A SunCam online continuing education course

ASME Welding Qualifications

Part I

Welding Procedures

By

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Learning Objectives

Upon completion of this course, the student should have a general understanding of how to qualify a welding procedure based on ASME Section IX. The student should also be able to perform reviews of welding procedure qualifications of their company and their company's vendors. This course is not a substitute for careful consideration of the many Code, Regulatory, and customer requirements for welding procedure qualification.

DISCLAIMER

While I have extensive experience in welded fabrication and service on ASME Committees, I do not speak for ASME. You must obtain final resolution of any question regarding ASME requirements only through the ASME inquiry process.

ASME WELDING PROCEDURE QUALIFICATION

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1.0 Introduction

Many applications, especially those involving boilers, pressure vessels, piping, and associated supports, require welding qualification to the rules of ASME Boiler and Pressure Vessel Code, Section IX (Section IX). You will probably need to perform Section IX welding procedure qualification(s) at some point. Section IX procedure qualifications demonstrate strength and ductility of the weld. Even qualifications for corrosion resistant and wear resistant overlays are primarily concerned with retaining strength and ductility of the underlying base metal while providing the necessary corrosion or wear properties.

In Section IX, you plan your qualification, weld qualification coupon(s), and perform physical testing to evaluate the coupon(s). If all goes well, you document the qualification in a Procedure Qualification Record (PQR), write a Welding Procedure Specification (WPS) supported by the PQR, and begin using the procedure. This paper illustrates the process by taking us through a simple Shielded Metal Arc Welding (SMAW) procedure qualification.

This paper uses the 2013 Edition of the ASME Boiler and Pressure Vessel Code, Section IX, Welding, Brazing, and Fusing Qualifications (Section IX). Different Editions and Addenda may vary slightly in detail but the principles remain the same. Aside from general requirements and appendices, Section IX consists of three parts. These parts are QW (Welding), QB (brazing), and QF (plastic fusion). We are using part QW for this paper to demonstrate welding procedure qualification. We cover welder performance qualifications in another lesson, ASME Welding Qualifications, Part II, Performance Qualifications (in development). References in this paper of the form “QW-x” is to text, tables, or figures in Section IX.

Having a copy of Section IX available may be useful but is not essential to completing this course. Having a copy of Section IX is essential when applying these concepts to actual work. There are exceptions and alternatives described in Section IX which are too detailed and involved to describe here but which may affect actual work.

2.0 Planning a Procedure Qualification

We are going to assume you are a small company doing some ASME work and have need for an SMAW procedure for carbon steel groove welds and fillet welds. No weld will be greater than 1 inch, no Post Weld Heat Treatment (PWHT) is involved, and toughness is not a factor.

We find the variables for qualifying welding procedures in Section IX, e.g. Table QW-253 for SMAW. Figure 2.1 is an adaptation of Table QW-253. Section IX divides variables into essential variables and nonessential variables. Supplementary essential variables are for welds that require toughness testing. We deleted the column "Supplementary Essential Variables" from the original Table QW-253 for simplification. If you are dealing with a qualification requiring toughness testing, just consider the "Supplementary Essential Variables" as additional "Essential Variables". You must record all variables in the PQR and WPS. Changes to essential variables require a new procedure qualification. Changes to nonessential variables do not require a new procedure qualification.

Example: "A-Numbers" (Table QW-442) are groupings of expected chemical analysis of weld metal deposited with a ferrous electrode. "F-Numbers" (Table QW-432) are groupings of operating characteristics of electrodes. A-Number and F-Number are essential variables that you cannot change without a new procedure qualification. The American Welding Society (AWS) classification that describes a unique type electrode, e.g. E7018 is a nonessential variable. You may interchange electrodes within A1 and F4 groups without a new procedure qualification.

Assign a value for each variable as we have done in the right hand column of Figure 2.1 for our example. The values for each variable will come from knowledge, experience, and technical references. You should include your welders when planning the qualification. They may or may not be good technical writers but their knowledge and skill will contribute to successful qualifications.

