Review of WPS's and PQR's

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Review of the WPS' and PQR's

The API candidate will be given a WPS and a PQR and will be asked to identify errors or unsupported requirements.

Questions will be asked about individual blocks on the WPS/PQR. *You will not be required to review the entire document*. The exam is in multiple choice format, normally 3 to 6 questions come from the WPS/PQR review.

When answering the questions about the WPS and/or the PQR, look for omitted information. *Every Essential and Nonessential* variable should be addressed. Common errors, such as filler metal F-Numbers and base metal thickness ranges are typically found. The PQR test coupon thickness T *can* and *often does* support only part of the thickness range stated on the WPS etc.

Limitations on the WPS/PQR Review

The API Body of Knowledge has limited the content of the WPS and PQR in the following key ways.

1. There will be only **one** welding process, and they have been limited to **SMAW, GTAW, GMAW or SAW.**

2. Just **one filler metal** i.e. all E-7018 with no mixing of F- Numbers.

3. There will not be different thickness' or different base metals welded to each other.

4. The P-Numbers are limited to P1, P3, P4, P5 and, P8

5. For P1, P3, P4, and, P5 the lower transition temperature is 1,333 ^{o} F and the upper is transformation is 1600 ^{o} F

Limitations on the WPS/PQR Review

Limits Continued:

6. Supplemental powdered fillers or consumable inserts will not be on the WPS/PQR.

7. Special welding processes such as corrosion resistant weld metal overlay and hard surfacing will not be present.

8. Welds with buttering of the ferritic member or excluded.

In short the WPS/PQR review will be of the most basic type, and will not require a great deal of expertise in Section IX.

WPS/PQR Mistakes are of Four Types

1. Missing variables, both Essentials and Non-Essentials on the WPS.

2. Missing Essential variables on the PQR, Non-Essentials are not required for the PQR.

3. Incorrect Essential Variables, such as the wrong F-Number for a filler metal or electrode. For example:

“The electrode E-6010 has an F-Number of 3 and often the wrong F-Number is assigned to it such as F-Number 4”

4. An Essential Variable listed on the WPS that is not supported by the PQR.

Note: Editorial mistakes such as misspellings of company names or typing errors are excluded from the exam. i.e.

Brief of Variables

We will use the SMAW QW-253 Brief of Variables as a check list as we go through the reviews of two WPS' and PQR's.

Confusion Welding and Wee Welders

Turn now to **Page 21** of Section IX and remove it for convenience during the review.

Confusion Welding WPS

The first checks are in the title of the WPS.

1. Does our WPS reference our PQR?
2. Has our welding process been listed?
3. Is the Type of welding listed, manual, automatic etc.?

* Note: The Type of Welding in box QW-410 at the bottom of QW-253 is out of order in reference to the box on the WPS, as it appears in the title instead of box QW-410 on the WPS.

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Confusion Welding** By: _____

Welding Procedure Specification No. **100** Date **8/25/92** Supporting PQR No (s) **100**

Revision No. **0** Date _____

Welding Process(es) **SMAW** Types **Manual**
(Automatic, Manual, Machine, or semi-Auto)

JOINTS (QW-402)

Joint Design **Single Vee Groove**

Backing (Yes) **X** (No) **X**

Backing Material (Type) **Flat Bar 1" x 1/4" P-No. 1 Material**
(Refer to both backing and retainers.)

☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches. Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of the weld groove may be specified.

(At the option of the Mfgr. sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details

No Retainers allowed
Root Spacing 0 to 1/16"
Bevel to 75 °

Confusion Welding WPS

Conclusion:

1. WPS references our PQR.
2. Our welding process is listed.
3. Type of welding is listed as manual.

No mistakes in the title page.

Confusion Welding WPS

Next we compare the variables in the **row QW-402 Joints** on QW-253 to the box **QW-402 Joints** on the WPS.

1. Groove design, is it addressed?
2. Backing has it been listed?
3. Has root spacing been detailed?
4. Finally have retainers been mentioned?

For definitions see **Page 56** of Section IX.

402.1 - A Change in Groove Design
402.4 - Deletion/Removal of Backing
402.10 - A Change in Root Spacing
402.11 – Addition or Removal Retainers

We go line by line checking the WPS **<** ;

QW-253
WELDING VARIABLES PROCEDURE SPECIFICATIONS (WPS)
Shielded Metal-Arc Welding (SMAW)

01
A03

Paragraph		Brief of Variables	Essential	Supplementary Essential	Nonessential
QW-402 Joints	.1	ϕ Groove design		↑ Not On Exam	X <
	.4	– Backing			X <
	.10	ϕ Root spacing			X <
	.11	± Retainers			X <

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Confusion Welding** By: _____

Welding Procedure Specification No. **100** Date **8/25/92** Supporting PQR No (s) **100**

Revision No. **0** Date _____

Welding Process(es) **SMAW** Types **Manual**
(Automatic, Manual, Machine, or semi-Auto)

JOINTS (QW-402)

Joint Design **Single Vee Groove**

Backing (Yes) **X** (No) **X**

Backing Material (Type) **Flat Bar 1" x 1/4" P-No. 1 Material**
(Refer to both backing and retainers.)

☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches. Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of the weld groove may be specified.

(At the option of the Mfgr. sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

Details

No Retainers allowed
Root Spacing 0 to 1/16"
Bevel to 75 °

Confusion Welding WPS

Conclusions: Nothing is missing, there are no mistakes in box QW-402 on the WPS. Note that Non-Essentials are only wrong if they are missing i.e. the Code user can choose any groove design, root spacing etc.

1. Groove Design is addressed as Single Vee.
2. Backing as Flat Bar P-No.1 steel material.
3. Retainers under Details are Not Allowed.
4. Root Spacing is present under Details.

Confusion Welding WPS

The next listings are in box QW-403 Base Metals.

1. Is the P-Number entered?
2. Is Base Metal Thickness present?
3. Has t pass > 1/2” been addressed?

* Note: During the review of the PQR we will confirm that all Essential Variables are in agreement between the WPS and the PQR regarding the specifications and ranges supported.

Confusion Welding WPS

PROCEDURE QUALIFICATIONS

QW-253
WELDING VARIABLES PROCEDURE ... NS (WPS)
Shielded Metal-Arc Weldin...

Must be on the WPS and PQR

Nonessentials may be on the PQR and do not have to agree with the WPS.

