
Ames Laboratory
Office: Engineering Services Group
Title: Welding Program
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Procedure No. 46200.001
Revision No. 9
Effective Date: 9/1/08
Review Date: 9/1/11

WELDING PROGRAM

This procedure shall be used for the operation of the welding activities in the Engineering Services Group at the Ames Laboratory.

Comments and questions regarding this procedure should be directed to the contact person listed below:

Name: Paul M. Berge
AWS Certified Welding Inspector
Address: 111 Metals Development
Phone: 294-5972

Sign-off Record:

Approved by: _____ Date: _____
Paul M. Berge, AWS Certified Welding Inspector

Approved by: _____ Date: _____
Terry R. Herrman, Manager, Engineering Services Group

Reviewed by: _____ Date: _____
Tom E. Wessels, Manager, Environment, Safety, Health & Assurance

Approved by: _____ Date: _____
Mark L. Murphy, Chief Operations Officer

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1.0 Revision/Review Log

This document will be reviewed once every 3 years as a minimum.

Revision Number	Effective Date	Contact Person	Pages Affected	Description of Revision
0	03/01/93	D. K. Rehbein	All	Initial Issue
1	03/01/93	D. K. Rehbein	All	Formatting Change
2	08/01/93	D. K. Rehbein	All	Formatting Change
3	11/10/93	D. K. Rehbein	1 3, 6	Revise Signatures Addition of Attachment
4	10/02/95	D. K. Rehbein	5 6	Change Requalification Period Remove Procedure 46200.002
5	03/04/97	D. K. Rehbein	3 All	Change Design Requirement Formatting Change
6	04/15/99	D. K. Rehbein	2	Change Review Period
7	08/01/02	D. K. Rehbein	2	Update Review Period
8	09/01/05	D. K. Rehbein	2	Update Review Period
9	09/01/08	P. M. Berge	All	Change of Contact and minor editorial changes. Reference Revision Description Summary Proc462_001Rev9desc090108.doc

2.0 Purpose and Scope

This procedure shall be used to control all welding performed by personnel under the supervision of the Engineering Services Group. It governs welder qualification, design, manufacture and inspection of welds and delineates necessary records and storage means thereof. It is written to be in conformance with the welding design, performance and inspection policy statement included in the ESH&A Program Manual (10200.002).

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3.0 Prerequisite Actions and Requirements

3.1 Definitions

ANSI - American National Standards Institute

ASME - American Society of Mechanical Engineers

ASNT - American Society for Nondestructive Testing

AWS - American Welding Society

Brazing Procedure Specification (BPS) - A written brazing procedure to provide direction to the brazer or brazing operator in making production joints.

Essential Variables - Welding variables that if changed alter the weldability and require requalification of PQR and WPS.

Procedure Qualification Record (PQR) - Record of welding or brazing data and variables recorded during welding of a test coupon. It also contains test results of a tested specimen.

Requalification Period (RP) - Time period commencing 30 days before the expiration of a welder's qualification to a WPS.

Weld(s), welder, welding shall also mean braze(s), brazer or brazing.

Welder - The person performing the welding operation or operating the equipment performing the weld in the case of semi-automatic or automatic welding equipment.

Welder Certification - Determining, verifying and attesting in writing to qualifications of a welder to a WPS.

Welder Qualification - Series of weld tests given to welders to be qualified for a specific WPS.

Welder Requalification Test - A test given to welders when qualification to a given WPS expires.

Welding Procedure Specification (WPS) - A written, qualified welding procedure prepared to provide direction in making production welds.

3.2 Certification, Qualification and Training

3.2.1 Design

Welding design shall be done using only qualified weld joints and procedures as defined by AWS and ASME and shall be checked and verified by the responsible Engineer.

3.2.2 Personnel Qualification

Welding personnel shall be qualified in accordance with AWS and ASME codes. Weld inspection shall be performed by personnel certified by AWS as Certified Welding Inspector. Weld inspections using techniques other than visual, proof or destructive tests shall be performed by personnel qualified by ASNT as Level 2 or above in that technique.

3.2.3 Training

Annual training shall be performed for all personnel involved in the welding process to ensure knowledge of and compliance with this procedure.

