DOCUMENT RESUME

ED 401 426 CE 072 918

TITLE	Specification for Qualification and Certification for Level III - Expert Welders.
INSTITUTION	American Welding Society, Miami, FL.
SPONS AGENCY	Department of Education, Washington, DC.
REPORT NO	AWS-QC12-96
PUB DATE	96
CONTRACT	V244B30006-95
NOTE	39p.; For the final program report, see CE 072 915. For related specifications and guides, see CE 072 916-919 and ED 398 388-389.
AVAILABLE FROM	American Welding Society, 550 N.W. LeJeune Road, Miami, FL 33126; phone: 800-334-WELD.
PUB TYPE	Guides - Non-Classroom Use (055) -- Legal/Legislative/Regulatory Materials (090)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Certification; *Employment Qualifications; Evaluation Criteria; *Minimum Competency Testing; Performance Tests; Postsecondary Education; Records (Forms); Required Courses; *Specifications; *Trade and Industrial Education; *Welding; Work Experience

ABSTRACT

This document defines the requirements and program for the American Welding Society to certify expert welders through an evaluation process entailing performance qualification and practical knowledge tests requiring the use of advanced reading, computational, and manual skills. The following items are included: statement of the standard's scope; definitions of key terms; requirements for participating organizations; education and work experience requirements; purposes/scope of the written examinations and performance tests; inspection, testing, and acceptance criteria; documentation requirement; certification procedure; and information about the National Registry of Level II-Advanced Welders. Appended are the following: visual inspection test report; face- and root-bend test report; and welding procedure specifications. Twelve figures/tables are included. (MN)

AWS QC12-96

Specification for Qualification and Certification for Level III - Expert Welders

American Welding Society

Key words — expert level welder, participating organization, performance tests, acceptance criteria, National Registry

Specification for Qualification and Certification for Level III - Expert Welders

Funded by the
U.S. Department of Education
Grant V244B30006-95

Prepared by the
AWS Education and Certification Departments

Under the Direction of the
AWS Education Grant Committee

Approved by the
AWS Board of Directors

Abstract

This standard defines the requirements and program for the American Welding Society to certify expert level welders. The certification of Level III - Expert Welders requires performance qualification and practical knowledge tests. These tests require more detailed skills of reading, computational, and manual skills to complete.

American Welding Society

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

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: 0-87171-485-X

American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126

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, substantiating investigation of the validity of that information for their particular use and the patent status of any item referred to herein.

With regard to technical inquiries made concerning AWS standards, oral opinions on AWS standards may be rendered. However, such opinions represent only the personal opinions of the particular individuals giving them. These individuals do not speak on behalf of AWS, nor do these oral opinions constitute official or unofficial opinions or interpretations of AWS. In addition, oral opinions are informal and should not be used as a substitute for an official interpretation.

This standard is subject to revision at any time by the AWS Certification Committee. Comments (recommendations, additions, or deletions) and any pertinent data that may be of use in improving this standard are requested and should be addressed to AWS Headquarters. Such comments will receive careful consideration by the AWS Certification Committee 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 Certification Committee 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, Miami, Florida 33126.

Personnel

AWS Education Grant Committee

F.G. Delaurier, Chairman	American Welding Society
N.C. Wall, Vice Chairman	American Welding Society
R.V. Reeve, Co-Secretary	American Welding Society
J.R. Hufsey, Co-Secretary	American Welding Society
R.L. O'Brien, Program Manager	American Welding Society
J. Bartley	Consulting Engineer
E.R. Bohnart	Miller Electric Mfg. Company
S.W. Bollinger	ESAB Welding & Cutting Products
F. Cusma	Pacific Northwest Ironworkers
J.E. Greer	Standard Refrigeration/Autorad
S.C. Helzer, Advisor	University of Northern Iowa
J. Hoeft	Miller Electric Mfg. Company
D.G. Howden	The Ohio State University
J.H. Ivy	Ingalls Shipbuilding
L.G. Kvidahl	Ingalls Shipbuilding
R. Murray	H & M Steel, Inc.
L.W. Myers	Dresser-Rand, Inc.
A.L. Petroski	Valmet, Inc. Honeycomb Division
R.C. Pierce	Welding Engineering Supply Co.
J.F. Key, Ex-Officio	Lockheed Martin
C.E. Pepper, Ex-Officio	Lockwood Greene Engineers
R.J. Teuscher, Ex-Officio	Industrial Gas Products

Foreword

(This Foreword is not a part of AWS QC12-96, *Specification for Qualification and Certification of Level III - Expert Welders*, but is included for information purposes only).

This standard extends the work of the American Welding Society to further define a national skill standard for Level III - Expert Welders. The American Welding Society was awarded Grant #V244B30006-95 for $1,059,626 by the U.S. Department of Education to develop standards and a certification program for welders during the period from July 1993 to July 1996. The total program cost is $2,132,094, of which 49.7% ($1,072,468) is an in-kind contribution by AWS.

To accomplish its goals, AWS organized an Education Grant Committee, which has representatives from all segments of the welding industry, including labor organizations and educational institutions. This Committee has overseen the efforts toward a standard for the qualification and certification of the Level III - Expert Welder.

The development of this National Skill Standard has involved the participation of the welding industry through a survey designed to determine a consensus of welder skills and competencies required for individuals seeking to continue the development of their welding skills.

The results of this industry survey were an occupational task analysis that formed the basis for curriculum guidelines to guide the training of the Level III - Expert Welder candidate.

This standard defines the requirements for the certification of such individuals and their entry into the National Registry of Level III - Expert Welders.

Comments and suggestions for improvement of this standard are welcome. They should be sent in writing to the Secretary, AWS Certification Committee, American Welding Society, 550 N.W. LeJeune Road, Miami, Florida 33126.

Table of Contents

Page No.