All MUST be on the WPS

Paragraph		Brief of Variables	Essential	Supplementary Essential	Nonessential
QW-402 Joints	.1	ϕ Groove design		Not on the exam	X
	.4	– Backing			X
	.10	ϕ Root spacing			X
	.11	± Retainers			X
QW-403 Base Metals	.5	ϕ Group Number			
	.6	*T* Limits Impact			
	.7	*T*/*t* Limits > 8 In. (203 mm)	X		
	.8	ϕ *T* Qualified	X		
	.9	*t* Pass > 1/2 In. (13 mm)	X		
	.11	ϕ P-No. qualified	X		
	.13	ϕ P-No. 5/9/10	X		
QW-404 Filler Metals	.4	ϕ F-Number	X		
	.5	ϕ A-Number	X		
	.6	ϕ Diameter			X
	.7	ϕ Diameter > 1/4 In. (6 mm)		X	
	.12	ϕ AWS classification		X	
	.30	ϕ *t*	X		
	.33	ϕ AWS classification			X

These Items we will ignore. They were addressed in the Qualifying of Essential Variables.

*BASE METALS (QW-403)
P-No. 1 Group No. _____ To P-No. 1 Group No. _____
OR
Specification type and grade _____
to Specification type and grade _____
OR
Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop.
Thickness Range:
Base Metal: Groove 1/16" to 1" Fillet All
Pipe Dia. Range: Groove Fillet
Other _____

*FILLER METALS (QW-404)			
Spec. No. (SFA)	5.1		
AWS No. (Class)	E-7018		
F-No.	3		
A-No.	1		
Size of Filler Metals			
Weld Metal			
Thickness Range:	1/16" to 1"		
Groove			
Fillet			
Electrode-Flux (Class)			
Flux Trade Name			
Consumable Insert			
Other			

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

Confusion Welding

Conclusions:

1. The P-Number is present.
2. Base metal thickness range is present.
3. **t pass > 1/2” is missing, not addressed! This is a mistake, as all essentials variables must be addressed.**

* Remember, all variables that apply to the process must be addressed on the WPS, **both essential and non-essential.**

Confusion Welding

Check the box QW-404 on the WPS for omissions.

1. Is the F-Number present and is it correct?
2. Is the A-Number present?
3. Diameter of electrodes allowed?
4. The range of weld metal t ?
5. AWS Classification how about it?

You may remember from our previous lesson that A-Numbers cannot be correctly identified without Section II Part C of the ASME Code. So we can only check for its presence on the form.

Confusion Welding WPS

PROCEDURE QUALIFICATIONS

QW-253
WELDING VARIABLES PROCEDURE ... NS (WPS)
Shielded Metal-Arc Weldin...

Must be on the WPS and PQR

Nonessentials may be on the PQR and do not have to agree with the WPS.

All MUST be on the WPS

Paragraph		Brief of Variables	Essential	Supplementary Essential	Nonessential
QW-402 Joints	.1	ϕ Groove design		Not on the exam	X
	.4	– Backing			X
	.10	ϕ Root spacing			X
	.11	± Retainers			X
QW-403 Base Metals	.5	ϕ Group Number			
	.6	*T* Limits Impact			
	.7	*T*/*t* Limits > 8 In. (203 mm)	X		
	.8	ϕ *T* Qualified	X		
	.9	*t* Pass > 1/2 In. (13 mm)	X		
	.11	ϕ P-No. qualified	X		
	.13	ϕ P-No. 5/9/10	X		
QW-404 Filler Metals	.4	ϕ F-Number	X		
	.5	ϕ A-Number	X		
	.6	ϕ Diameter			X
	.7	ϕ Diameter > 1/4 In. (6 mm)		X	
	.12	ϕ AWS classification		X	
	.30	ϕ *t*	X		
	.33	ϕ AWS classification			X

These Items we will ignore. They were addressed in the Qualifying of Essential Variables.

*BASE METALS (QW-403)
P-No. 1 Group No. _____ To P-No. 1 Group No. _____
OR
Specification type and grade _____
to Specification type and grade _____
OR
Chem. Analysis and Mech. Prop. _____
to Chem. Analysis and Mech. Prop.
Thickness Range:
Base Metal: Groove 1/16" to 1" Fillet All
Pipe Dia. Range: Groove Fillet
Other _____

*FILLER METALS (QW-404)			
Spec. No. (SFA)	5.1		
AWS No. (Class)	E-7018		
F-No.	3		
A-No.	1		
Size of Filler Metals			
Weld Metal			
Thickness Range:	1/16" to 1"		
Groove			
Fillet			
Electrode-Flux (Class)			
Flux Trade Name			
Consumable Insert			
Other			

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

Confusion Welding

Everything on the list is present, but is the Essential Variable F-Number correct? We can't check the A-Number without Section II Part C.

Turn to **Page 132** and look at the F-Numbers. Check the F-Number for E-7018 which appears under the title E-XX18.

QW-432
F-NUMBERS (NONFERROUS)
Grouping of Electrodes and Welding Rods for Qualification

F-No.	ASME Specification	AWS Classification		UNS No.
		Steel and Steel Alloys		
4	SFA-5.1	EXX15		...
4	SFA-5.1	EXX16		...
4	SFA-5.1	EXX18	**E-7018**	...
4	SFA-5.1	EXX18M	**E-8018**	...
			Etc.	

Confusion Welding

Conclusions:

1. The F-Number is present but wrong!
2. The A-Number is present.
3. Diameter/Size of electrodes are missing!
4. The range of weld metal t is present.
5. AWS Classification is listed.

Confusion Welding

Now to the back of the WPS to the box QW-405 Positions.

1. Are the positions allowed for welding present?
2. Has progression permitted been entered?

Since fillets are not on the list of QW-253 you may ignore this entry for the purposes of the test.

QW-405 Positions	.1	+ Position			X
	.2	ϕ Position		X	
	.3	ϕ ↑↓ Vertical welding			X
QW-406 Preheat	.1	Decrease > 100°F (56°C)	X		
	.2	ϕ Preheat maint.			X
	.3	Increase > 100°F (56°C) (IP)		X	
QW-407 PWHT	.1	ϕ PWHT	X		
	.2	ϕ PWHT (T & T range)		X	
	.4	*T* Limits	X		
QW-409 Electrical Characteristics	.1	> Heat Input		X	
	.4	ϕ Current or polarity		X	X
	.8	ϕ I & E range			X
QW-410 Technique	.1	ϕ String/weave			X
	.5	ϕ Method cleaning			X
	.6	ϕ Method back gouge			X
	.9	ϕ Multiple to single pass/side		X	X
	.25	ϕ Manual or automatic			X
	.26	± Peening			X

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: **6G**

Welding Progression: Up **YES** Down _____

Position(s) of Fillet: _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: **None**

Time Range: _____

PREHEAT (QW-406)

Preheat Temp. Min. **60 °F**

Interpass Temp. Max. **350 °F**

Preheat Maintenance _____

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC **DC** Polarity **Straight**

Amps (Range) **100 – 175** Volts **20 - 28**

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: **N/A**

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: **N/A**

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: **N/A**

Confusion Welding

Conclusion:

1. The positions allowed for welding are present?
2. Progression permitted has been entered?

There are no mistakes. However the positions allowed would have been better stated in actual practice by using Flat, Horizontal, Vertical and Overhead (F,H,V,O). 6G is a welder’s all positions qualification test.

