright-Patterson Air Force Base
<i>C. L. Null*</i>	Naval Sea Systems Command
<i>A. S. Olivares</i>	The Hartford Steam Boiler Inspection and Insurance Company
<i>G. W. Oyler**</i>	Welding Research Council
<i>S. Panezic</i>	Canadian Welding Bureau
<i>D. J. Schell</i>	Westinghouse Idaho Nuclear Company Incorporated
<i>J. J. Sekely</i>	Welding Services, Incorporated
<i>A. W. Sindel</i>	C-E Natco
<i>W. R. Smith, Sr.**</i>	Bechtel Group, Incorporated
<i>C. E. Spaeder</i>	Lehigh University
<i>V. W. Sutter</i>	American Welding Institute
<i>G. M. Wisbrock, Jr.</i>	LTV Missiles and Electronics Group Missiles Division

*Advisor

**Retired

Foreword

(This Foreword is not a part of the ANSI/AWS B2.1.004-90, *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 specifications has been expressed by many individuals and organizations. The purpose of a welding procedure qualification is to provide test data for assessing the properties of a weld joint.

This Welding Procedure Specification is an outgrowth of the coordinated work of the Welding Procedures Committee of WRC and the Committee on Welding Qualification of 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, *Symbols for Welding and Nondestructive Testing*.

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 will be most welcome. They should be addressed to: Secretary, AWS Committee on Welding Qualification, American Welding Society, 550 N.W. LeJeune Road, P.O. Box 351040, Miami, Florida 33135.

Standard Welding Procedure Specification (WPS)

Gas Metal Arc Welding of Carbon Steel (M-1, Group 1), 10 through 18 Gage, in the As-Welded Condition, With or Without Backing.

**Welding Research Council¹ —
Supporting PQR Numbers: 092A, 093A, 094A, 095A, 096B, 097A,
098A, 099A, 100A, 101A, 102B, 103A**

Application

The data to support this Standard Welding Procedure Specification (WPS) have been derived from two or more Procedure Qualification Records (PQR's) completed according to the requirements in AWS B2.1 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.

The referencing fabrication code or specification and the engineering requirements are intended to specify any requirements related to design, need for heat-treatment, fabricating, tolerances, quality control, safe welding and

testing practices, and examinations and tests applicable to the end product.

A Standard WPS does not replace or substitute for fabrication codes, specifications, contract requirements, or capability and judgement 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.

A Standard WPS may be supplemented by attached or referenced information and instructions that may be necessary to make an acceptable weldment.

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)

PROCESS:	GMAW (Gas Metal Arc Welding) Semiautomatic Short Circuiting Transfer Mode
BASE METAL:	Carbon Steel ² , M-1, Group 1 to M-1, Group 1
BASE METAL THICKNESS RANGE: ³	Groove Weld: 18 ga. (0.0478 in.) through 10 ga. (0.1345 in.) Fillet Weld: 18 ga. (0.0478 in.) through 10 ga. (0.1345 in.)
WELD METAL THICKNESS RANGE:	Groove Weld: Base metal thickness plus reinforcement, max. Fillet Weld Leg: Base metal thickness, min.
MAXIMUM WELD BEAD THICKNESS:	Base metal thickness plus reinforcement
BACKING:	Optional
BACKING MATERIAL:	Carbon Steel ² , M-1
ALLOWABLE JOINT DESIGNS:	See Figure 1
WELDING POSITIONS:	All
VERTICAL WELDING PROGRESSION:	Optional
PREHEAT TEMPERATURE:	50°F minimum, 120°F maximum
INTERPASS TEMPERATURE:	No maximum
PREHEAT TEMPERATURE MAINTENANCE:	Continuous or special heating not required
POSTWELD HEAT-TREATMENT:	None (not qualified for PWHT)
TECHNIQUE:	Beads: Stringer or weave Peening: No Cleaning: Joint shall be dry prior to welding Initial Cleaning: Mechanical or chemical Interpass Cleaning: Mechanical only
SINGLE OR MULTIPLE ELECTRODE:	Single
SINGLE OR MULTIPLE PASS:	Either
CONTACT TUBE TO WORK PIECE DISTANCE:	1/2 in. nominal
FILLER METAL SPECIFICATION:	ANSI/AWS A5.18 ASME SFA 5.18 AWS/ASME ² F Number 6
GAS:	Torch Shielding: Argon plus Carbon Dioxide Composition: 75% Argon, 25% Carbon Dioxide Gas Nozzle Size: 1/2 in. diameter minimum (I.D.) Flow Rate: 20 to 40 ft ³ /h Root Shielding Gas: None Trailing Gas: None