Personnel iii
Foreword iv
List of Tables vi
List of Figures vi

1. Scope 1

2. Definitions 1

3. Requirements for Participating Organizations 2

4. Education and Work Experience 3

5. Written Examination 4

6. Performance Tests 5

7. Inspection, Testing, and Acceptance Criteria 7

8. Documentation 7

9. Certification 8

10. National Registry of Level III - Expert Welders 8

Annex A - Visual Inspection Test Report 11

Annex B - Face- and Root-Bend Test Report 12

Annex C - Welding Procedure Specifications 13

List of Tables

Table		Page No.
1	Inspection Criteria for Level III - Expert Welders	9
2	Acceptance Criteria for Face- and Root-Bends	10

List of Figures

Figure		Page No.
1	SMAW, Carbon Steel - Pipe, Performance Qualification Test	16
2	SMAW, Stainless Steel - Pipe, Performance Qualification Test	17
3	GMAW-S, Carbon Steel - Pipe, Performance Qualification Test	18
4	GMAW-P, Aluminum - Pipe, Performance Qualification Test	19
5	FCAW-S, FCAW-G, Carbon Steel - Pipe, Performance Qualification Test	20
6	GTAW, Carbon Steel, Stainless Steel and Aluminum - Round Tubing, Performance Qualification Tests	21
7	Test Pipe Specimen Locations	22
8	Face- and Root-Bend Specimens	23
9	Typical Guided-Bend Test Fixture	24
10	Alternative Wrap Around Bend Test Fixture	25

Specification for Qualification and Certification for Level III - Expert Welders

1. Scope

1.1 This standard establishes the minimum requirements for an organization to participate with the American Welding Society (AWS) in the qualification and certification of expert welders.

1.2 This standard specifies practical knowledge and performance tests that require a more detailed level of reading, computational, and manual skills to successfully complete.

1.3 All individuals that meet the specified performance at a facility meeting **3. Requirements for Participating Organizations** will be listed in The National Registry of Level III - Expert Welders at the American Welding Society.

1.4 Organizations not meeting **3. Requirements for Participating Organizations** may use this standard, but individuals they certify will not be listed in the National Registry of Level III - Expert Welders.

1.5 Although a written test including questions on safety is required by this standard, this standard is not intended to address safety and health. Safety and health requirements are provided in ANSI Z49.1, *Safety in Welding and Cutting*, other safety and health standards, and federal, state, and local government regulations. The responsibility for safety of the Level III - Expert Welder is primarily with the welder, the Participating Organization during training and testing, and afterwards, with the employer.

1.6 The requirements of this standard shall not supersede the authority of the training facility as established by the local evaluation guidelines.

2. Definitions

The terms used in this standard are defined in ANSI/AWS A3.0, *Standard Welding Terms and Definitions*. Other terms are defined as follows:

1) Participating Organization - Any organization meeting **3. Requirements for Participating Organizations.**

2) Level III - Expert Welder - An individual employed in this position is considered to possess a prerequisite amount of knowledge, attitude, skills, and habits required to perform tasks autonomously, including the selection and use of appropriate techniques and equipment, and to apply theoretical knowledge and motor skills with minimum supervision.

3. Requirements for Participating Organizations

3.1 Participating Organizations may be training-and-testing or testing-only facilities.

3.2 Participating Organizations shall maintain and follow a quality manual that assures compliance with this standard.

3.3 An application for registration as a Participating Organization shall be submitted with a cover letter signed by the Senior Official at the Facility. The cover letter shall certify to AWS that the Facility has a Quality Program which will be rigorously followed, and that the requirements of this standard will be met.

3.3.1 If the Participating Organization is a training-and-testing organization, the letter shall also state that their curriculum follows AWS EG4.0, *Guide for Training and Qualification of Welding Personnel, Level III - Expert Welders.*

3.3.2 Participating Organizations already registered for the Entry Level Welder and Level II - Advanced Welder training program must notify AWS of their intention to administer the Level III - Expert Welder curriculum.

3.4 Test supervisors for training-and-testing or testing-only Participating Organizations should be AWS Certified Welding Inspectors.

3.5 Instructors for testing-and-training Participating Organizations should be AWS Certified Welding Educators.

3.6 Quality System Audits. Audits may be required if evidence of nonconformance with the Participating Organization's Quality Program or this standard exists.

3.6.1 Allegations of nonconformance supported by documentary evidence will be presented to the AWS Certification Committee. The Committee may require:

1) A written statement by the Senior Official of the Participating Organization with supporting evidence refuting the allegations, and a statement by the Senior Official of the Participating Organization that the requirements of the Participating Organization Quality Program and this standard have been met in the past, and will be met in the future, or

2) An on-site quality audit by an AWS-approved assessor to verify that the requirements of the Quality Program and this standard have been and are being met.

3.6.2 If a quality audit is required by the Committee, then the Participating Organization has two options, as follows:

1) The Participating Organization may decline to be audited and resign from the program, or

2) The Participating Organization may agree to be audited, in which case the Senior Official of the Participating Organization shall issue a purchase order to AWS for administrative fees and expenses of the assessor.

4. Education and Work Experience

4.1 Trainees desiring AWS Level III - Expert Welder Certification through training under the requirements of AWS QC12 shall meet the requirements of sections **1.3.7** and **1.3.8** of the EG4.0-96 *Guide for the Training and Qualification of Welding Personnel, Level III - Expert Welder* and document two years of multiple welding process work experience (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that has a direct relationship to weldments fabricated to a code, specification or employer's qualified welding procedure.

4.2 Trainees desiring AWS Level III - Expert Welder Certification through testing and examination under the requirements of AWS QC12 shall meet the requirement of sections **1.3.7** and **1.3.8** of the EG4.0-96 *Guide for the Training and Qualification of Welding Personnel, Level III - Expert Welder* and document seven years welding work experience. Said work experience shall consist of three years in a single process and 4 years using multiple processes, (with a minimum of 6 months fabrication experience that includes drawing interpretation, layout and fitup duties) that have a direct relationship to weldments fabricated to a code, specification or employer's qualified welding procedure.

4.3 At the discretion of a Participating Organization, credit for completion of individual training requirements and work experience may be simultaneously granted to an AWS QC12 Level III - Expert Welder applicant provided the work experience or experiential learning meets or exceeds the requirements for either work experience or training.

5. Written Examination

5.1 The written examination is designed to show that the Level III - Expert Welder understands the following subjects:

Mathematics
Safe Practices
Fabrication Principles and Practices
Nondestructive Examination and Piping Symbol Interpretation
Use of Welding Codes and Standards
Welding Inspection and Testing
Cutting and Welding Theory
Welding Metallurgy and Weldability
Cutting and Welding Terms and Definitions

5.2 Trainees desiring AWS Level III - Expert Welder Certification shall pass a three part examination consisting of Part A - Welding Fundamentals and Safety (based on the applicable subject matter identified in section 3 of the EG4.0-96 *Guide for the Training and Qualification of Welding Personnel, Level III - Expert Welder*, Part B - *Practical Welding Specification Interpretation* (visual examination of weld samples), and Part C - Open Code Book (open book examination based on one of the following: AWS D1.1, API 1104 or ASME Section IX).