Confusion Welding

Now Preheat in box QW-406.

1. Has Preheat Temp. been entered?
2. Preheat Maintenance is it there?

Since Interpass Temp. is a Supplementary Essential you may ignore this entry for the purposes of the test.

QW-405 Positions	.1	+ Position			X
	.2	ϕ Position		X	
	.3	ϕ ↑↓ Vertical welding			X
QW-406 Preheat	.1	Decrease > 100°F (56°C)	X		
	.2	ϕ Preheat maint.			X
	.3	Increase > 100°F (56°C) (IP)		X	
QW-407 PWHT	.1	ϕ PWHT	X		
	.2	ϕ PWHT (T & T range)		X	
	.4	*T* Limits	X		
QW-409 Electrical Characteristics	.1	> Heat Input		X	
	.4	ϕ Current or polarity		X	X
	.8	ϕ I & E range			X
QW-410 Technique	.1	ϕ String/weave			X
	.5	ϕ Method cleaning			X
	.6	ϕ Method back gouge			X
	.9	ϕ Multiple to single pass/side		X	X
	.25	ϕ Manual or automatic			X
	.26	± Peening			X

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: **6G**

Welding Progression: Up **YES** Down _____

Position(s) of Fillet: _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: **None**

Time Range: _____

PREHEAT (QW-406)

Preheat Temp. Min. **60 °F**

Interpass Temp. Max. **350 °F**

Preheat Maintenance _____

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC **DC** Polarity **Straight**

Amps (Range) **100 – 175** Volts **20 - 28**

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: **N/A**

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: **N/A**

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: **N/A**

Confusion Welding

Conclusion:

1. Preheat Temp. has been entered.
2. Interpass Temp is present but was not required.
3. Preheat Maintenance Temp. is missing!

There is **one mistake**. Preheat Maintenance Temp. is not present, this is an error by omission of a Non-Essential Variable.

Confusion Welding

Now Post Weld Heat Treatment in box QW-407.

1. Simple it is addressed as NONE.

We will check it against the PQR during the PQR review portion of this instruction.

QW-405 Positions	.1	+ Position			X
	.2	ϕ Position		X	
	.3	ϕ ↑↓ Vertical welding			X
QW-406 Preheat	.1	Decrease > 100°F (56°C)	X		
	.2	ϕ Preheat maint.			X
	.3	Increase > 100°F (56°C) (IP)		X	
QW-407 PWHT	.1	ϕ PWHT	X		
	.2	ϕ PWHT (T & T range)		X	
	.4	*T* Limits	X		
QW-409 Electrical Characteristics	.1	> Heat Input		X	
	.4	ϕ Current or polarity		X	X
	.8	ϕ I & E range			X
QW-410 Technique	.1	ϕ String/weave			X
	.5	ϕ Method cleaning			X
	.6	ϕ Method back gouge			X
	.9	ϕ Multiple to single pass/side		X	X
	.25	ϕ Manual or automatic			X
	.26	± Peening			X

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: **6G**

Welding Progression: Up **YES** Down _____

Position(s) of Fillet: _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: **None**

Time Range: _____

PREHEAT (QW-406)

Preheat Temp. Min. **60 °F**

Interpass Temp. Max. **350 °F**

Preheat Maintenance _____

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC **DC** Polarity **Straight**

Amps (Range) **100 – 175** Volts **20 - 28**

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: **N/A**

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: **N/A**

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: **N/A**

Confusion Welding

Conclusion:

All we need do is to make sure it is in agreement with what occurred during the making of the supporting PQR test coupon. We will compare those during the PQR portion of this review.

Confusion Welding

Next up is the box QW-408 Gases.

This is not applicable to the SMAW Process. We will ignore it completely on this review.

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: **6G**

Welding Progression: Up **YES** Down _____

Position(s) of Fillet: _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: **None**

Time Range: _____

PREHEAT (QW-406)

Preheat Temp. Min. **60 °F**

Interpass Temp. Max. **350 °F**

Preheat Maintenance _____

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC **DC** Polarity **Straight**

Amps (Range) **100 – 175** Volts **20 - 28**

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: **N/A**

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: **N/A**

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: **N/A**

Confusion Welding

Now for box QW-409 Electrical Characteristics.

1. Has the Current been entered?
2. How about the Polarity?
3. What about the Amps (**I**) ?
4. Volts (**E**)?

QW-405 Positions	.1	+ Position			X
	.2	ϕ Position		X	
	.3	ϕ ↑↓ Vertical welding			X
QW-406 Preheat	.1	Decrease > 100°F (56°C)	X		
	.2	ϕ Preheat maint.			X
	.3	Increase > 100°F (56°C) (IP)		X	
QW-407 PWHT	.1	ϕ PWHT	X		
	.2	ϕ PWHT (T & T range)		X	
	.4	*T* Limits	X		
QW-409 Electrical Characteristics	.1	> Heat Input		X	
	.4	ϕ Current or polarity		X	X
	.8	ϕ I & E range			X
QW-410 Technique	.1	ϕ String/weave			X
	.5	ϕ Method cleaning			X
	.6	ϕ Method back gouge			X
	.9	ϕ Multiple to single pass/side		X	X
	.25	ϕ Manual or automatic			X
	.26	± Peening			X

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: **6G**

Welding Progression: Up **YES** Down _____

Position(s) of Fillet: _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: **None**

Time Range: _____

PREHEAT (QW-406)

Preheat Temp. Min. **60 °F**

Interpass Temp. Max. **350 °F**

Preheat Maintenance _____

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC **DC** Polarity **Straight**

Amps (Range) **100 – 175** Volts **20 - 28**

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: **N/A**

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: **N/A**

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: **N/A**

Confusion Welding

Conclusion:

1. The Current has been entered.
2. Polarity is there.
3. Amps (**I**) are present.
4. Volts (**E**) it is there.

No mistakes in block QW-409

Confusion Welding

Finally block QW-410 Technique

1. String or Weave allowed or both?
2. Initial or interpass cleaning, how?
3. Method of Back Gouging?
4. Multiple to Single pass/side permitted?
5. Peening, is it there?
6. Manual or Automatic welding?