Variables (1)		Essential	Nonessential	Qualification Example
Joints	Groove Design		X	We will use a single "V" with a 60 degree included angle, i.e. a 30-degree bevel on each half of the qualification assembly.
	Backing		X	We will use a steel backing strip of composition similar to the base metal.
	Root Spacing		X	Approximately 1/8 in.
	Retainers		X	No non-fusing retainers
Base Metals (2)	T Qualified (4)	X		Coupons are ½ in thick which will qualify for up to 1 inch base metal for groove welds
	t pass > ½ in.	X		No pass > ½ in.
	P-No Qualified	X		We will use SA-516, Grade 70 carbon steel (P 1) base material.
Filler Metals	F-Number	X		We will use E7018 electrodes that are F 4.
	A-Number	X		E7018 electrodes will deposit mild steel (A 1) weld metal.
	Diameter		X	We will use 1/8 inch electrodes
	t	X		Deposited weld thickness will be ½-inch qualifying 1-inch weld thickness (4).
	Classification		X	We'll use SFA 5.4, Type E7018 electrodes
Positions	+ Position		X	We will weld in the flat (1G) position.
	Vertical welding		X	We do not plan any vertical welding.
Preheat	Decrease > 100F	X		No bead will be started unless the coupon is at least 60F.
	Preheat Maint.		X	Preheat maintenance refers to holding preheat until PWHT is performed. We will not perform PWHT on this qualification.
PWHT	PWHT	X		No PWHT will be performed.
	T Limits	X		No PWHT above upper transformation temperature
Electrical Characteristics	Current or Polarity		X	Direct current electrode positive (DCEP)
	I & E Range		X	106 to 183 amperes 20 to 24 volts
Technique	String/Weave		X	Weave
	Method cleaning		X	Grinding and Wire Brushing
	Method back gouge		X	Not used
	Multiple to Single pass/side		X	Multiple
	Manual or automatic		X	Manual
	Peening		X	We will not peen the weld.
	Use of thermal processes	X		Applies only to P No. 11 base materials.

Notes:

1. For simplification, we deleted "Supplementary Essential" variables.
2. "T" is base metal thickness. "t" is deposited weld metal thickness.
3. This Figure is only a summary. Section IX explains each variable in more detail.
4. Section IX permits a groove weld qualification to also qualify fillet welds of all base metal thicknesses and weld sizes.