5.3 A minimum passing grade of 75% is required with at least 90% of the safety questions answered correctly, with no limits on retests. Individuals failing one part of the written examination must retest on all parts of the examination.

5.4 As an option, Level III - Expert Welder applicants may substitute the AWS QC1 Certified Welding Inspector (CWI) examination for the Level III - Expert Welder written examination. The applicant shall pass the AWS QC1 Certified Welding Inspector exam with a minimum cutoff score equal to or greater than the passing score required for CWI.

5.4.1 Current AWS Certified Welding Inspectors (CWI) or Certified Associate Welding Inspectors (CAWI) with an examination score of 72% or higher shall be recognized as having met the requirements for AWS QC12 Expert Welder written examination provided they pass a supplemental safety examination with a minimum passing score of 90% accuracy.

5.4.2 In accordance with the requirements of this standard, all applicants for written examinations administered under AWS *QC1, Standard for AWS Certification of Welding Inspectors* shall be required to take a supplemental written safety examination and pass with 90% accuracy.

6. Performance Tests

Performance tests are designed to show that the Level III - Expert Welder can:

1) Pass a performance qualification test using SMAW, on carbon steel pipe, in the 6GR position. (Refer to Figure 1)
2) Pass a performance qualification test using SMAW, on stainless steel pipe, or on carbon steel pipe using 300 series filler metal, in the 6G position. (Refer to Figure 2)
3) Pass a performance qualification test using GMAW-S, on carbon steel pipe in the 6G position. (Refer to Figure 3)
4) Pass a performance qualification test using GMAW-P, on aluminum pipe in the 6G position. (Refer to Figure 4)
5) Pass a performance qualification test using FCAW-S, on carbon steel pipe in the 6G position. (Refer to Figure 5)
6) Pass a performance qualification test using FCAW-G, on carbon steel pipe in the 6G position. (Refer to Figure 5)
7) Pass a performance qualification test using GTAW, on carbon steel in the 6G position in pipe or round tubing. (Refer to Figure 6)
8) Pass a performance qualification test using GTAW, on carbon steel or stainless steel pipe using 300 series filler metal, in the 6G position in pipe or round tubing. (Refer to Figure 6)
9) Pass a performance qualification test using GTAW, on carbon steel or stainless steel pipe using 300 series filler metal, in the 6G position in pipe or round tubing using a consumable insert. The consumable insert type is optional and shall be stainless steel material. (Refer to Figure 6)
10) Pass a performance qualification test using GTAW, on aluminum in the 6G position in pipe or round tubing. (Refer to Figure 6)

6.1 The Level III - Expert Welder shall prepare, by mechanical, oxyfuel gas, or plasma arc cutting, the parts as designated in Figures 1 through 6.

6.2 The Level III - Expert Welder shall assemble the parts prepared in **6.1**, as shown in Figures 1 through 6.

6.3 The Level III - Expert Welder shall weld the assemblies using the WPS indicated on the drawing for each assembly. The WPSs specified are listed in Annex C.

6.4 Participating Organizations may qualify and certify Level III - Expert Welder performance qualification tests at an AWS QC4 Accredited Test Facility using the AWS QC7, *Standard for AWS Certified Welders.* All welder performance will be in accordance with the AWS QC7 Supplement G, AWS *Performance Qualification Test*, and AWS B2.1, *Standard for Welding Procedure and Performance Qualification.* The purpose of AWS QC7 is to document the ability of welders to deposit sound welds (qualify) and to impose controls on the documentation and maintenance of certification (certify). Welder performance qualification tests

administered within the AWS QC7 program are conducted at AWS Accredited Test Facilities. Such facilities operate under the requirements of AWS QC4, *Standard for Accreditation of Test Facilities for AWS Certified Welder Program.*

6.4.1 As an option, Participating Organizations may elect to substitute any of the performance qualifications listed in section **4.2** *Performance Qualifications*, of the AWS EG4.0 *Guide for the Training and Qualification of Welding Personnel, Level III - Expert Welder* for the performance qualifications tests required by AWS QC12 and detailed in section **3** of the AWS EG4.0-96 *Guide for the Training and Qualification of Welding Personnel, Level III - Expert Welder.* Substituted performance qualifications shall cover all aspects of the replaced performance qualification test, with respect to welding process, welding positions, base metal, filler metal and product form.

6.4.2 Current AWS QC7 Certified Welders desiring AWS QC12 Level III - Expert Welder Certification may apply for completion status of any mandatory welder performance qualification test with the AWS QC12 Expert Welder Program. AWS QC7 Certified Welders desiring recognition as having met the requirements for welder performance qualification testing as set forth in the AWS QC12 - Expert Welder Program shall meet the following conditions:

1) The applicant's AWS QC7 certification meets or exceeds the requirements set forth in the AWS QC12 - Expert Welder Program for any welder performance qualification test being superseded by the current certification.

2) At the time of application for recognition, the AWS QC7 Certified Welder shall produce his/her certification card(s) and present it to the AWS QC12 Facility Representative for review. The AWS QC7 Facility Representative shall verify that the card is current. The card shall be maintained in good condition.

3) The AWS QC12 Facility Representative shall record the AWS QC7 Welder's certification number and test description. Prior to recognition the Facility Representative shall contact the AWS Certification Department to verify the applicant's current status. The Facility Representative may request from AWS Certification Department a detailed description of the applicant's certification so compatibility with AWS QC12 performance qualifications can be ascertained.

4) The AWS QC7 Certified Welder and the AWS QC12 Facility Representative shall be aware that the card is the property of the American Welding Society. Evidence of tampering with the card shall be sufficient cause for rejection of recognition and shall require return of the card to the AWS Certification Department for investigation. An investigation by the Certification Committee may result in dismissal of the charges, suspension, revocation of certification, or renewal qualification, depending upon circumstances. The Committee will provide an explanation for its actions.