QW-405 Positions	.1	+ Position			X
	.2	ϕ Position		X	
	.3	ϕ ↑↓ Vertical welding			X
QW-406 Preheat	.1	Decrease > 100°F (56°C)	X		
	.2	ϕ Preheat maint.			X
	.3	Increase > 100°F (56°C) (IP)		X	
QW-407 PWHT	.1	ϕ PWHT	X		
	.2	ϕ PWHT (T & T range)		X	
	.4	*T* Limits	X		
QW-409 Electrical Characteristics	.1	> Heat Input		X	
	.4	ϕ Current or polarity		X	X
	.8	ϕ I & E range			X
QW-410 Technique	.1	ϕ String/weave			X
	.5	ϕ Method cleaning			X
	.6	ϕ Method back gouge			X
	.9	ϕ Multiple to single pass/side		X	X
	.25	ϕ Manual or automatic			X
	.26	± Peening			X

TECHNIQUE (QW-410)

String or Weave Bead **String or Weave**

Orifice or Gas Cup Size

Initial and Interpass Cleaning (Brushing, Grinding, etc.) **Brushing, Chipping, or Grinding**

Method of Back Gouging **Air Arc**

Oscillation

Contact Tube to Work Distance

Multiple or Single Pass (per side)

Multiple or Single Electrodes

Travel Speed (Range)

Peening **None Allowed**

Other

Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot wire Addition, Technique, Torch Angle, Etc.
		Class	Dia.	Type Polarity	Amp Range			

Confusion Welding

Conclusion:

1. String or Weave both are allowed.
2. Initial or interpass cleaning, addressed.
3. Method of Back Gouging present.
4. Multiple to Single pass/side, not addressed!
5. Peening addressed as None Allowed.
6. Manual/Automatic appears in the title.

One mistake. Multiple or Single Pass an error by omission.

Confusion Welding

Now to the Front of the PQR and its title section.

There isn't much to see here. The correct company name etc., but the API Body of Knowledge specifies that the **WPS will be supported by only one PQR and it will be the correct one.** This leaves the welding Process which is addressed as **SMAW**. All others are non-essential variables and those **are not required** to be on the PQR, in fact they could be missing. Anything else in the title will fall under Editorial and is not considered on the exam WPS/PQR review questions.

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

(See QW-200.2, Section IX, ASME Boiler & Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon.

Company Name: **Confusion Welding**

Procedure Qualification Record No.: **100** Date: **6/18/92**

WPS No.:

Welding Process (es) **SMAW**

Types (Manual, Automatic, Semi-Auto.) **Manual**

JOINTS (QW-402)

Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

Confusion Welding

Conclusion:

1. SMAW has been addressed, **no mistakes** in the PQR title.

Note: The PQR does not have to reference the WPS. A single PQR may support multiple WPS' since WPS' are often written years after the PQR was made. How could you know the WPS number years before it will be written?

Confusion Welding

We start all over using QW-253 and the box QW-402 Joints on the PQR, all of those are Non-Essential Variables and are not required on the PQR. **Nothing to do here. The box is blank and that is not a mistake.**

Note: In a real world PQR, you would never leave the joint design information blank, in fact you would detail it, but Section IX clearly states that Non-Essentials are optional. However the Construction Code will usually force this information be present. For the PQR **on this examination it is not required.**

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

(See QW-200.2, Section IX, ASME Boiler & Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon.

Company Name: **Confusion Welding**

Procedure Qualification Record No.: **100** Date: **6/18/92**

WPS No.:

Welding Process (es) **SMAW**

Types (Manual, Automatic, Semi-Auto.) **Manual**

JOINTS (QW-402)

Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

Confusion Welding

Using QW-253 in the box QW- 403 Base Metals, we check the following items:

1. Has the P-Number been addressed and does it agree with the WPS?

2. Has the thickness of test coupon been entered and does it support the full range stated on the WPS for production welding?

BASE METALS (QW403)

Material Spec. **SA-53**

Type or Grade: **Gr.B**

P No. to P No.:

Thickness of Test Coupon: **0.500"** Dia.: **10"**

Other:

FILLER METALS (QW-404)

F No 1:	**4**	2:		
A No 1:	**1**	2:		
SFA Spec Number	1:	**5.1**	2:	
AWS Class. No	1:	**E-7018**	2:	
Size of Electrode	1:	"	2:	"

POSITION (QW-405)

Welding Position 1: 2:

Welding Progress: 1: 2:

PREHEAT (QW-406)

Preheat Temp. : **175 ° F**

Interpass Temp.: °F

Other

POSTWELD HEAT TREATMENT (QW-407)

Type:

Temp:

Time:

GAS (QW-408)

Shielding 1:

2:

Shield Flow (cfh) 1: 2:

Purge Gas :

Purge Flow :

Trailing Gas :

Trailing Flow

ELECTRICAL CHARACTERISTICS (QW-409)

Current	1:		2:	
Max Amps	1:		2:	
Max Volts	1:		2:	
Joules	1:		2:	
Tungsten Size			:	
Tungsten Type				
Pulsing Current				

TECHNIQUE (QW-410)

Bead Type	1:		2:	
Bead Width	1:		2:	
Cup Size	:			
Back Gouging	:			
Layers	1:		2:	
Electrodes	1:		2:	
Travel Speed	1:		2:	
Oscillation	:			

Confusion Welding

Conclusion:

1. No P-Numbers listed!
2. The thickness of the test Coupon is stated to be 0.500 but it does not support the full range stated on the WPS of 1/16” to 1”.

There are two mistakes, No P-Numbers and the thickness range qualified by the coupon is not adequate for the WPS’ proposed thickness’.

Turn now to QW-451.1 on **Page 139.**

QW-451.1
GROOVE-WELD TENSION TESTS AND TRANSVERSE-BEND TESTS

Thickness T of Test Coupon Welded, in. (mm)	Range of Thickness T of Base Metal Qualified, in. (mm) [Notes (1) and (2)]		Thickness t of Deposited Weld Metal Qualified, in. (mm) [Notes (1) and (2)]	Type and Number of Tests Required (Tension and Guided-Bend Tests) [Note (2)]			
	Min.	Max.	Max.	Tension, QW-150	Side Bend, QW-160	Face Bend, QW-160	Root Bend, QW-160
Less than $^1/_{16}$ (1.6)	T	$2T$	$2t$	2	...	2	2
$^1/_{16}$ to $^3/_8$ (1.6 to 10), incl.	$^1/_{16}$ (1.6)	$2T$	$2t$	2	Note (3)	2	2
Over $^3/_8$ (10), but less than $^3/_4$ (19)	$^3/_{16}$ (4.8)	$2T$	$2t$	2	Note (3)	2	2
$^3/_4$ (19) to less than $1^1/_2$ (38)	$^3/_{16}$ (4.8)	$2T$	$2t$ when $t < ^3/_4$ (19)	2 [Note (4)]	4	...	...
$^3/_4$ (19) to less than $1^1/_2$ (38)	$^3/_{16}$ (4.8)	$2T$	$2T$ when $t \geq ^3/_4$ (19)	2 [Note (4)]	4	...	...
$1^1/_2$ (38) and over	$^3/_{16}$ (4.8)	8 (203) [Note (5)]	$2t$ when $t < ^3/_4$ (19)	2 [Note (4)]	4	...	...
$1^1/_2$ (38) and over	$^3/_{16}$ (4.8)	8 (203) [Note (5)]	8 (203) [Note (5)] when $t \geq ^3/_4$ (19)	2 [Note (4)]	4	...	...