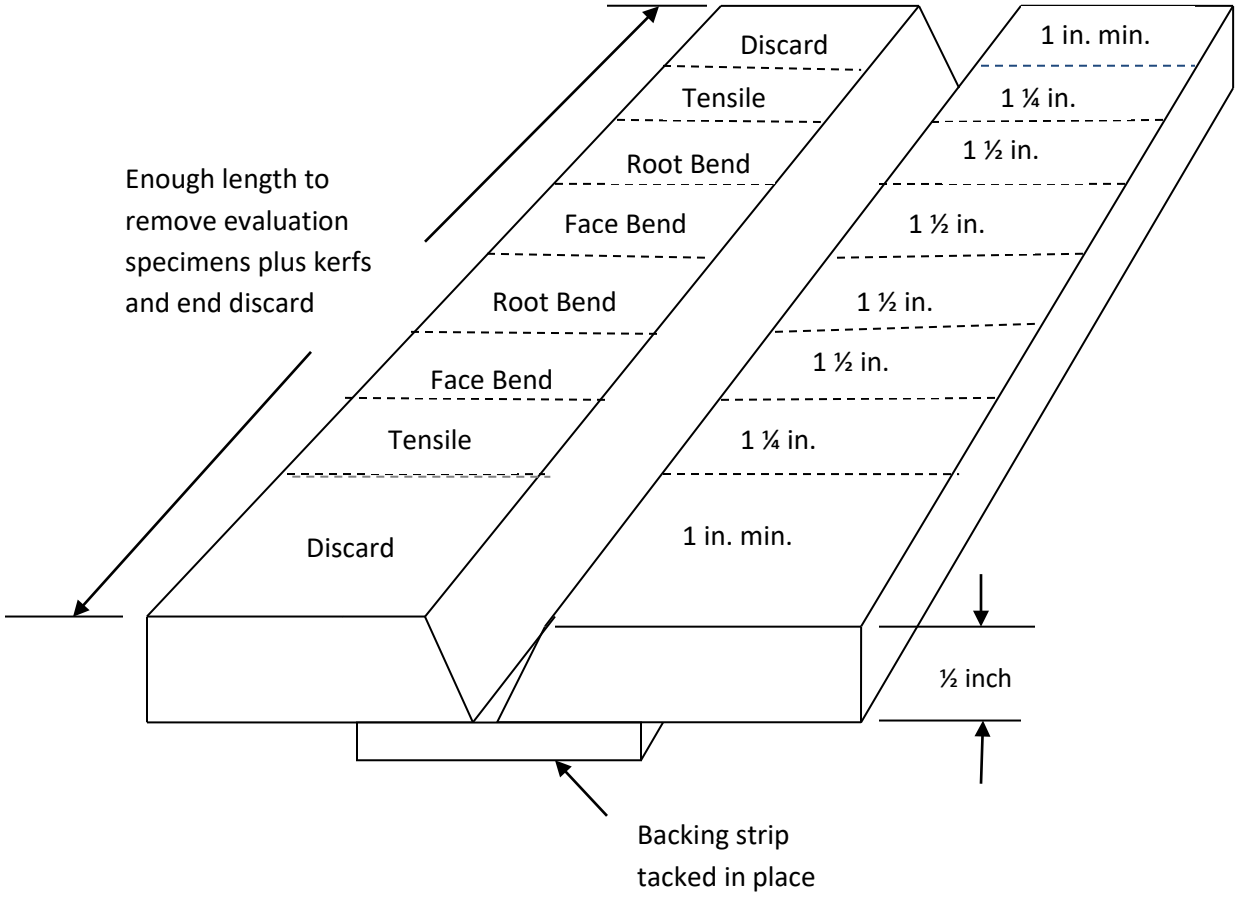
Figure 2.1

Welding Variables for SMAW Adapted from Table QW-253

3.0 Welding the Procedure Qualification Coupon(s)

Review the enumeration of variables you used when planning the qualification against the Section IX listing of "essential" variables. If you do not already have a PQR that covers these variables, you will need to qualify your WPS prior to use.

We will use the variables from the right hand column of Figure 2.1, to weld our qualification coupon(s). We will set up our qualification coupon as shown in Figure 3.1. Welding the qualification coupon is a quality assurance function. You should have a folder to include notes, filler metal certifications, base metal certifications, etc. Photographs are not required but are a nice addition. Arrange to focus on the qualification while minimizing distractions. You should record all variables, essential and nonessential.



Notes:

1. Dotted lines indicate required sequence of removal of evaluation specimens after welding.
2. Backing strip should be the same P-Number or similar material so as not to affect weld chemistry and should be thick enough to prevent burn thru.
3. Joint geometry is a 60 degree included angle (30 degrees on each plate) with an approximately 1/8 inch root opening.

Figure 3.1
Set Up for Welding Qualification Coupon

Your company must weld the qualification coupon(s). This means supervised by an employee of your company with authority to accept or reject the qualification. It may also include a contract person reporting directly to your company. You should document all variables during the qualification welding.

BONUS: You may credit the welder performing a successful PQR weld with a Welder Performance Qualification (WPQ) bounded by the performance variables of the sample weld. See Welding Qualifications Part II, Welding Performance Qualification (in preparation).

If changes to variables are necessary during qualification welding, record the changes in detail. If changes to essential variables are necessary, you will need to evaluate whether the change still meets Section IX and your needs.

4.0 Evaluating the Procedure Qualification Coupon(s)

4.1 Determining Required Tests

You now need to evaluate the completed qualification coupon(s). Most qualifications, including our example, are for "strength" welds. Per Table QW-451.1, our example requires two tensile tests, two face bend tests, and two root bend tests.

4.2 Bend Tests

Bend tests are used to evaluate ductility and soundness of the weld. The most common bend tests are the transverse side bend or face and root bends shown in Figure QW-462.2 and QW-462.3(a). The specimens are bent 180 degrees around a mandrel of specified diameter (Figure QW-466.1). Bend side bends in either direction unless there is an evident flaw. If there is, place the flaw in tension. Face bends place the face in tension. Root bends place the root in tension. The acceptance criterion is no open flaw exceeding 1/8 inch after bending.