5) AWS QC7 Certified Welders applying for AWS QC12 Level III - Welder Certification whether through training, examination and testing or testing and examination alone shall meet all requirements for written examination, performance qualifications and work experience in accordance with AWS QC12, Level III - Expert Welder Program rules prior to issuance of certification.

7. Inspection, Testing, and Acceptance Criteria

7.1 All cut edges shall be visually examined and the cut surfaces shall meet the criteria of AWS C4.1 Sample 2 with grinding. After inspection, the cut surfaces may be conditioned to bright metal.

7.2 All assemblies shall be visually examined and the welds shall meet the acceptance criteria shown in Table 1.

7.3 All test assemblies shall be either bend tested or radiographed.

7.3.1 All test assemblies shall be cut to produce face- and root-bend specimens as shown in Figure 7.

7.3.2 Face- and root-bend specimens shall be conditioned as shown in Figure 8, and bent in a bend fixture similar to Figure 9 or 10, in accordance with ANSI/AWS B4.0, *Standard Methods for Mechanical Testing of Welds.*

7.3.3 Face- and root-bend specimens after bending shall meet the requirements of Table 2.

7.4 Test assemblies radiographed shall be in accordance with AWS B2.1 *Standard for Weld Procedure and Performance Qualification* and the welds shall meet the acceptance criteria shown in Table 1 of this document.

8. Documentation

For each successful Level III - Expert Welder, the Participating Organization shall prepare a report containing the following:

1) The Level III - Expert Welder's name and Social Security Number,

2) The actual grade on the written examinations,

3) The actual grade on the Safety portion of the written examination,

4) The results of the performance qualification tests.

9. Certification

9.1 The Participating Organization shall send the report to the American Welding Society.

9.2 The American Welding Society shall enter the data into the Level III - Expert Welder database.

10. National Registry of Level III - Expert Welders

The Level III - Expert Welder database shall function as the National Registry of Level III - Expert Welders.

10.1 Persons listed in the databank are not required to maintain registration by reporting welding activities.

10.2 Public disclosure of individual records in the National Registry of Level III - Expert Welders shall be at the discretion of the individual welders.

Table 1

Inspection Criteria for Level III - Expert Welders

1) There shall be no cracks or incomplete fusion.

2) There shall be no incomplete joint penetration in groove welds except as permitted for partial joint penetration groove welds.

3) The Test Supervisor shall examine the weld for acceptable appearance, and shall be satisfied that the welder is skilled in using the process and procedure specified for the test.

4) Undercut shall not exceed the lesser of 10% of the base metal thickness or 1/32 in. (0.8 mm).

5) Where visual examination is the only criterion for acceptance, all weld passes are subject to visual examination, at the discretion of the Test Supervisor.

6) The frequency of porosity shall not exceed one in each 4 in. (100 mm) of weld length and the maximum diameter shall not exceed 3/32 in. (2.4 mm).

7) Welds shall be free from overlap.

8) On pipe tests with offset internal diameters, a discernable edge on the smaller inside diameter is acceptable.

Table 2

Acceptance Criteria for Face- and Root-Bends

For acceptance, the convex surface of the face- and root-bend specimens shall meet both of the following requirements:

1. No single indication shall exceed 1/8" (3.2 mm), measured in any direction on the surface.

2. The sum of the greatest dimensions of all indications on the surface, which exceed 1/32" (0.8 mm), but are less than or equal to 1/8" (3.2 mm), shall not exceed 3/8" (9.6 mm).

Cracks occurring at the corner of the specimens shall not be considered unless there is definite evidence that they result from slag inclusions or other internal discontinuities.

Annex A

Visual Inspection Test Report

Visual Inspection

Name of Student: _____
Social Security No.: _____
Sample # _____

Size:

Under ___ OK ___ Excessive ___

Undercut:

Acceptable ___ Rejected ___

Porosity:

Diameter of Largest ___

Acceptable ___ Rejected ___

Overlap:

Acceptable ___ Rejected ___

Penetration:

Acceptable ___ Rejected ___

Appearance:

Acceptable ___ Rejected ___

Cracks:

Acceptable ___ Rejected ___

Name: _____ Date: _____
(Please Print)

Signature: _____

Annex B

Face- and Root-Bend Test Report

Name of Student: _____

Social Security No.: _____

6G Face-bend:

Length of each discontinuity (Over 1/32") ___ ___ ___ ___ Sum ___

Accept _____ Reject _____

6G Root-bend:

Length of each discontinuity (Over 1/32") ___ ___ ___ ___ Sum ___

Accept _____ Reject _____

Name: _____ Date:
(Please Print)

Signature: _____

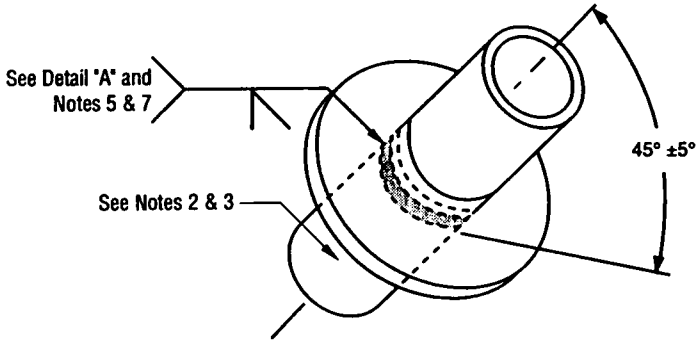
Annex C

Welding Procedure Specifications

ANSI/AWS B2.1.001	*Standard Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Carbon Steel, (M-1/P-1, Group 1 or 2), 3/16 through 3/4 inch, in the As-Welded Condition, With Backing.*
ANSI/AWS B2.1.008	*Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Carbon Steel, (M-1, Group 1), 10 Gauge through 18 Gauge, in the As-Welded Condition, With or Without Backing.*
ANSI/AWS B2.1.009	*Standard Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel, (M-8/P-8), 10 Gauge through 18 Gauge, in the As-Welded Condition, With or Without Backing.*
ANSI/AWS B2.1.010	*Standard Welding Procedure Specification (WPS) for Gas Tungsten Welding of Carbon Steel to Austenitic Stainless Steel, (M-1/P-8 or P8), 10 Gauge through 18 Gauge, in the As-Welded Condition, With or Without Backing.*
ANSI/AWS B2.1.015	*Standard Welding Procedure Specification (WPS) for Gas Tungsten Welding of Aluminum,(M-22/P-22), 10 Gauge through 18 Gauge, in the As-Welded Condition, With or Without Backing.*
ANSI/AWS B2.1-1-016	*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.*
ANSI/AWS B2.1.1.019	*Standard Welding Procedure Specification (WPS) for CO_2 Shielded Flux Cored Arc Welding of Carbon Steel,(M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, E70T-1 and E71T-1, As-Welded Condition.*
ANSI/AWS B2.1.1.020	*Standard Welding Procedure Specification (WPS) for 75% Argon 25% CO_2 Shielded Flux Cored Arc Welding of Carbon Steel,(M-1/P-1/S-1, Group 1 or 2), 1/8 through 1 1/2 inch Thick, E70T-1 and E71T-1, As-Welded or PWHT Condition.*
ANSI/AWS B2.1-1-022	*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, E6010,(Vertical Uphill) Followed by E7018, As-Welded or PWHT Condition.*