NOTES:
(1) The following variables further restrict the limits shown in this table when they are referenced in QW-250 for the process under consideration: QW-403.9, QW-403.10, QW-403.32, and QW-407.4. Also, QW-202.2, QW-202.3, and QW-202.4 provide exemptions that supersede the limits of this table.
(2) For combination of welding procedures, see QW-200.4.
(3) Four side-bend tests may be substituted for the required face- and root-bend tests, when thickness T is $^3/_8$ in. (10 mm) and over.
(4) See QW-151.1, QW-151.2, and QW-151.3 for details on multiple specimens when coupon thicknesses are over 1 in. (25 mm).
(5) For the welding processes of QW-403.7 only; otherwise per Note (1) or $2T$, or $2t$, whichever is applicable.

Confusion Welding

Conclusion continued:

We can see that the range supported by the coupon is from 3/16” to 2T. Our T is 0.500 so the range supported is from 3/16” to 1”. Look back to the front of the WPS, it states a range of 1/16” to 1”.

The entire range of thickness on the WPS is not supported by the PQR’s test coupon thickness, since it does not support a thickness below 3/16”.

Confusion Welding

One last thing to consider. What is the P-Number of SA-53 Grade B? What should have been entered in the P-Number boxes? Turn now to **Page 69.**

A03

QW/QB-422 FERROUS P-NUMBERS AND S-NUMBERS

Grouping of Base Metals for Qualification

GENERAL NOTE: To convert from ksi to MPa, multiply tensile strength in table by 6.9.

Spec. No.	Type or Grade	UNS No.	Minimum Specified Tensile, ksi	Welding				Brazing		Nominal Composition	Product Form
				P-No.	Group No.	S-No.	Group No.	P-No.	S-No.		
SA-36	...	K02600	58	1	1	...	...	101	...	C–Mn–Si	Plate, bar, & shapes
SA-53	Type F	...	48	1	1	...	...	101	...	C	Furnace welded pipe
SA-53	Type S, Gr. A	K02504	48	1	1	...	...	101	...	C	Smls. pipe
SA-53	Type E, Gr. A	K02504	48	1	1	...	...	101	...	C	Resistance welded pipe
SA-53	Type E, Gr. B	K03005	60	1	1	...	...	101	...	C–Mn	Resistance welded pipe
SA-53	Type S, Gr. B	K03005	60	1	1	...	...	101	...	C–Mn	Smls. pipe

Confusion Welding

Turn your attention to box QW-404 Filler Metals.

1.Has the F-Number been addressed and correctly?
2. Has the A -Number been entered?
3. AWS Classification, is it present?

Note: Since Supplementary Essentials will not be on the exam, the AWS Class in this case is a Non-Essential Variable. By Section IX, it is not required on the PQR! Strange but true, it could be omitted and only the F-Number listed. Real world it would be there.

BASE METALS (QW403)

Material Spec. **SA-53**

Type or Grade: **Gr.B**

P No. to P No.:

Thickness of Test Coupon: **0.500"** Dia.: **10"**

Other:

FILLER METALS (QW-404)

F No 1:	**4**	2:		
A No 1:	**1**	2:		
SFA Spec Number	1:	**5.1**	2:	
AWS Class. No	1:	**E-7018**	2:	
Size of Electrode	1:	"	2:	"

POSITION (QW-405)

Welding Position 1: 2:

Welding Progress: 1: 2:

PREHEAT (QW-406)

Preheat Temp. : **175 ° F**

Interpass Temp.: °F

Other

POSTWELD HEAT TREATMENT (QW-407)

Type:

Temp:

Time:

GAS (QW-408)

Shielding 1:

2:

Shield Flow (cfh) 1: 2:

Purge Gas :

Purge Flow :

Trailing Gas :

Trailing Flow

ELECTRICAL CHARACTERISTICS (QW-409)

Current	1:		2:	
Max Amps	1:		2:	
Max Volts	1:		2:	
Joules	1:		2:	
Tungsten Size			:	
Tungsten Type				
Pulsing Current				

TECHNIQUE (QW-410)

Bead Type	1:		2:	
Bead Width	1:		2:	
Cup Size	:			
Back Gouging	:			
Layers	1:		2:	
Electrodes	1:		2:	
Travel Speed	1:		2:	
Oscillation	:			

Confusion Welding

Conclusions:

1. The F-No. for E-7018 is correct and is present.
2. The A-No. is present.
3. AWS Class is shown as E-7018.

No Mistakes!

Confusion Welding

Skipping the Non-Essentials of QW-405 Positions and turning to QW-406 Preheat we ask the following:

1. Preheat Temp, is it there and if so does it support the WPS values?
2. Interpass Temp do we need it?

BASE METALS (QW403)

Material Spec. **SA-53**

Type or Grade: **Gr.B**

P No. to P No.:

Thickness of Test Coupon: **0.500"** Dia.: **10"**

Other:

FILLER METALS (QW-404)

F No 1:	**4**	2:		
A No 1:	**1**	2:		
SFA Spec Number	1:	**5.1**	2:	
AWS Class. No	1:	**E-7018**	2:	
Size of Electrode	1:	"	2:	"

POSITION (QW-405)

Welding Position 1: 2:

Welding Progress: 1: 2:

PREHEAT (QW-406)

Preheat Temp. : **175 ° F**

Interpass Temp.: ° F

Other

POSTWELD HEAT TREATMENT (QW-407)

Type:

Temp:

Time:

GAS (QW-408)

Shielding 1:

2:

Shield Flow (cfh) 1: 2:

Purge Gas :

Purge Flow :

Trailing Gas :

Trailing Flow

ELECTRICAL CHARACTERISTICS (QW-409)

Current	1:		2:	
Max Amps	1:		2:	
Max Volts	1:		2:	
Joules	1:		2:	
Tungsten Size			:	
Tungsten Type				
Pulsing Current				

TECHNIQUE (QW-410)

Bead Type	1:		2:	
Bead Width	1:		2:	
Cup Size	:			
Back Gouging	:			
Layers	1:		2:	
Electrodes	1:		2:	
Travel Speed	1:		2:	
Oscillation	:			

Confusion Welding

Conclusions:

1. Preheat Temp is there but does not support the WPS, the PQR must be within 100 ºF of the WPS' listed preheat for production which is only 60 ºF.