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3.3 Safety

Personnel operating or in close proximity during operation of welding equipment shall be required to abide by the precautions as outlined in ANSI/AWS Z49.1. By its nature, welding equipment involves the use of electrical power sufficient to cause electrocution and temperatures sufficient to cause severe burns. Eye protection sufficient to safeguard personnel from the extremely bright light and concurrent infrared radiation during welding shall be made available to all affected personnel and shall be used as conditions dictate. Many welding operations, particularly those involving shielding fluxes, may generate irritating and/or toxic fumes and smoke. Those operations shall be performed under conditions with sufficient venting to protect the operator. If any doubt exists, contact the Ames Laboratory Environment, Safety and Health Group for assistance in determining safe operating conditions.

4.0 Performance

4.1 Exemption from Inspection

Welding jobs performed by Engineering Services personnel shall be inspected except in those cases designated by the Design Engineer. Jobs not requiring inspection must carry the signature of the responsible Design Engineer eliminating inspection and shall be exempted from the remainder of this procedure.

4.2 Welding Procedure Specifications (See Attachment 1)

4.2.1 Development

The Welding Procedure Specifications and Brazing Procedure Specifications shall be developed, written and revised by the Welding Inspector according to AWS and ASME codes. If a WPS does not exist for the job to be done the Welding Inspector shall be contacted for the development of an applicable WPS.

4.2.2 Availability

The WPS shall be made available for the welder to read by his supervisor.

4.2.3 Essential Variable Changes

When changes are made to the essential variables of a WPS (as defined by AWS and/or ASME) it shall be requalified and reissued with new revision number.

4.2.4 Non-Essential Variables Changes

When changes are made in non-essential variables the WPS is changed and reissued with a new revision number.

4.2.5 Revision Indication

Revisions in procedures will be marked with the letter R in the margin. Descriptions of revisions will be transmitted with revised procedures.

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4.2.6 Distribution

Distribution of WPS's and revisions will be directed by the Welding Inspector.

4.3 Procedure Qualification Record (PQR)

4.3.1 Governing Codes

Qualification and certification of all PRQ(s) shall be in accordance with requirements of ASME, Section IX and/or AWS codes.

4.3.2 Qualification

Each WPS shall be qualified by welding of test coupons and testing of specimens.

4.3.3 Recording of Data and Results

Welding and brazing data and test results shall be recorded on the appropriate Procedure Qualification Record (PQR) form. Attachments 2 and 3 are typical of the PQR forms used for welding and brazing, respectively.

4.3.4 Record-keeping

The PQR(s) are certified and filed under direction of the Welding Inspector.

4.3.5 Essential Variable Changes

Changes made to essential variables of a WPS require that the PQR be requalified by steps 4.3.1, 4.3.2, and 4.3.3.

4.3.6 Issuance

After qualification and certification of the PQR, the WPS may be issued for use.

4.4 Welder Qualification

4.4.1 Governing Codes

All welding qualification tests shall be conducted in accordance with ASME, Section IX and/or AWS codes.

4.4.2 Necessity of Testing

A Welder Qualification Test is necessary when a job requires welding to a WPS that the welder has not qualified under. This test shall require the welder to weld test coupons as specified by the ASME and/or AWS codes.

4.4.3 Testing

Weld test coupons will be subjected to visual examination by the Welding Inspector. Weld coupons that pass visual examination will be tested by destructive methods in accordance with ASME, Section IX and/or AWS codes. In lieu of destructive testing, weld test coupons for welder qualification may be examined by 100% radiographic inspection. Welders whose

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coupons fail examination will be given further training before retesting or will be required to make two (2) good retest coupons. Retest coupons will be reexamined using the same inspection techniques that failed the previous coupon.

4.4.4 Record Maintenance

Records will be maintained by the Welding Inspector for successful tests on form Record of Welder or Welding Operator Qualification Test (Attachment 4). For brazing, the Brazing Performance Qualification Record (Attachment 5) will be used. The completed form is signed by the Welding Inspector, certifying the results of the test.