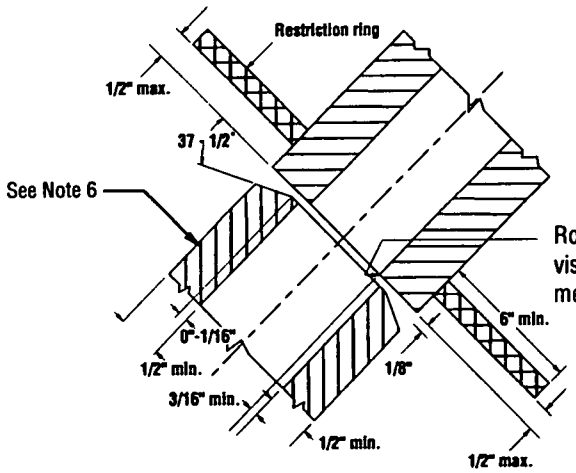
ANSI/AWS B2.1-1-023	*Standard Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Austenitic Stainless Steel,(M-8/P-8/S-8, Group 1), 1/8 through 1 1/2 inch Thick, As-Welded Condition.*
ANSI/AWS B2.1-1-027	*Standard Welding Procedure Specification (WPS) for Self-Shielded Flux Cored Arc Welding of Carbon Steel,(M-1/P-1/S-1, Group 1 or 2), 1/8 through 3/4 inch Thick, E71T-11, As-Welded Condition.*
AWS-1-GMAW-S	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Short Circuit Transfer on Carbon Steel,(M1/P1, Group 1 or 2), 3/16 through 3/4 inch Thick, in the As-Welded Condition.*
AWS-2-GMAW	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Spray Transfer on Carbon Steel,(M1/P1, Group 1 or 2), 3/16 through 3/4 inch Thick, in the As-Welded Condition.*
AWS-5-GTAW	*Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Aluminum,(M-23 or P-23), 10 Gauge through 18 Gauge, As-Welded Condition, With or Without Backing.*
AWS2-1-SMAW	*Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Austenitic Steel to Carbon Steel (M-1 to M-8 or P-8), 1/8 through 1/2 inch Thick,in the As-Welded Condition.*
AWS2-1-GMAW	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Spray Transfer of Aluminum, (M-23/P-23/S-23), 1/8 through 3/4 inch Thick,in the As-Welded Condition.*
AWS2-1.1-GMAW	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Spray Transfer of Aluminum, (M-22/P-22/S-22), 1/8 through 3/4 inch Thick,in the As-Welded Condition.*
AWS2-2-GMAW	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Short Circuit Transfer of Carbon Steel, (M-1/P-1/S-1, Group 1 or 2), 1/8 inch Thick, in the As-Welded Condition.*
AWS2-3-GMAW	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Spray Transfer of Carbon Steel, (M-1/P-1/S-1 Group 1 or 2), 1/8 inch through 1/2 inch Thick,in the As-Welded Condition.*
AWS2-1-GTAW	*Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Aluminum, (M-23/P-23/S-23), 10 through 18 Gauge Thick, in the As-Welded Condition.*

AWS2-1.1-GTAW	*Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Aluminum, (M-22/P-22/S-22), 10 through 18 Gauge Thick, in the As-Welded Condition.*
AWS3-SMAW-1	*Welding Procedure Specification (WPS) for Shielded Metal Arc Welding of Carbon Steel Pipe (M-1/P-1/S-1, Group 1 or 2), in the 6GR Position.*
AWS3-GMAW-P-1	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Pulsed Spray Transfer of Aluminum, (M-22/P-22/S-22), 1/8 through 3/4 inch Thick, in the As-Welded Condition.*
AWS3-GMAW-P-2	*Welding Procedure Specification (WPS) for Gas Metal Arc Welding-Pulsed Spray Transfer of Aluminum, (M-23/P-23/S-23), 1/8 through 3/4 inch Thick, in the As-Welded Condition.*
AWS3-GTAW-1	*Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Carbon Steel to Austenitic Stainless Steel, (M-1 to M-8 or P-8), 10 Gauge through 18 Gauge, in the As-Welded Condition, With Consumable Insert.*
AWS3-GTAW-2	*Welding Procedure Specification (WPS) for Gas Tungsten Arc Welding of Austenitic Stainless Steel, (M-1 to M-8 or P-8), 10 Gauge through 18 Gauge, in the As-Welded Condition, With Consumable Insert.*



PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6GR (Multiple Welding Test Position With Restriction Ring)



DETAIL "A"

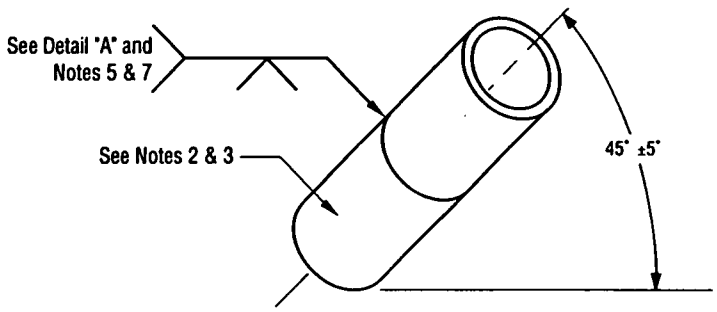
Root face of thicker section partially visable after welding. Welder shall not melt root edge of thicker section.

