

QUALIFICATION OF PROCEDURES & WELDERS

The American Welding Society (AWS) *Structural Welding Code – Steel*, D1.1-2010, is the code for fabricating and erecting welded steel structures. The code was specifically developed for welded steel structures that utilize carbon or low alloy steels that are 1/8 in or thicker.

Per AWS D1.1 Clauses 3 and 4, qualification with respect to the performance of welding is required for the following:

1. The welding procedure itself (WPS), either prequalified or qualified by test
2. The welder performing the work (WPQ)

The welding contractor is responsible for the development and documentation of all welding procedures and for the qualification of their welding personnel.



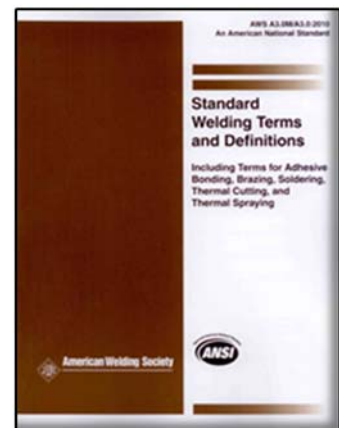
DEFINITIONS - AWS A3.0; Standard Welding Terms & Definitions

Prequalified Welding Procedure Specification (PWPS) – a welding procedure specification in compliance with the stipulated conditions of a particular welding code or specification and therefore acceptable for use under that code or specification without a requirement for qualification testing.

Welder Performance Qualification (WPQ) (or Welder Certification) – written verification that a welder has produced welds meeting the prescribed standards of welder performance.

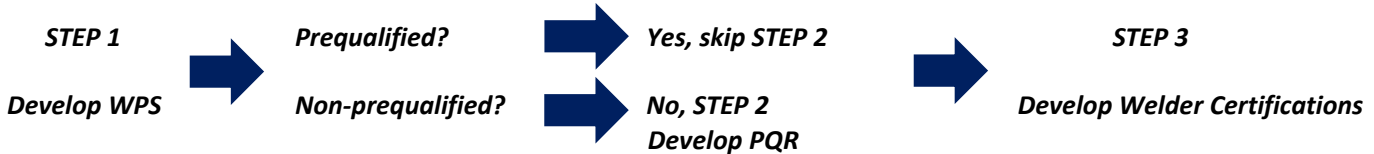
Welding Procedure Qualification Record (WPQR) - a record of welding variables used to produce an acceptable test weldment and the results of tests conducted on the weldment to qualify a welding procedure specification.

Welding Procedure Specification (WPS) - a document providing the required welding variables for a specific application to assure repeatability by properly trained welders.





QUALIFICATION OF PROCEDURES & WELDERS STEPS



STEP 1 – DEVELOP WPS:

Develop the welding procedure:

1. The weld procedure must precede the welder qualification
2. The weld procedure must precede production or field welding
3. A welding procedure is performed to show the compatibility of the following:
 - a. Base metal(s)
 - b. Weld filler metal(s)
 - c. Weld processes
 - d. Welding technique(s)

There are three general approaches to procedure qualification:

1. Prequalified procedures
2. Actual procedure qualification testing
3. Mock-up tests for special applications (*not addressed in this document*)

There are numerous procedures which are *prequalified* – a Prequalified Welding Procedure Specification (PWPS). This means that a qualification test for the weld procedure is not required. AWS D1.1 prequalified procedures cover joints, processes, and positions.

If a weld procedure is prequalified, you do **NOT** need a qualification test for the procedure. However, a written WPS is still required to be on file.

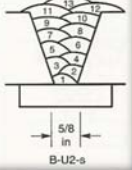
Each process and weld joint configuration for a project requires a welding procedure specification (WPS). A test WPS is not sufficient. **A WPS is basically the recipe that the welder follows to ensure that he will produce a sound weld.**

In order to be valid, the WPS must be approved and dated by the organization who authorized the WPS.