4.4.5 Certification Responsibility

Welders and their supervisors are responsible for keeping certification current.

4.4.6 Performance Qualification

The performance qualifications of a welder or welding operator shall be affected under the following conditions:

4.4.6.1 No Work Performed

When the welder has not welded to a procedure during a period of 6 months or more, qualification for that procedure shall be expired. When the welder has not welded to any procedure during a period of 6 months, qualification to all procedures shall be expired.

4.4.6.2 Unsatisfactory Work

When there is a specific reason to question the welder's ability to make welds that meet the specification, the qualification that supports the welding in question shall be considered expired.

4.4.6.3 Extension of Qualification

The welder's qualification for a specific procedure is extended for an additional 6 months whenever the Welding Inspector inspects a job that demonstrates the welder's ability to meet that welding procedure specification.

4.4.7 Renewal of Qualification

Renewal of qualification for conditions 4.4.6.1 or 4.4.6.2 above may be made in a single test joint (plate or pipe) on any thickness, position or material within the limits of the procedure to reestablish the welder's or welding operator's qualification for any thickness, position or material for the procedure for which he/she was previously qualified.

4.4.8 Determination of Appropriate WPS

The supervisor-in-charge (SIC) determines which WPS the welder will need for the work to be done. The SIC will contact the Welding Inspector to schedule the welder for Qualification/Certification Tests if additional WPS are required.

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4.4.9 Record Maintenance

Records of jobs will be maintained by the clerical staff of the Engineering Services Group under the direction of the Welding Inspector.

4.5 Welding Inspection

4.5.1 Notification of Need

The Welding Inspector shall be notified by the SIC or Engineer responsible for the work that is to be done during the planning stages. This will ensure time for verification of base materials, gathering of material certifications, obtaining proper weld filler materials and qualification of the welder.

4.5.2 Availability of Design Materials

The Engineer will provide a complete set of drawings, material certifications or other documentation for items purchased from outside vendors and specifications which shall be made available to the Welding Inspector at a reasonable time before the job begins.

4.5.3 Examination of Materials

The Welding Inspector shall examine base and weld filler materials to determine that they meet the job requirements, proper bevel, cleanliness, purge and setup.

4.5.4 Inspection Type

The Welding Inspector shall examine welds as specified on design drawings: visual, proof, dye-penetrant, radiography, etc. Inspections involving techniques other than visual or proof will be performed by personnel certified by ASNT as Level 2 or above for that technique.

4.5.5 Weld Report

The Welding Inspector will generate weld reports recording work performed. These reports will become a permanent part of the job records. At the end of the job, the Welding Inspector will transfer the weld reports to the SIC.

4.5.6 Work Scheduling

The SIC will be responsible to inform the Welding Inspector of the work schedule and that work will stop at hold points designated by the Welding Inspector when required.

5.0 Post Performance Activity

6.0 Additional Information

6.1 References

ANSI/AWS D1.1-94, Structural Welding Code-Steel
ANSI/AWS D1.2-94, Structural Welding Code-Aluminum
ANSI/AWS Z49.1, Safety in Welding and Cutting

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ASME Pressure Vessel Code Section VIII-Pressure Vessels
ASNT SNT-TC-1A Recommended Practice for Nondestructive Testing
ASME Pressure Vessel Code Section IX-Welding and Brazing Qualifications

6.2 Attachments

Attachment 1 - Welding Procedure Specification
Attachment 2 - Procedure Qualification Record (welding)
Attachment 3 - Procedure Qualification Record (brazing)
Attachment 4 - Record of Welder or Welding Operator Qualification Test
Attachment 5 - Brazing Performance Qualification Record

**AMES LABORATORY-USDOE
WELDING PROCEDURE SPECIFICATION**

WPS No.	SAMPLE
Page	1 of 2

WPS No. _____ By _____ Date _____
 Authorized By _____ Date _____ Revision _____
 Welding Process(es) _____ Type: Manual Machine Semi-Auto Automatic
 Supporting PQR No(s) _____

JOINTS

Type _____
 Single Weld Double Weld
 Backing _____
 Backing Material _____
 Root Opening _____
 Root Face Dimension _____
 Groove Angle _____ Radius(J-U) _____
 Back Gouging _____