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

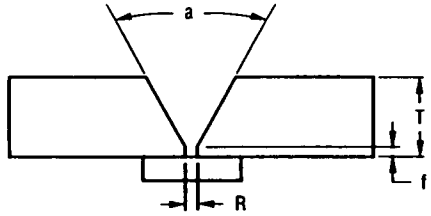
1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using the AWS QC7 option.
2. 12" Ø Schedule 80 M-1/P-1/S-1 carbon steel pipe. Other Schedules of pipe 6" Ø or greater may be used provided the requirements for minimum offset root and minimum wall thickness can be met. See Detail "A".
3. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
4. Without backing. Restriction ring to suit diameter of pipe.
5. All welding done in position.
6. All parts may be mechanically cut or machine OFC unless otherwise specified. I.D. of chamfered section bored to obtain a 0.500 in. (12.7 mm) minimum wall thickness. Depth of bore 1 1/2 in. minimum. Refer to Detail "A".
7. Use WPS AWS3-SMAW-1.
8. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification. Machine bend test coupons to dimension of thinner wall thickness of two mating sections prior to bending.

Figure 1 - SMAW, Carbon Steel, Performance Qualification Test, 6GR Position



PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6G



a = 60° minimum
R = 3/16", +1/4" -1/16"
f = R/2 maximum

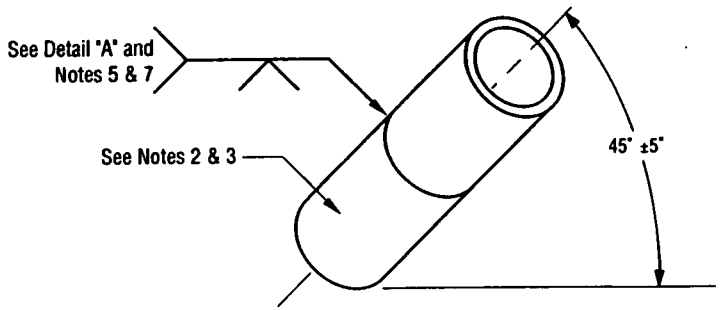
DETAIL "A" - Joint Geometry With Backing

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

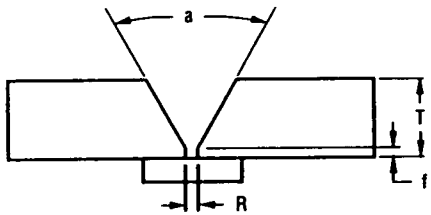
1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using the AWS QC7 option.
2. 2 1/2" - 6" Ø Schedule 40 M1/P1/S-1 carbon steel or Schedule 10S M-8/P-8 stainless steel pipe. Pipe diameter and base metal type optional within range specified.
3. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections, each a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
4. With backing. Refer to Detail. "A". Backing ring to suit diameter and nominal wall thickness of pipe.
5. All welding done in position.
6. All parts may be mechanically cut, machine OFC or PAC.
7. Use WPS AWS2-1-SMAW for carbon steel pipe.
   Use WPS ANSI/AWS B2.1-8-023 for stainless steel pipe.
8. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification

Figure 2 - SMAW, Stainless Steel, Performance Qualification Test, 6G Position



PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6G



a = 60° minimum
R = 3/16", +1/4" -1/16"
f = R/2 maximum

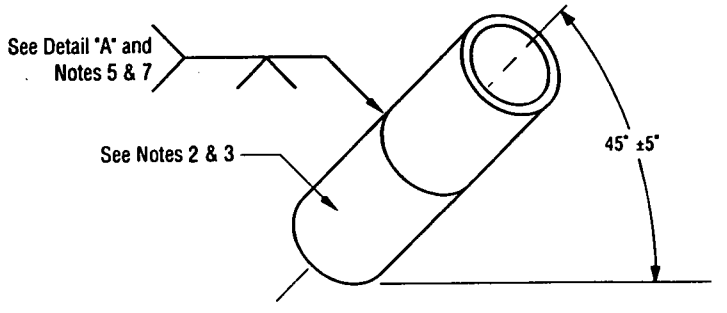
DETAIL "A" - Joint Geometry With Backing

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

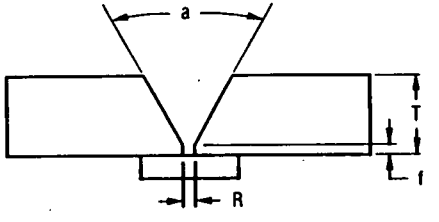
1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using the AWS QC7 option.
2. 2 1/2" - 6" Ø Schedule 40 M-1/P-1/S-1 carbon steel pipe. Pipe diameter optional within range specified.
3. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections, each a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
4. With backing. Refer to Detail. "A". Backing ring to suit diameter and nominal wall thickness of pipe.
5. All welding done in position.
6. All parts may be mechanically cut or machine OFC.
7. Use WPS AWS2-2-GMAW .
8. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification.

Figure 3 - GMAW-S, Carbon Steel, Performance Qualification Test, 6G Position



PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6G



a = 60° - 90°
R = 3/16" to 1/4"
f = 3/32" ±0"

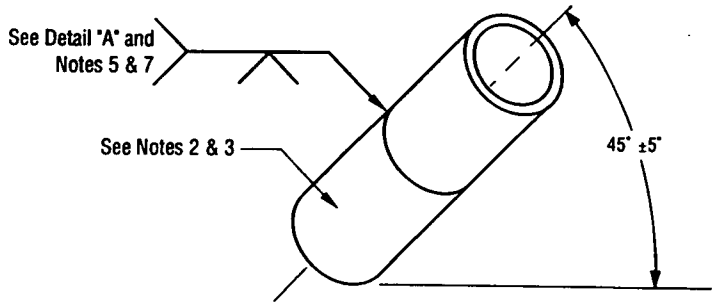
DETAIL "A" - Joint Geometry With Backing

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

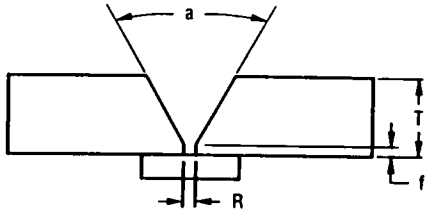
1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using the AWS QC7 option.
2. 2 1/2" - 6" Ø Schedule 40 M-22/P-22/S-22 or M-23/P-23/S-23 aluminum pipe. Pipe diameter and material optional within range specified.
3. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections, each a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
4. With backing. Refer to Detail. "A". Backing ring to suit diameter and nominal wall thickness of pipe.
5. All welding done in position.
6. All parts may be mechanically cut or machine PAC.
7. For M-22/P-22/S-22 use WPS AWS3— GMAW-P—1.
   For M-23/P-23/S-23 use WPS AWS3— GMAW-P—2.
8. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification.