The PQR was qualified with a preheat of 175 ºF !

To fix this you could revise the WPS to a minimum preheat of **75 ºF** (175 – 100 = 75 ºF).

Take a look at the paragraph QW-406.1 on **Page 62 of Section IX**.

Confusion Welding

QW-406 Preheat

QW-406.1 A decrease of more than 100°F (56°C) in the preheat temperature qualified. The minimum temperature for welding shall be specified in the WPS.

Confusion Welding

Conclusions cont’d:

2. Interpass Temp is not there, but we do not need it since it is a Supplementary Essential.

One Mistake Preheat does not support the WPS.

Confusion Welding

Now the Postweld Heat Treatment.

1. Is it present and does it agree with the WPS' Type, Temp and Time?

BASE METALS (QW403)

Material Spec. **SA-53**

Type or Grade: **Gr.B**

P No. to P No.:

Thickness of Test Coupon: **0.500"** Dia.: **10"**

Other:

FILLER METALS (QW-404)

F No 1:	**4**	2:		
A No 1:	**1**	2:		
SFA Spec Number	1:	**5.1**	2:	
AWS Class. No	1:	**E-7018**	2:	
Size of Electrode	1:	"	2:	"

POSITION (QW-405)

Welding Position 1: 2:

Welding Progress: 1: 2:

PREHEAT (QW-406)

Preheat Temp. : **175 ° F**

Interpass Temp.: ° F

Other

POSTWELD HEAT TREATMENT (QW-407)

Type:

Temp:

Time:

GAS (QW-408)

Shielding 1:

2:

Shield Flow (cfh) 1: 2:

Purge Gas :

Purge Flow :

Trailing Gas :

Trailing Flow

ELECTRICAL CHARACTERISTICS (QW-409)

Current	1:		2:	
Max Amps	1:		2:	
Max Volts	1:		2:	
Joules	1:		2:	
Tungsten Size			:	
Tungsten Type				
Pulsing Current				

TECHNIQUE (QW-410)

Bead Type	1:		2:	
Bead Width	1:		2:	
Cup Size	:			
Back Gouging	:			
Layers	1:		2:	
Electrodes	1:		2:	
Travel Speed	1:		2:	
Oscillation	:			

Confusion Welding

Conclusions:

1. Well since the block is empty, there is only one conclusion. The Essential Variable PWHT has not been addressed. The block being empty does not mean it was not done, it may or may not have been postweld heat treated. How can anyone know for sure.

One mistake, PWHT not addressed.

Confusion Welding

All the remaining blocks contain Non-Essential Variables and are blank.

They are not needed on a PQR so we will just pass those blocks and turn to the **back of the PQR.**

Confusion Welding

Next the Tensile Tests listed in the block QW-150.

1. Are the correct number of tension tests present?
2. Is the math correct?
3. Did the specimens fail at or above the Minimum stated in the rules of QW-153.1 for SA-53 Grade B?

PQR No. _____

********** TENSILE TEST (QW-150)**********

Specimen No.	Width	Thickness	Area (in^2)	Ultimate Total Load (Lbs)	Ultimate Unit Stress (PSI)	Type of Failure & Location
1	**.750**	**.453**	**.340**	**25,010**	**73,559**	**Base Met. Ductile**
2	**.753**	**.456**	**.343**	**24,050**	**70,116**	**Base Met. Ductile**

********** GUIDED BEND TESTS (QW-160)**********

BEND – Type and Figure	Results
Side	**1/6" Opening on Face, no Rejectable defects**
	No Open Defects
Face	**1/6" Opening on Face, no Rejectable defects**
Face	**No Open Defects**

********** TOUGHNESS TESTS (QW-170)**********

Specimen No.	Notch Location	Specimen Size	Test Temp	Impact Values			Drop Weight Break (Y/N)
				Ft. lbs.	Shear	Mils	

Comments: _____

Confusion Welding

Conclusions:

1. The correct number of tension tests are present, two.

2. The math is correct (using normal rounding).

3. The specimens did meet the Minimum stated by the rules of QW-153.1 for the SA-53 Grade B pipe.

Now confirm the above statements.

You can see on right that we need two tension tests.

A03

QW-451.1
GROOVE-WELD TENSION TESTS AND TRANSVERSE-BEND TESTS

Thickness T of Test Coupon Welded, in. (mm)	Range of Thickness T of Base Metal Qualified, in. (mm) [Notes (1) and (2)]		Thickness t of Deposited Weld Metal Qualified, in. (mm) [Notes (1) and (2)]	Type and Number of Tests Required (Tension and Guided-Bend Tests) [Note (2)]			
	Min.	Max.	Max.	Tension, QW-150	Side Bend, QW-160	Face Bend, QW-160	Root Bend, QW-160
Less than $1/16$ (1.6)	T	$2T$	$2t$	2	...	2	2
$1/16$ to $3/8$ (1.6 to 10), incl.	$1/16$ (1.6)	$2T$	$2t$	2	Note (3)	2	2
Over $3/8$ (10), but less than $3/4$ (19)	$3/16$ (4.8)	$2T$	$2t$	2	Note (3)	2	2
$3/4$ (19) to less than $1\,1/2$ (38)	$3/16$ (4.8)	$2T$	$2t$ when $t < 3/4$ (19)	2 [Note (4)]	4	...	...
$3/4$ (19) to less than $1\,1/2$ (38)	$3/16$ (4.8)	$2T$	$2T$ when $t \geq 3/4$ (19)	2 [Note (4)]	4	...	...
$1\,1/2$ (38) and over	$3/16$ (4.8)	8 (203) [Note (5)]	$2t$ when $t < 3/4$ (19)	2 [Note (4)]	4	...	...
$1\,1/2$ (38) and over	$3/16$ (4.8)	8 (203) [Note (5)]	8 (203) [Note (5)] when $t \geq 3/4$ (19)	2 [Note (4)]	4	...	...