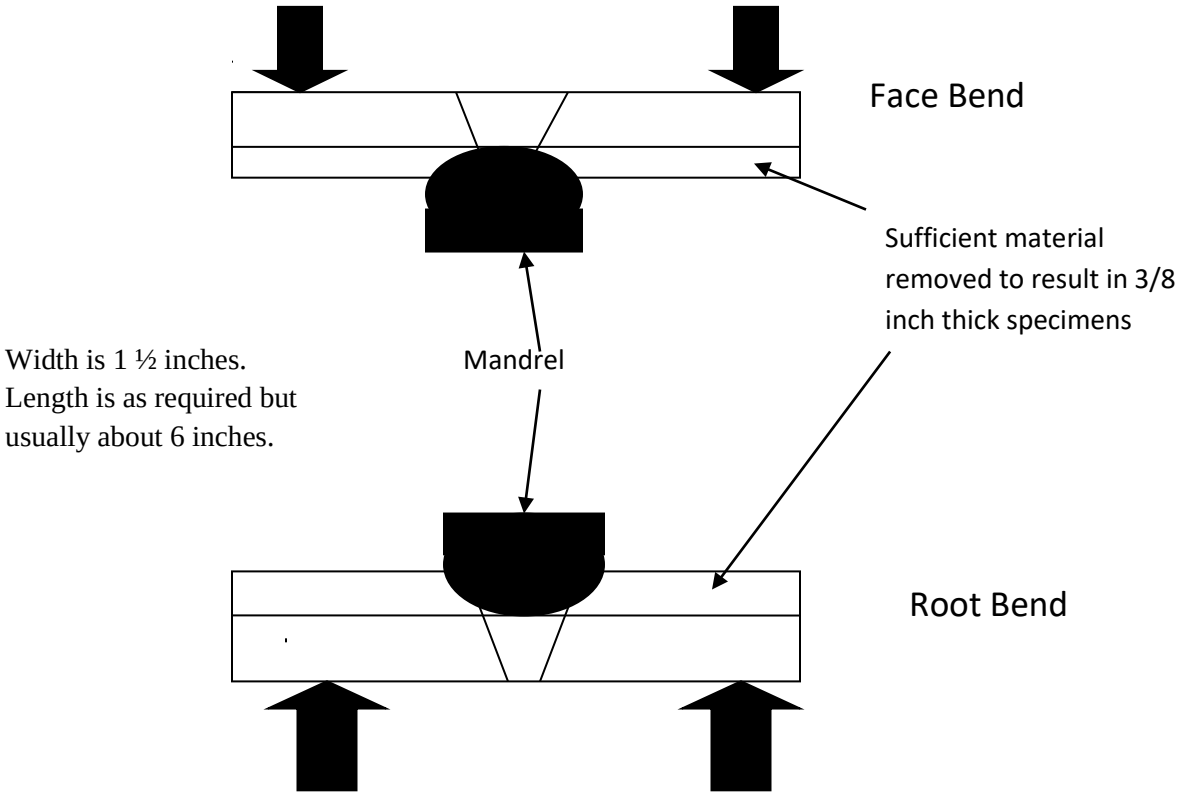


Figure 4.2
Face and Root Bend Tests Specimens

4.3 Tensile Tests

Tensile tests demonstrate the strength of the weld to ensure it neither bends nor breaks at design loads or below. The most common tensile test is the reduced section shown in Figure QW-462.1(a) and re-sketched here in Figure 4.3. Machined round specimens shown in Figure QW-462.1(d) may also be used. In most cases, two tensile specimens are required. The acceptance criterion is that the ultimate tensile strength meets or exceeds the specified ultimate tensile strength of either base metal.

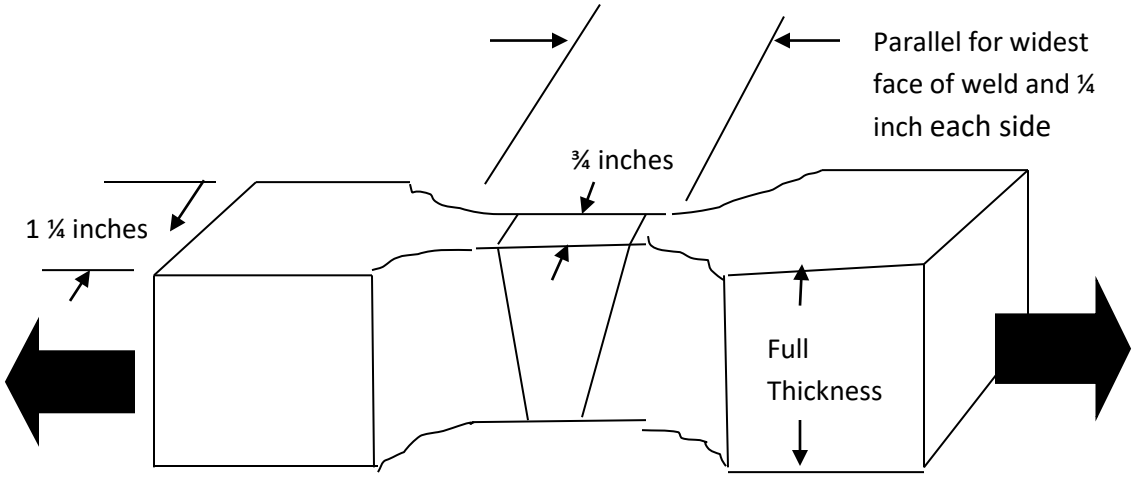


Figure 4.3
Reduced Section Tensile Test Specimen

4.4 Other Tests (Not required in our example)

4.4.1 Toughness Tests

Toughness tests are usually Charpy impact specimens but there are others. Their purpose is to demonstrate the energy necessary to cause failure. Low energy, brittle failure is very bad. Charpy Impact testing strikes a notched bar by a swinging hammer. Toughness testing is necessary when sudden loading is applied and are usually required when qualifying temperbead welds. Acceptance criteria generally involve proving your weld will meet toughness criteria and will not adversely affect the base material toughness.