Figure 4 - GMAW-P, Aluminum, Performance Qualification Test, 6G Position



PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6G



a = 60° minimum
R = 3/16", +1/4" -1/16"
f = R/2 maximum

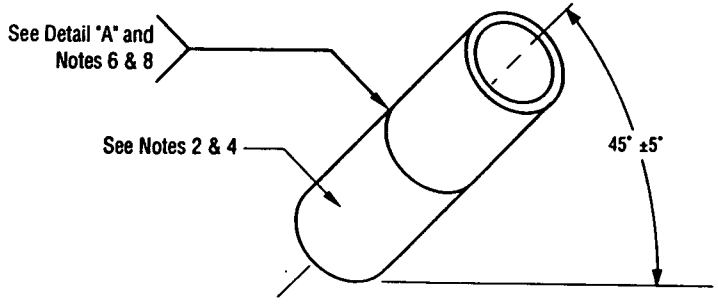
DETAIL "A" - Joint Geometry With Backing

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

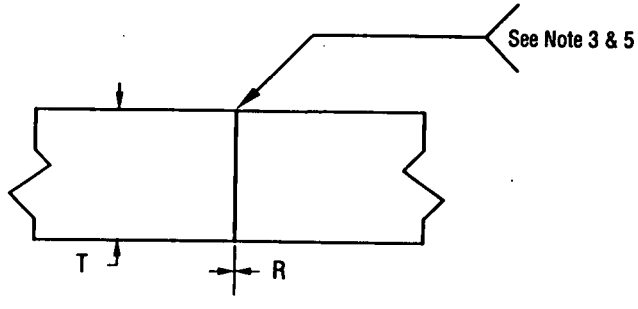
1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using the AWS QC7 option.
2. 2 1/2" - 6" Ø Schedule 40 M-1/P-1/S-1 carbon steel pipe. Pipe diameter optional within range specified.
3. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections, each a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
4. With backing. Refer to Detail. "A". Backing ring to suit diameter and nominal wall thickness of pipe.
5. All welding done in position.
6. All parts may be mechanically cut or machine OFC.
7. For FCAW-S use WPS ANSI/AWS B2.1-027.
   For FCAW-G use WPS ANSI/AWS B2.1-020.
8. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification.

Figure 5 - FCAW-S, FCAW-G, Performance Qualification Test, 6G Position



ROUND TUBING OR PIPE INCLINATION FIXED (45° ±5°) AND NOT ROTATED DURING WELDING

TEST POSITION 6G



R = T/2 (minimum) — T (maximum)
T = 0.05" — 0.120".

Detail "A" - without backing

INCH	MM
1/16	1.6
1/8	3.2
1/4	6.4
1/2	12.7
1	25.4

Notes:

1. Duplicate performance qualification tests are not required if welder is tested under AWS QC12 using AWS QC7 option.
2. 2 1/2" Ø carbon steel, stainless steel and aluminum round tubing (0.05" - 0.14". wall thickness) or Schedule 40 (aluminum or carbon steel)or 10S pipe (0.120" wall thickness). Round tubing diameter and wall thickness optional within range specified. Pipe Schedule optional according to material requirements.
3. Round tubing or pipe wall thickness greater than 0.0625" chamfer both pipe sections to form V-groove. Round tubing less than or equal to 0.0625" wall thickness use Square-groove.
4. The standard pipe groove test weldment for performance qualification shall consist of two pipe sections, each a minimum of 3 in. (76 mm) long joined by welding to make one test weldment a minimum of 6 in. (150 mm) long.
5. Without backing. Refer to Detail "A". Root shielding required. Consumable insert required for one stainless steel test. Consumable insert type optional.
6. All welding done in position.
7. Parts may be mechanically cut, machine OFC or machine PAC.
8. For carbon steel use WPS ANSI/AWS B2.1.008.
   For stainless steel use WPS ANSI/AWS B2.1.009, ANSI/AWS B2.1.010, AWS3—GTAW—1, or AWS3—GTAW—2.
   For aluminum use WPS AWS2-1-GTAW or AWS2-1.1-GTAW.
9. Visual examination in accordance with the requirements of QC12, Table 1. Bend test or Radiograph in accordance with the requirements of QC12, Table 2 and Annex D, Figures 7 and 8. Except as specified in AWS EG4.0, Section 4.2 Performance Qualification.

Figure 6 - GTAW Performance Qualification Test, 6G Position

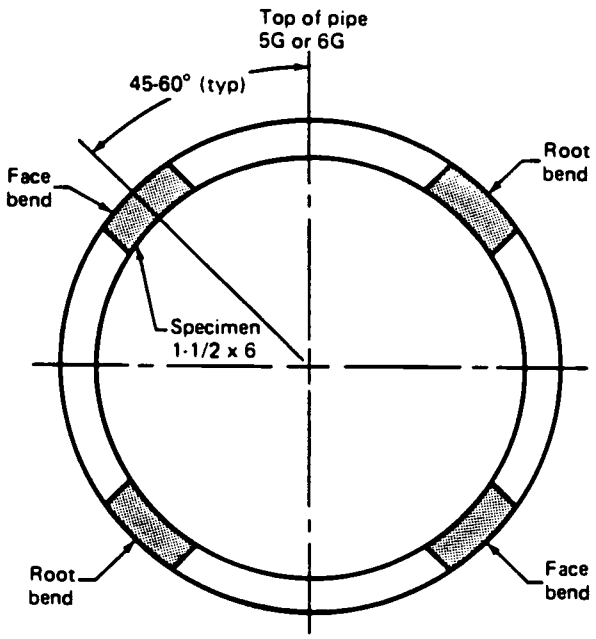
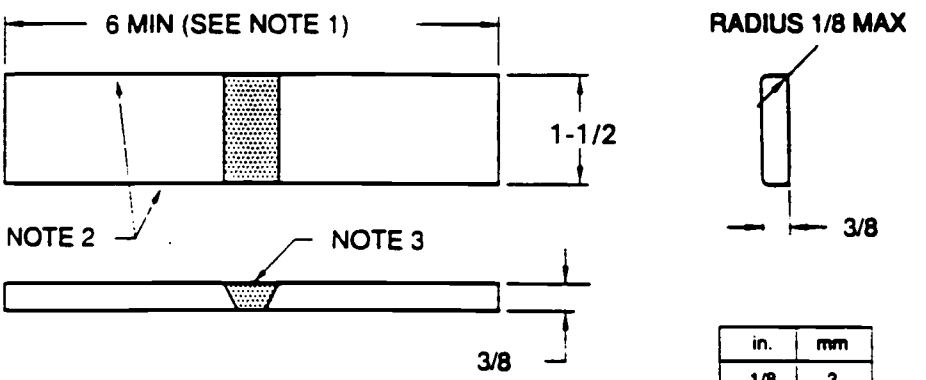