2. As detailed in AWS B2.1, and ASME B&PV Code, Section IX.

3. See ASTM Specification for base metal thickness tolerances.

Standard Welding Procedure Specification (WPS)

CURRENT (Type and Polarity):

DCEP

WELDING PARAMETERS:

Base Metal	FILLER METAL		AMPERES		Volts
	Classification	Dia. (in.)	Groove	Fillet	
18 ga.	ER70S-6	0.035	60/85	70/90	15/17
17 ga.	ER70S-6	0.035	65/92	76/93	15/17
16 ga.	ER70S-6	0.035	70/99	81/96	15/17
15 ga.	ER70S-6	0.035	75/105	87/100	16/19
14 ga.	ER70S-6	0.035	80/112	92/105	16/19
13 ga.	ER70S-6	0.035	85/118	98/108	16/19
12 ga.	ER70S-6	0.035	90/127	103/112	18/20
11 ga.	ER70S-6	0.035	95/132	109/116	18/20
10 ga.	ER70S-6	0.035	100/140	115/120	18/20

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

Dated _____

DATE _____ APPROVED BY _____ TITLE _____

Standard Welding Procedure Specification (WPS)

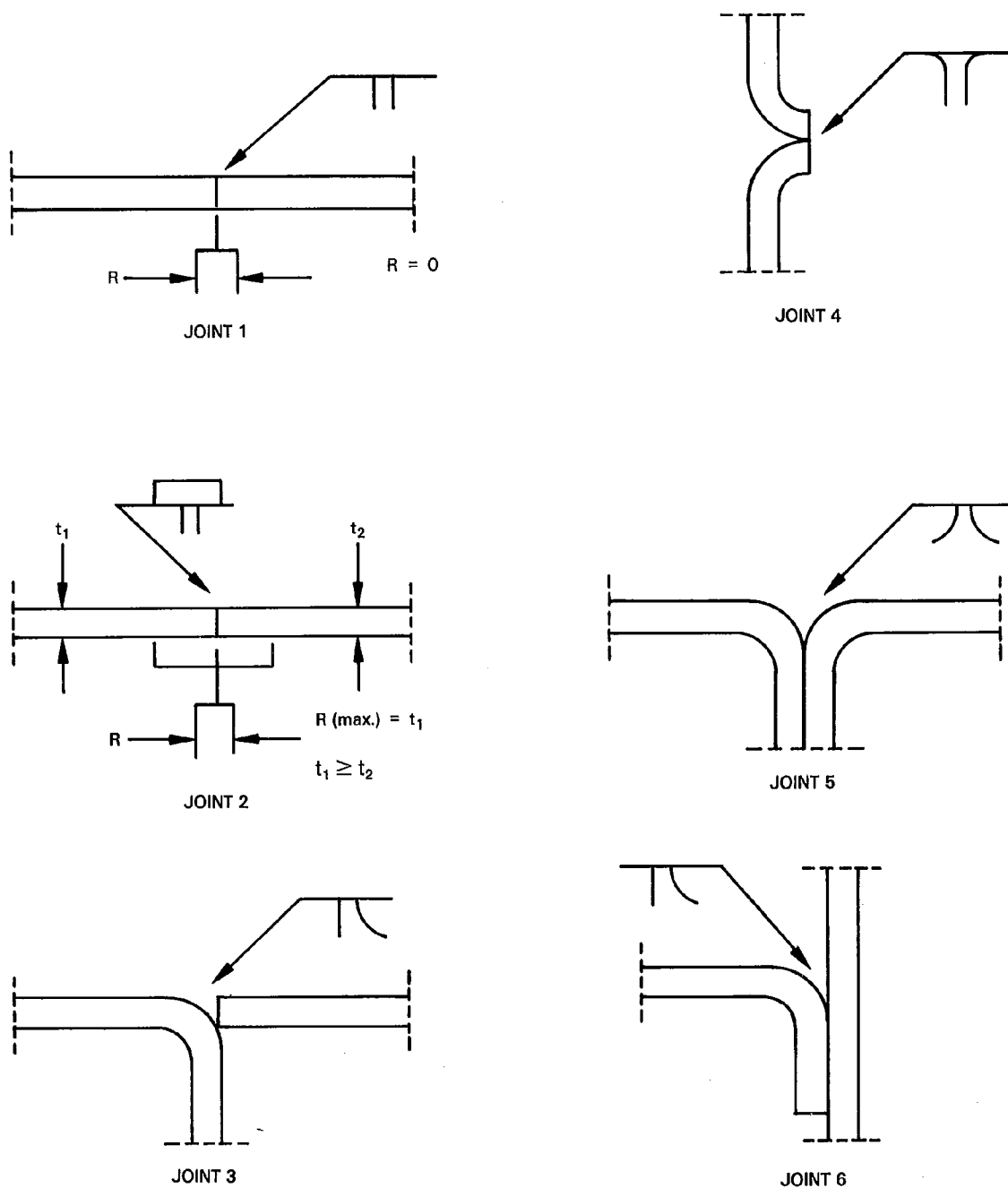


Figure 1 — Allowable Joint Designs

Standard Welding Procedure Specification (WPS)