4.4.2 Chemical Analysis

Chemical analysis is required when qualifying a procedure for applying a corrosion resistant overlay. Your company determines the necessary analysis and the qualification demonstrates the thickness of overlay necessary to meet that analysis.

4.4.3 Hardness Tests

Hardness testing is required when qualifying a procedure for applying a wear resistant overlay. The qualification demonstrates the depth necessary to obtain the desired hardness.

4.4.4 Fillet Weld Test

Fillet weld tests involve welding a "tee" configuration coupon and demonstrating adequate weld contour and soundness. We evaluate soundness by breaking the coupon and examining the fracture surface. We evaluate weld contour by etching and examining a cross section of the weld.

4.5. Use of Vendors

Your company or a contractor may perform evaluation testing. Your company is always responsible for evaluating the test results and accepting or rejecting the qualification regardless of who performs the testing.

5.0 Documenting the Procedure Qualification

5.1 Procedure Qualification Record (PQR)

A PQR is the document that records the variables for making a sample weld, the tests performed on the sample weld, and the results of those tests.

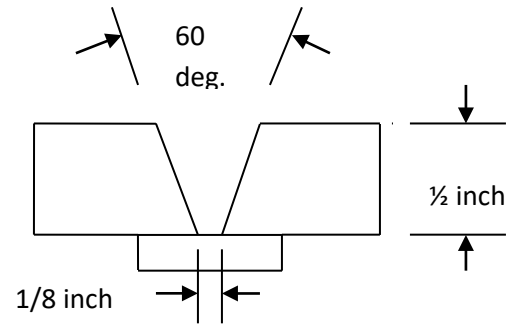
Figure 5.1 shows a form for PQRs similar to that suggested in Section IX. The information requested on the Section IX form is mandatory but can alter the format as necessary. ASME welcomes use of their form. We have completed Figure 5.1 with data we might expect for our example qualification.

Approve the PQR in accordance with your administrative procedure for WPS/PQR. Approved PQRs may not be altered, are valid forever, and should be retained as a record. Your program must describe how to maintain PQRs and cross-reference them to the WPS(s) they support. A PQR may support multiple WPSs. A WPS may reference multiple PQRs.

FORM QW-483 SUGGESTED FORMAT FOR PROCEDURE QUALIFICATION RECORDS (PQR)

Organization Name ***Your Company***
Procedure Qualification Record No. ***123*** Date ***xx/yy/zzzz***
WPS No. ***ABC***
Welding Process(ess) ***Shielded Metal Arc Welding (SMAW)***
Types (Manual, Automatic, Semi-Automatic) ***Manual***

JOINTS (QW-402)



Groove Design of Test Coupon
(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal and process used)

BASE METALS
Material Spec. ***SA-516***
Type/Grade, or UNS Number ***70***
P-No. ***1*** Group No. ***NA*** to P-No. ***1*** Group No. ***NA***
Thickness of Test Coupon ***1/2 inch***
Diameter of Test Coupon ***Plate***
Maximum Pass Thickness ***Less than ½ inch***

FILLER METALS
SFA Specification ***5.4***
AWS Classification ***E7018***
Filler Metal F-No. ***4***
Weld Metal Analysis A-No. ***1***
Size of Filler Metal ***1/8 inch***
Filler Metal Product Form ***Covered Electrode***
Supplemental Filler Metal ***NA***
Electrode Flux Classification ***NA***
Flux Type ***NA***
Flux Trade Name NA
Weld Metal Thickness ***1/2 inch***

POSITION
Position of Groove ***Flat (1G)***
Weld Progression (Uphill, Downhill) ***NA***

PREHEAT
Preheat Temperature ***60F minimum***
Interpass Temperature ***Not Recorded***

POSTWELD HEAT TREATMENT
Temperature ***Not performed***
Time ***NA***

GAS

	Percent Composition Gas(es)	(Mixture)	Flow Rate
Shielding	***NA***	***NA***	***NA***
Trailing	***NA***	***NA***	***NA***
Backing	***NA***	***NA***	***NA***