Figure 7 - SMAW Test Pipe Specimen Location

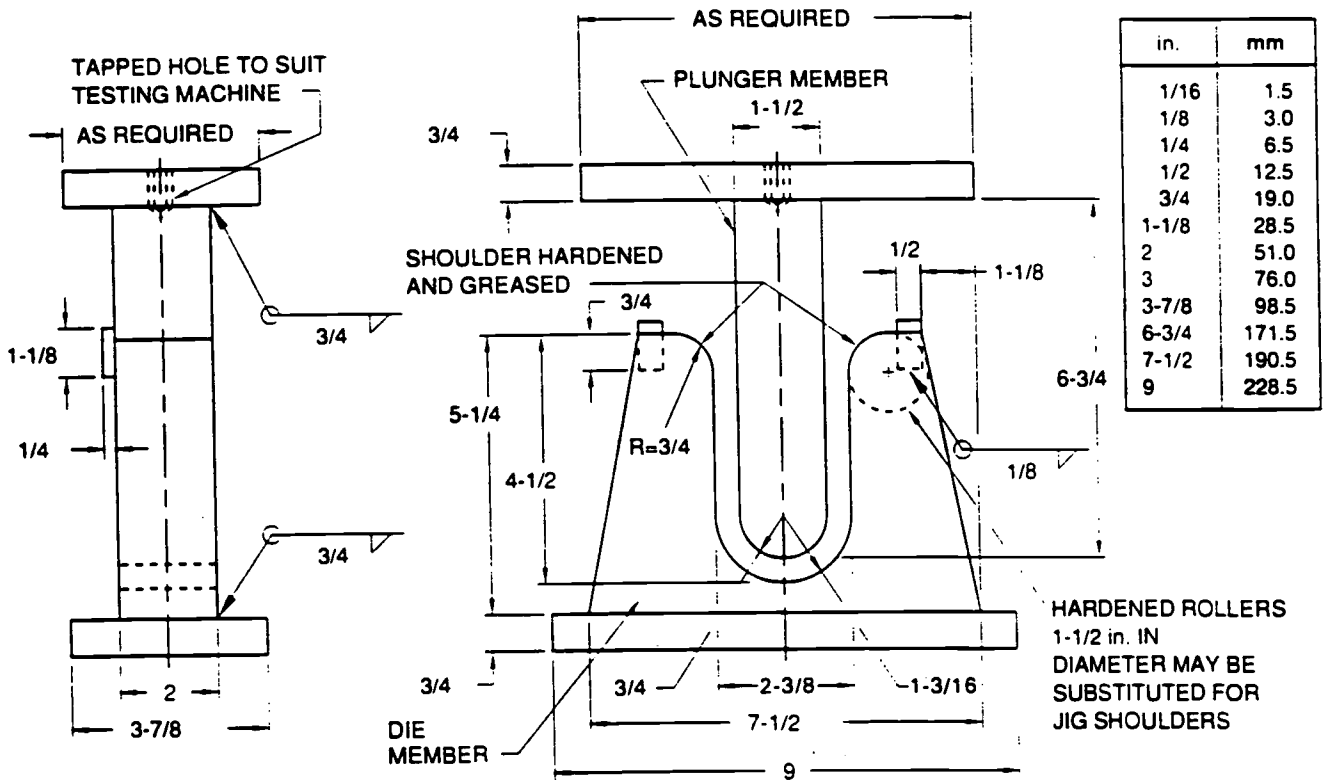


in.	mm
1/8	3
3/8	10
1-1/2	38
6	150

Notes:

1. A longer specimen length may be necessary.
2. These edges may be oxygen-cut and may or may not be machined.
3. The weld reinforcement, and any backing, shall be removed flush with the surface of the specimen.
4. Cut surfaces shall be smooth and parallel.

Figure 8 - Face- and Root-Bend Specimens



in.	mm
1/16	1.5
1/8	3.0
1/4	6.5
1/2	12.5
3/4	19.0
1-1/8	28.5
2	51.0
3	76.0
3-7/8	98.5
6-3/4	171.5
7-1/2	190.5
9	228.5

Figure 9 - Typical Guided-Bend Test Fixture

in.	mm
3/8	10
7/16	11
3/4	19
1-1/2	38

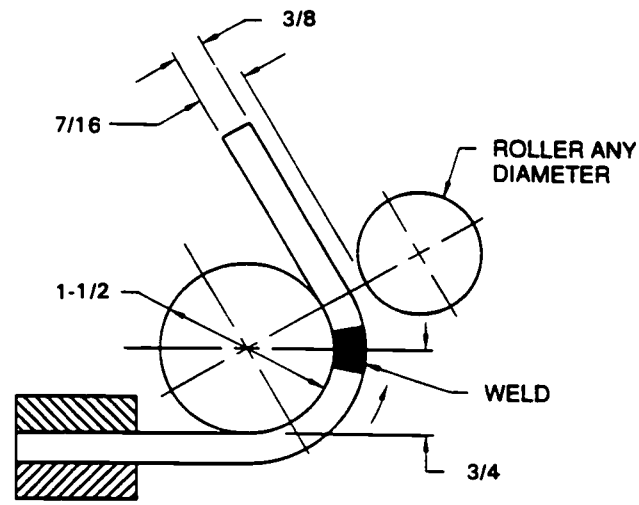


Figure 10 - Alternative Wrap Around Bend Test Fixture

NOTICE

REPRODUCTION BASIS

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☒ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").