BASE METALS

Specifications _____
 Type or Grade _____
 Thickness _____
 Groove _____ - _____
 Fillet _____ - _____

FILLER METALS

AWS Spec _____
 Class. _____

SHIELDING

Flux _____
 Electrode-Flux Class _____
 Gas _____
 Composition _____
 Flow Rate _____
 Gas Cup Size _____

PREHEAT

Preheat Temp., Min. _____
 Interpass Temp., Min _____ Max _____
 Preheat Note _____

POSITION

Groove _____ Fillet _____
 Vertical Progression Up Down

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW) Short-Circuiting
 Globular Spray
 Current AC DCEP

TECHNIQUE

Stringer or Weave Bead _____
 Multi or Single Pass (per side) _____
 Number of Electrodes _____
 Electrode Spacing
 Longitudinal _____
 Lateral _____
 Angle _____
 Contact Tube to Work Dis. _____
 Peening _____

POSTWELD HEAT TREATMENT

PWHT Required _____
 Temperature _____ Time _____

**AMES LABORATORY - USDOE
PROCEDURE QUALIFICATION RECORD**

PQR No.	SAMPLE
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TESTS

TENSILE TESTS						
Specimen No.	Width	Thickness	Area	Ultimate Total Load (lb)	Ultimate Unit Stress (psi)	Character of Failure & Location
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

GUIDED-BEND TESTS			
Specimen No.	Bend Type	Result	Remarks
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

<p>VISUAL INSPECTION</p> <p>Appearance _____</p> <p>Undercut _____</p> <p>Piping Porosity _____</p> <p>Convexity _____</p> <p>Test Date _____</p> <p>Witnessed By _____</p> <p>OTHER TESTS</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>	<p>RADIOGRAPHIC-ULTRASONIC EXAM</p> <p>RT - Report No. _____ Result _____</p> <p>UT - Report No. _____ Result _____</p> <p>FILLET WELD TEST RESULTS</p> <p>Min. Size Multiple Pass Macroetch</p> <p>1. _____ 2. _____ 3. _____</p> <p>Max. Size Multiple Pass Macroetch</p> <p>1. _____ 2. _____ 3. _____</p> <p>ALL-WELD-METAL TENSION TEST</p> <p>Tensile Strength (psi) _____</p> <p>Yield Point/Strength (psi) _____</p> <p>Pct Elongation in 2 in. _____</p> <p>Laboratory Test No. _____</p>
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Welder's Name _____ Clock # _____ Stamp # _____

Tests Conducted By _____ Laboratory _____

Test Number _____ Per _____ Code Date _____

We the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of section 5, Part B of ANSI/AWS D1.1 - Structure Welding Code - Steel

Signed _____ Date _____

Title _____

**AMES LABORATORY - USDOE
PROCEDURE QUALIFICATION RECORD**

PQR No.	SAMPLE
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GENERAL NOTES

REMARK

DRAWING

PROCEDURE QUALIFICATION RECORD (Brazing)

BPQR No _____ Date _____ BPS No _____

Company _____

Brazers' Name and ID _____

Brazing Process _____ Manual _____ Mechanized _____ Automatic _____

Brazing Equipment _____

BRAZING CONDITIONS

BASE METAL:

Identification _____ BM No _____

Thickness _____ Preparation _____

Other _____

FILLER METAL:

FM No _____ AWS Classification _____

Form _____ Method of Application _____

FLUX: AWS Type _____ Other _____

ATMOSPHERE: AWS Type _____ Other _____

TEMPERATURE _____ TEST POSITION _____

TIME _____ CURRENT _____

FUEL GAS _____ TIP SIZE _____

POSTBRAZE CLEANING _____

POSTBRAZE HEAT TREATMENT _____

OTHER _____

JOINT: (Sketch on following page)

Type _____

Clearance _____

Other _____

TEST RESULTS

BPQR No _____ Date _____

VISUAL	Pass	Fail
_____	_____	_____
_____	_____	_____
_____	_____	_____

TENSION			Pass	Fail
Specimen No	UTS (psi)	Remarks		
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____
_____	_____	_____	_____	_____