ELECTRICAL CHARACTERISTICS
Current ***Direct Current (DC)***
Polarity ***Electrode Positive (EP)***
Amps. ***100-165*** **Volts** ***20-24***
Tungsten Electrode Size ***NA***
Mode of Metal Transfer for GMAW (FCAW)
Heat Input ***NA***

TECHNIQUE
Travel Speed ***3 to 6 ipm***
String or Weave Bead ***Weave***
Oscillation
Multipass or Single Pass (Per Side) ***Multi***
Single or Multiple Electrodes ***Single***

Figure 5.1(a)
Suggested PQR Form Similar to Section IX (Front)

FORM QW-483 (Back)

PQR No. ***123***

Tensile Test (QW-150)

Specimen No.	Width	Thickness	Area, (Sq. in.)	Ultimate Total Load	Ultimate Unit Stress, (psi)	Type of Failure and Location
T-1	***0.75 inches***	***0.51 Inches***	***0.383***	***27,424 Lbs.***	***71,603***	***Ductile/Base Metal***
T-2	**0.76 inches**	***0.52 inches***	***0.395***	***27,808 Lbs.***	***70,400***	***Ductile/Base Metal***

Guided Bend Tests (QW-160)

Type and Figure No.		Result
FB-1	***Face Bend (QW-160.x)***	***Satisfactory***
FB-2	***Face Bend (QW-160.x)***	***Satisfactory***
RB-1	***Root Bend (QW-160.y)***	***Satisfactory***
RB-2	**Root Bend (QW-160.y)**	***Satisfactory (one 1/16 inch imperfection)***

Toughness Tests (QW-170)

Notch Location	Specimen Size	Test Temperature	Impact Values			Drop Weight Break (Y/N)
			Ft-lb or J	% Shear	Mils (in.) mm	

Comments ***No toughness tests were performed.***

Fillet-Weld Test (QW-180)

Result---Satisfactory: Yes _____ No _____ Penetration into Parent Metal: Yes ___ No ___

Macro---Results _____***No fillet weld tests were performed.***_____

Other Tests

Type of Test _____

Deposit Analysis _____

Welder's Name _____***John Doe***_____ Clock No. __***ID***_____ Stamp No, ___***JD***_____

Tests Conducted By _____***Your Company***_____ Laboratory Test No. __***1***__

We 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 IX of the ASME Boiler and Pressure Vessel Code.

Organization ____***Your Company***_____

Date ___***Date you certified this PQR***_____ Certified by ____***Student***_____

(Detail of record of tests are illustrative only and may be modified to conform to the type and number of tests required by the Code.)

Figure 5.1(b)

Suggested PQR Form Similar to Section IX (Back)

You may not alter an approved PQR. You may supplement approved PQRs to correct errors that do not affect the qualification status. You may supplement approved PQRs to document additional testing. Should additional qualification testing requirements arise, you may weld a PQR Supplement to the same essential variables as the original PQR. Only the additional testing is required on the supplement weld.

We once had to repair a carbon steel containment penetration weld that required Charpy impact testing which the original fabricator had performed for their PQR. Our WPS did not include Charpy impact testing. We welded a coupon to the same essential variables as our original PQR but only performed Charpy impact testing on it. We documented the Charpy testing as a supplement to our original PQR.

5.2 Welding Procedure Specification (WPS)

The WPS is the final product of the procedure qualification process. The WPS instructs the welder by listing the range of each variable (essential and nonessential) plus any additional information you feel the welder may need. I once reviewed a vendor's WPS that called for DCEN (straight polarity) when DCEP (reverse polarity) was appropriate. They showed me their welding machine on which they had performed their qualification. An electrician had reversed the leads internally. If the face of the machine said DCEN, you were actually welding DCEP. For the welder's benefit, the WPS was indicating how to set up the welding machine. Since this was the only welding machine in their shop, the WPS met the requirement for "instruction to the welder". The vendor agreed to restrict their WPS to this machine.

Figure 5.2 is a WPS we developed meeting the essential variables of our example qualification (Figure 2.1) and using a form similar to the suggested form found in Section IX. ASME welcomes u se of this form without any copyright restrictions. We added the nonessential variables and typical additional instructions to meet our needs. You would use the same approach for your WPS. It may be convenient to specify some nonessential variables such as joint geometry or minimum preheat temperature on work

Control documents. For some processes such as carbon arc gouging or preening, it may be useful to write stand alone generic procedures and reference them on the WPS.