NOTES:
(1) The following variables further restrict the limits shown in this table when they are referenced in QW-250 for the process under consideration: QW-403.9, QW-403.10, QW-403.32, and QW-407.4. Also, QW-202.2, QW-202.3, and QW-202.4 provide exemptions that supersede the limits of this table.
(2) For combination of welding procedures, see QW-200.4.
(3) Four side-bend tests may be substituted for the required face- and root-bend tests, when thickness T is $3/8$ in. (10 mm) and over.
(4) See QW-151.1, QW-151.2, and QW-151.3 for details on multiple specimens when coupon thicknesses are over 1 in. (25 mm).
(5) For the welding processes of QW-403.7 only; otherwise per Note (1) or $2T$, or $2t$, whichever is applicable.

Turn to **Page 5** of Section IX

QW-152 Tension Test Procedure

The tension test specimen shall be ruptured under tensile load. The tensile strength shall be computed by dividing the ultimate total load by the least cross-sectional area of the specimen as calculated from actual measurements made before the load is applied.

Confusion Welding

By QW-152 area into load = Tensile Strength

Specimen No. 1

.750” x .453: = .340 sq.”
25010 lbs/.340 sq.” = 73,559 PSI

Specimen No. 2

.753” x .456” = .343 sq.”
24,050 lbs/.343 sq.” = 70,116 PSI

Turn to page 69 of Section IX. The Minimum Specified Tensile Strength is 60,000 PSI.

A03

QW/QB-422 FERROUS P-NUMBERS AND S-NUMBERS
Grouping of Base Metals for Qualification

GENERAL NOTE: To convert from ksi to MPa, multiply tensile strength in table by 6.9.

Spec. No.	Type or Grade	UNS No.	Minimum Specified Tensile, ksi	Welding				Brazing		Nominal Composition	Product Form
				P-No.	Group No.	S-No.	Group No.	P-No.	S-No.		
SA-36	...	K02600	58	1	1	...	...	101	...	C–Mn–Si	Plate, bar, & shapes
SA-53	Type F	...	48	1	1	...	...	101	...	C	Furnace welded pipe
SA-53	Type S, Gr. A	K02504	48	1	1	...	...	101	...	C	Smls. pipe
SA-53	Type E, Gr. A	K02504	48	1	1	...	...	101	...	C	Resistance welded pipe
SA-53	Type E, Gr. B	K03005	60	1	1	...	...	101	...	C–Mn	Resistance welded pipe
SA-53	Type S, Gr. B	K03005	60	1	1	...	...	101	...	C–Mn	Smls. pipe

Confusion Welding

Conclusions Continued:

3. The specimens did meet the Minimum stated in the rules of QW-151.3 for SA-53 Grade B. It has a minimum specified tensile strength of 60,000 PSI. According to the requirements of Section IX the specimens could have failed 5% below that and still been acceptable. They failed in the base metal which is also a requirement of QW-153.1

Confusion Welding

Now the Bend Specimens

1. Are the correct number present?
2. Are they the correct types?
3. Where the results reported and acceptable?

PQR No. _____

********** TENSILE TEST (QW-150)**********

Specimen No.	Width	Thickness	Area (in^2)	Ultimate Total Load (Lbs)	Ultimate Unit Stress (PSI)	Type of Failure & Location
1	**.750**	**.453**	**.340**	**25,010**	**73,559**	**Base Met. Ductile**
2	**.753**	**.456**	**.343**	**24,050**	**70,116**	**Base Met. Ductile**

********** GUIDED BEND TESTS (QW-160)**********

BEND – Type and Figure	Results
Side	**1/6" Opening on Face, no Rejectable defects**
	No Open Defects
Face	**1/6" Opening on Face, no Rejectable defects**
Face	**No Open Defects**

********** TOUGHNESS TESTS (QW-170)**********

Specimen No.	Notch Location	Specimen Size	Test Temp	Impact Values			Drop Weight Break (Y/N)
				Ft. lbs.	Shear	Mils	

Comments: _____

Confusion Welding

Conclusions:

1. The correct number is 4 and only three are fully present.

2. They are not the correct types, it should be all face and root bends (4 total), or since the coupon is at least 3/8” (.500) 4 side bends are permitted.

3. The results were reported and are not acceptable.

There are three mistakes, incorrect number and types of bend specimens, max size of defect

Confusion Welding

Last, the bottom of the PQR.

1. Has the PQR been signed?

Conclusion: No.

This is a mistake a PQR is not certified without a signature.

********** FILLET WELD TEST (QW-180)**********

Result – Satisfactory: Yes _____ No _____ Penetration into parent metal: Yes _____ No _____

Macro - Results	

OTHER TESTS

Type of Test: _____

Deposit Analysis: _____

Other: _____

Welder's Name: **Billy Bob Jones** Clock No _____ Stamp No. **23**

Test conducted by: **In House** Laboratory Test Number: _____

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 ASME Section IX.

Manufacturer: **Confusion Welding**

Date: **6/18/92** By: _____

Wee Welders

Now we will do the second WPS/PQR review. We will go through this box by box and find the mistakes and do a recap at the end of this lesson.

QW-482 SUGGESTED FORMAT FOR WELDING PROCEDURE SPECIFICATIONS (WPS)
(See QW-200.1, Section IX, ASME Boiler and Pressure Vessel Code)

Company Name **Wee Welders** By: **B. Gone**
Welding Procedure Specification No. **R-20** Date **1-25-92** Supporting PQR No (s) **R-20**
Revision No. _____ Date _____
Welding Process(es) **SMAW** Types **Manual**
(Automatic, Manual, Machine, or semi-Auto)

JOINTS (QW-402) Details

Joint Design **J-Groove, Single Vee, Double Vee**
Backing (Yes) **Yes** (No) _____
Backing Material (Type) **Weld Metal**
(Refer to both backing and retainers.)

☐ Metal ☐ Nonfusing Metal
☐ Nonmetallic ☐ Other

Sketches. Production Drawings, Weld Symbols or Written Description should show the general arrangement of the parts to be welded. Where applicable, the root spacing and the details of the weld groove may be specified.

(At the option of the Mfgr. sketches may be attached to illustrate joint design, weld layers and bead sequence, e.g. for notch toughness procedures, for multiple process procedures, etc.)

***BASE METALS (QW-403)**

P-No. 3 Group No. _____ To P-No. 3 Group No. _____

OR

Specification type and grade _____

to Specification type and grade _____

OR

Chem. Analysis and Mech. Prop. _____

to Chem. Analysis and Mech. Prop.