BEND			Pass	Fail
Specimen No	Remarks			
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

MACROETCH			Pass	Fail
Specimen No	Remarks			
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

PEEL			Pass	Fail
Specimen No	Remarks			
_____	_____	_____	_____	
_____	_____	_____	_____	
_____	_____	_____	_____	

We certify that the information in this record is correct and that the test brazements were prepared, brazed, and tested in accordance with the requirements of the American Welding Society Standard for Brazing Procedure and Performance Qualification, ANSI/AWS B2.2-91 and with the requirements of the American Society of Mechanical Engineers, Section IX, Part QB.

Approved By _____

Qualifier

RECORD OF WELDER OR WELDING OPERATOR QUALIFICATION TESTS IN ACCORDANCE WITH QW-484 SUGGESTED FORMAT

Welder's Name: _____ Employee Number: _____
 Welding Process(es) used _____ Type: _____
 Identification of WPS followed by welder during welding of test coupon: _____
 Base material(s) welded: _____ Thickness: _____

Manual or Semiautomatic Variables for Each Process (QW-350)	Actual Values	Range Qualified
Backing (metal, weld metal, welded from both sides, flux, etc)(QW-402)	_____	_____
ASME P-No. _____ to ASME P-No. (QW-403)	_____	_____
____Plate____Pipe (enter diameter, if pipe)	_____	_____
Filler metal specification (SFA): _____ Classification (QW-404)	_____	_____
Fill metal F-No.	_____	_____
Consumable Insert for GTAW or PAW	_____	_____
Weld deposit thickness for each welding process	_____	_____
Welding position (1G, %g, etc)(QW-405)	_____	_____
Progression (uphill/downhill)	_____	_____
Backing gas for GTAW, PAW or GMAW; fuel gas for OFW (QW-408)	_____	_____
GMAW transfer mode (QW-409)	_____	_____
GTAW welding current type/polarity	_____	_____

Machine Welding Variables for the Process Used (QW-360)	Actual Values	Range Qualified
Direct/remote visual control	_____	_____
Automatic voltage control (GTAW)	_____	_____
Automatic joint tracking	_____	_____
Welding position (1G, 5G, etc)	_____	_____
Consumable insert	_____	_____
Backing (metal, weld metal, welded from both sides, flux, etc)	_____	_____

Guided Bend Test Results

Guided Bend Tests Type QW-462.2 (Side) Results QW-462.3(a)(Trans. R&F) Type QW462.3(b)(Long. R&F) Results

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Radiographic test results (QW-304 and QW-305) _____

_____ (alternative qualification of groove welds by radiography.)

Fillet Weld -- Fracture test _____ Length and percent of defects _____ in.

Macro test fusion _____ Fillet leg size _____ in. x _____ in. Concavity/convexity _____ in.

Welding tests conducted by _____

Radiographic tests conducted by _____

Laboratory Test No. _____

We certify that the statements in this record are correct and the test coupons were prepared, welded and tested in accordance with the requirements of Section IX of the ASME Code.

Organization _____

By _____ Date _____

BRAZING PERFORMANCE QUALIFICATION RECORD

Name _____ Employee Number _____

BPS No _____ Date _____

Brazing Process _____ Brazer _____ Operator _____

TEST BRAZEMENT

Base Metal ID _____ BM No _____ BM T _____

Filler Metal ID _____ FM No _____ FM Feed _____

Test Position _____ Joint Type _____

TEST RESULTS

VISUAL	PASS	FAIL
_____	_____	_____
_____	_____	_____
_____	_____	_____

MACROETCH OR PEEL

Specimen	Remarks	PASS	FAIL
No			
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

QUALIFIED FOR

Brazing Process _____ Position _____

BM No _____ BM T _____

FM No _____ FM Feed _____

Joint Type _____

Other _____

The above named individual is qualified in accordance with the American Welding Society Standard for Brazing Procedure and Performance Qualification, ANSI/AWS B2.2-91 and with the American Society of Mechanical Engineers, Section IX, Part QB.

Date _____

Signed _____

Qualifier