Your WPS may consist of a single document or multiple documents. Most companies have a document labeled "WPS" which list most variables and references generic documents to cover such items as post weld heat treatment methods, cleaning methods, etc. For example, a variable says a single weld bead may not exceed 2 inches in thickness unless specifically qualified. Since weld beads this thick were not a common occurrence in our shop, we specified the requirement in a generic procedure.

We used a single V joint with a backing strip in qualification. Joint design details are a nonessential variable. We can use any groove or fillet dimensions that fit our needs on the WPS so long as we specify them up front. You can note dimensions in companion work control documents.

Base metal type (P-Number) and thickness are essential variables. Since we used ½-inch thick type P 1 base material in qualification, we are limited to type P 1 in the WPS. We are also limited to 2T or 1-inch base metal thickness except for fillet welds which are unlimited. Group number is a subset of P number and is only applicable when Supplementary Essential Variables apply. Supplementary Essential variables did not apply for our example PQR.

The PQR preheat temperature of 60F permits WPS minimum preheat temperature up to 100F below 60F (minus 40F). We specified a more realistic preheat of 60F but permitted higher preheats to be specified on the work control documents if needed to prevent porosity or to prevent cracking of restrained welds. Preheat temperature would be more of an issue if we were welding alloy steel needing 300, 400, or 500F minimum preheat. Preheat maintenance refers to holding preheat temperature until PWHT is performed. It is a nonessential variable but is also not applicable to our example since we did not perform PWHT. On a different but similar

note, we did provide instructions for slow cooling when higher preheat temperatures are used.

Filler metal F-number and A-number are essential variables. Filler material diameter and AWS classification are nonessential variables. We specified some of the most commonly used types and sizes meeting the essential variable of A-1/F-4 electrodes.

Position is a nonessential variable for procedure qualification so we specified, “All Position in our WPS, even though we welded the qualification in the flat (1G)” position. We specified uphill progression for vertical welding because that is much easier for F-4 type low hydrogen electrodes. Position becomes a very important variable in welder performance qualification.

Electrical Characteristics are all nonessential variables so we can specify whatever current type, polarity, and amperage/voltage ranges we feel appropriate in our WPS.

All the Techniques are nonessential variables so we may specify them, as we feel appropriate in our WPS. We may find it useful to write and reference brief technical instructions for the techniques that need more detail than a brief sentence or two on the WPS.

The classic instructions for peening are to not peen the root or final surface, the root to avoid “punch thru” by the peening tool and the final surface to avoid work hardening. We do not expect any thin roots but subsequent beads will not anneal the final surface.

As necessary, we may use carbon arc gouging. If we will subsequently weld upon a gouged surface, we require grinding to bright metal to ensure we have removed any material with excessive carbon contamination.

FORM QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)

Organization Name ***Your Company*** By ***Student***
Welding Procedure Specification No. ***ABC*** Date ***Today*** Supporting PQR No.(s) ***123***
Revision No. ***0*** Date ***Date WPS revision approved***
Welding Process(es) ***SMAW*** Type(s) ***Manual***

JOINTS (QW-402)	Details
Joint Design ***Grooves and Fillets*** Root Spacing ***Per "Details"*** Backing: Yes ***X*** No _____ Backing Material (Type) ***Carbon Steel (Fusible)*** (Refer to both backing and retainers) Sketches, Production Drawings, Weld Symbols, or written description should show the general arrangement of the parts to be welded. Where applicable, the details of weld groove may be specified. Sketches may be attached to illustrate joint design, weld layers, and bead sequence (e.g. for notch toughness procedures, for multiple process procedures, etc.)	***Joint design details per manufacturing documents.***

BASE METALS (QW-403)
P-No. ***1*** Group No. ***NA*** to P-No. ***1*** Group No. ***NA***
OR
Specification and type/grade or UNS Number _____
To Specification and type/grade or UNS Number _____
OR
Chem Analysis and Mech. Prop. _____
To Chem. Analysis and Mech. Prop. _____
Thickness Range:
Base Metal: Groove ***1 inch maximum*** Fillet ***All***
Maximum Pass Thickness ***Less than ½ inch***
Other ***Not for use on products with toughness requirements***

FILLER METALS (QW-404)	1	2
Spec. No. (SFA)	***5.4***	***Single process procedure***
AWS No. (Class)	***E7015, E7016, E7018***	
F-No.	***4***	
A-No.	***1***	
Size of Filler Metals	***3/32, 1/8, 5/32, 3/16 inch***	
Filler Metal Product Form	***Covered Electrode***	
Weld Metal Deposited Thickness		
Groove	***1 inch***	
Fillet	***Unlimited***	