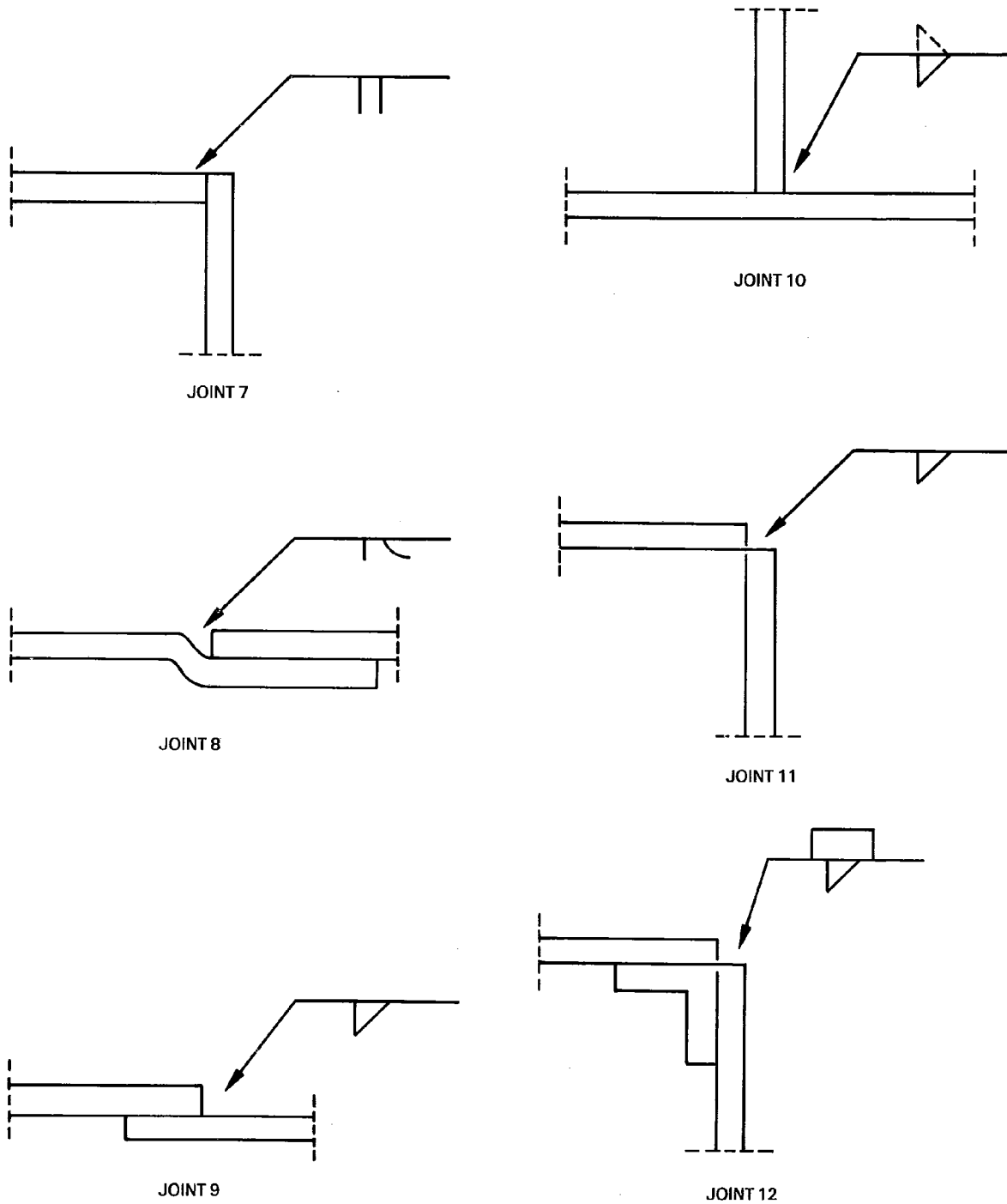


Figure 1 (Continued) — Allowable Joint Designs

Standard Welding Procedure Specification (WPS)

Metric Equivalents

in.	mm	°F	°C	ft ³ /h	L/min
0.0350	0.889	50	10	20	9.4
0.0478	1.214	120	49	40	18.9
0.1345	3.416				
1/2	12.7				
5/8	15.9				