Thickness Range:

Base Metal: Groove **1/16" to 3/4"** Fillet _____

Pipe Dia. Range: Groove Fillet

Other _____

***FILLER METALS (QW-404)**			
Spec. No. (SFA)	**5.1**		
AWS No. (Class)	**E-8018**		
F-No.	**4**		
A-No.	**1**		
Size of Filler Metals	**3/32, 1/8, 5/32"**		
Weld Metal Thickness Range:	**1/16" to 3/4"**		
Groove			
Fillet			
Electrode-Flux (Class)			
Flux Trade Name			
Consumable Insert			
Other			

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

QW-482 (Back)

WPS No. _____ Rev. _____

POSITIONS (QW-405)

Position(s) of Groove: ALL

Welding Progression: Up Vertical Down _____

Position(s) of Fillet _____

POSTWELD HEAT TREATMENT (QW-407)

Temperature Range: 1150 +/- 50 ° F

Time Range: 1 Hr./in of Thickness 1/2 Hour min.

PREHEAT (QW-406)

Preheat Temp. Min. 32 ° F

Interpass Temp. Max. 450 ° F

Preheat Maintenance

(Continuous or special heating where applicable should be recorded)

GAS (QW-408)

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

ELECTRICAL CHARACTERISTICS (QW-409)

Current AC or DC: DC Polarity: Reverse

Amps (Range): 90 - 180 Volts: 19 - 25

(Amps and volts range should be recorded for each electrode size, position, and thickness, etc. This information may be listed in a tabular form similar to that shown.

Tungsten Electrode Size and Type: N/A

(Pure Tungsten, 2% Thoriated, etc.)

Mode of Metal Transfer for GMAW: N/A

(Spray arc, short circuiting arc, etc.)

Electrode Wire feed speed range: N/A

TECHNIQUE (QW-410)

String or Weave Bead: **String**

Orifice or Gas Cup Size:

Initial and Interpass Cleaning (Brushing, Grinding, etc.): **Grinding, Chipping, or Wire Brushing**

Method of Back Gouging: **Grinding**

Oscillation:

Contact Tube to Work Distance:

Multiple or Single Pass (per side):

Multiple or Single Electrodes:

Travel Speed (Range):

Peening: **No Peening Allowed**

Other: **No t pass > 1/2"**

Weld Layer(s)	Process	Filler Metal		Current		Volt Range	Travel Speed Range	Other (e.g., Remarks, Comments, Hot wire Addition, Technique, Torch Angle, Etc.
		Class	Dia.	Type Polarity	Amp Range			

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

(See QW-200.2, Section IX, ASME Boiler & Pressure Vessel Code)

Record Actual Conditions Used to Weld Test Coupon.

Company Name: **Wee Welders**

Procedure Qualification Record No.: **R-20** Date: **1/30/92**

WPS No.: **R-20**

Welding Process (es) 1. **SMAW** 2.

Types (Manual, Automatic, Semi-Auto.) 1. 2.

JOINTS (QW-402)

Groove Design of Test Coupon

(For combination qualifications, the deposited weld metal thickness shall be recorded for each filler metal or process used.)

BASE METALS (QW403)

Material Spec. **SA-369**

Type or Grade: **FP 1**

P No. **3** to P No.: **3**

Thickness of Test Coupon: **0.365"** Dia.: **10"**

Other:

FILLER METALS (QW-404)

F No	1:	**4**	2:	
A No	1:	**1**	2:	
SFA Spec Number	1:	**5.1**	2:	
AWS Class. No	1:	**E-8018**	2:	
Size of Electrode	1:	"	2:	"
Size of Filler	1:		2:	
Flux Class.	:			
Deposit Thk.	1:	"	2:	"
Trade Name				
Consum. Insert	:			

POSITION (QW-405)

Welding Position	1:		2:	
Welding Progress:	1:		2:	

PREHEAT (QW-406)

Preheat Temp. : **70° F**

Interpass Temp.: **° F**

Other

POSTWELD HEAT TREATMENT (QW-407)

Type:

Temp: **1150°F**

Time: **30 mins.**

GAS (QW-408)

Shielding	1:			
	2:			
Shield Flow (cfh)	1:		2:	
Purge Gas	:			
Purge Flow	:			
Trailing Gas	:			
Trailing Flow				

ELECTRICAL CHARACTERISTICS (QW-409)

Current	1:		2:	
Max Amps	1:		2:	
Max Volts	1:		2:	
Joules	1:		2:	
Tungsten Size			:	
Tungsten Type				
Pulsing Current				

TECHNIQUE (QW-410)

Bead Type	1:		2:	
Bead Width	1:		2:	
Cup Size	:			
Back Gouging	:			
Layers	1:		2:	
Electrodes	1:		2:	
Travel Speed	1:		2:	
Oscillation	:			

PQR No. _____

********** TENSILE TEST (QW-150)**********

Specimen No.	Width	Thickness	Area (in^2)	Ultimate Total Load (Lbs)	Ultimate Unit Stress (PSI)	Type of Failure & Location
1	**.752"**	**.360"**	**.270"**	**14,025**	**51,944**	**B.M Ductile**
2	**.749"**	**.362"**	**.271"**	**14,950**	**55,166**	**B.M. Ductile**

********** GUIDED BEND TESTS (QW-160)**********

BEND – Type and Figure	Results
Side per QW-462.2	**No-Defects-Acceptable**
Side per QW-462.2	**No-Defects-Acceptable**
Side per QW-462.2	**No-Defects-Acceptable**
Side per QW-462.2	**1/32" Linear-Acceptable**

********** TOUGHNESS TESTS (QW-170)**********

Specimen No.	Notch Location	Specimen Size	Test Temp	Impact Values			Drop Weight Break (Y/N)
				Ft. lbs.	Shear	Mils	

Comments: _____

********** FILLET WELD TEST (QW-180)**********

Result – Satisfactory: Yes _____ No _____ Penetration into parent metal: Yes _____ No _____

Macro - Results	

OTHER TESTS

Type of Test: _____

Deposit Analysis: _____

Other: _____

Welder's Name: **Wee Wille** Clock No **2526** Stamp No. **28A**

Test conducted by: _____ Laboratory Test Number: **OU-812**

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 ASME Section IX.

Manufacturer: **Wee Welding**

Date: **1-30-92** By: Jim Wee

Mistakes on the WPS:

Joints (QW-402)

1. Root gap not addressed
2. Retainers not addressed

Technique (QW-410)

3. Multi or single pass not addressed.

Mistakes on the PQR:

Filler Metals (QW-404)

4. E-8018 is not F-No. 3.

5. Weld metal thickness not addressed.

Mistakes on the PQR Cont'd:

Tensile Tests (QW-150)

6. First tensile specimen was not within the tolerance. The specimen failed at less than 95 % of the specified ultimate tensile strength for the material.

Guided Bend Tests (QW-160)

7. The test coupon is 0.365" and it must be 0.375 or greater to use side bends. The coupons should have been subjected to two face and two root bends.