**Each base metal-filler metal combination should be recorded individually.*

Figure 5.2(a)
Suggested WPS Form Similar to ASME Section IX (Front)

FORM QW-482 (Back)

WPS No. *ABC* **Rev.** ***0***

POSITIONS ***All (Uphill for vertical)***
PREHEAT ***60F Minimum***

POSTWELD HEAT TREATMENT
Not permitted

Weld Pass(es)	Process	FILLER METAL		Current Type and Polarity	Amps (Range	Volts (Range)	Travel Speed (Range)	Other (e.g. Remarks, Hot Wire Addition, Technique, Torch Angle, etc.)
		Classification	Diameter					
	SMAW	***E7015, E7016, or E7018***	***3/32***	***DCEP***	***65 – 110***	***20 – 22***	***3 5***	***3/16 inch dia. E7018 shall not be used in vertical and overhead position.***
			1/8	***DCEP***	***100 -165***	***20 – 24***	***3 – 6***	
			5/32	***DCEP***	***120 – 220***	***21 – 24***	***4 – 12***	
			3/16	***DCEP***	***180 - 275)***	***22 -26***	***6 - 12***	

TECHNIQUE
String or Weave Bead ***Either***
Orfice, Nozzle, or Gas Cup Size ***NA***
Initial and Interpass Cleaning (Brush, Grinding, etc.) ***Wire brushing and grinding as required***
Method of Back Gouging ***Grinding and/or carbon arc gouging as required. Carbon arc gouged surfaces to be welded upon must be ground to bright metal***
Oscillation ***NA***
Contact Tube to Work Distance ***NA***
Multiple or Single Pass (per Side) ***Multiple***
Multiple or Single Electrodes ***Single***
Electrode Spacing ***NA***
Peening ***Peening is permitted except on the final weld layer.***

Additional Instructions and Notes

1. ***This WPS is for welding with backing only. Types of backing include (a) backing placed at the root of a joint and welding from one side only (single welded joints), (b) weld metal backing when welding from both sides (double welded joints), and (c) base or weld metal 1/8 inch or greater at the bottom of defect excavations.***
2. ***Higher preheats may be used if needed to prevent porosity or to prevent cracking of restrained welds. Completed weld shall be slowly cooled to 100F or less under insulating material when the required preheat is 175F or greater.***

Note: Some items not applicable to SMAW have been deleted for simplicity.

Figure 5.2(b)
Suggested WPS Form Similar to ASME Section IX (Back)

6.0 Additional Requirements

In addition to Section IX, Construction Code, Regulatory, or Customer requirements may affect qualification. You may be required or you may want to incorporate these requirements in your original qualification or in a supplement.

6.1 Construction Code requirements

The Construction Code (Sections I, III, VIII, or XI) may impose additional requirements. Such additional requirements may include tube-to-tube sheet welding, temperbead welding, thermocouple attachment welding, CAD welding, etc.

6.2 Regulatory Requirements

In my experience, Regulatory requirements usually mean Nuclear Regulatory Commission (NRC) requirements. While they usually refer to NDE methods on production welds, they can include such things as delta ferrite control in austenitic welds or additional requirements for temperbead welds.

6.3 Customer Requirements

I recall building nuclear steam generators and pressurizers for a Japanese power company. In addition to the Section IX requirement for bending PQR specimens around a mandrel, the customer required us further bend the specimens flat upon themselves.

In another case, we were concerned about the effects of residual boric acid. Borated water (boric acid) is the coolant in the primary loop of a pressurized water nuclear power plant. Residual boric acid could have an effect on the weld when repairing these components. We welded sample specimens on material we immersed in boric acid, boiled dry, and then cleaned. We incorporated the cleaning method into the PQR and WPS.

In another case, we were to perform fillet welded patches on some coal handling equipment in a fossil power plant. The welding side was relatively clean but the opposite side had too much coal dust to clean. We

performed beads on varying thicknesses of plate and varying current levels while measuring the temperature opposite the weld to ensure it would remain below the ignition temperature to avoid a coal dust explosion.

We had an item on our WPS form labeled “Compliance” where we stated all sources from which we drew qualification requirements. For example, a temperbead WPS might list Section IX and Section XI meaning the WPS/PQR meets all requirements of Section IX and additional temperbead requirements of ASME Section XI.