Welding Procedure Specification (WPS)

A welding procedure specification should include the following:

- ✓ Company Name
- ✓ Welding Process
- ✓ Supporting PQR's
- ✓ Identification No.
- ✓ Revision No.
- ✓ Date
- ✓ Authorizing Individual
- ✓ Joint Design
- ✓ Base Metals
- ✓ Filler Metals
- ✓ Shielding
- ✓ Preheat
- ✓ Position
- ✓ Electrical Characteristics
- ✓ Technique
- ✓ Post-weld Heat Treatment
- ✓ Welding Procedure Information

WELDING PROCEDURE SPECIFICATION (WPS) Yes <input checked="" type="checkbox"/>								
PREQUALIFIED <input checked="" type="checkbox"/>				QUALIFIED BY TESTING <input type="checkbox"/>				
or PROCEDURE QUALIFICATION RECORDS (PQR) Yes <input type="checkbox"/>								
Company Name		LECO		Identification #		W2081		
Welding Process(es)		SAW		Revision		2		
Supporting PQR No.(s)		Prequalified		Date		1-3-89		
Authorized by		C. W. Hayes		By		R. Jones		
Type—Manual <input type="checkbox"/>		Machine <input checked="" type="checkbox"/>		Date		1-3-89		
Semi-automatic <input type="checkbox"/>		Automatic <input type="checkbox"/>						
JOINT DESIGN USED				POSITION				
Type: Butt				Position of Groove: F Fillet: --				
Single <input checked="" type="checkbox"/> Double Weld <input type="checkbox"/>				Vertical Progression: Up <input type="checkbox"/> Down <input type="checkbox"/>				
Backing: Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>				ELECTRICAL CHARACTERISTICS				
Backing Material: ASTM A 36				Transfer Mode (GMAW) Short-Circuiting <input type="checkbox"/>				
Root Opening 5/8" Root Face Dimension --				Globular <input type="checkbox"/> Spray <input type="checkbox"/>				
Groove Angle: 20° Radius (J-U) --				Current: AC <input type="checkbox"/> DCEP <input checked="" type="checkbox"/> DCEN <input type="checkbox"/> Pulsed <input type="checkbox"/>				
Back Gouging: Yes <input type="checkbox"/> No <input checked="" type="checkbox"/> Method --				Power Source: CC <input type="checkbox"/> CV <input type="checkbox"/>				
BASE METALS				Other --				
Material Spec: ASTM A 36				Tungsten Electrode (GTAW)				
Type or Grade --				Size: --				
Thickness: Groove 1" Fillet --				Type: --				
Diameter (Pipe) --				TECHNIQUE				
FILLER METALS				Stringer or Weave Bead: Stringer				
AWS Specification A5.17				Multi-pass or Single Pass (per side) Multipass				
AWS Classification EM12K				Number of Electrodes 1				
SHIELDING				Electrode Spacing				
Flux 860 Gas --				Longitudinal --				
Composition --				Lateral --				
Electrode-Flux (Class) F7A2-EM12K Flow Rate --				Angle --				
Gas Cup Size --				Contact Tube to Work Distance 1-1/4"				
PREHEAT				Peening None				
Preheat Temp., Min. 150°F				Interpass Cleaning: slag Removed				
Interpass Temp., Min. 150°F Max. 350°F				POSTWELD HEAT TREATMENT				
				Temp. N.A.				
				Time --				
WELDING PROCEDURE								
Pass or Weld Layer(s)	Process	Filler Metals		Current		Volts	Travel Speed	Joint Details
		Class	Diam.	Type & Polarity	Amps or Wire Feed Speed			
1-n	SAW	EM12K	5/32"	DC+	45 ipm 550 Amps ±10%	28 V ±7%	16 ipm ±15%	

Per AWS D1.1 Clause 3, all prequalified WPS documents shall be written. A WPS can be written by a CWI or a qualified individual. Each welding process and weld joint configuration specified on the project drawings requires a welding procedure specification (WPS). For example, fillet welds, PJP welds, and CJP welds may be specified. Groove welds may be single bevel or double bevel.





STEP 2 – DEVELOP WPQR:

If your weld procedure is *NOT* prequalified per AWS D1.1 Clause 3, you need a qualification test for the procedure per AWS D1.1 Clause 4.

A welding procedure specification should include the following results and information:

- ✓ Tensile Test
- ✓ Guided Bend
- ✓ Visual Inspection
- ✓ Radiographic-Ultrasonic
- ✓ Fillet Weld Test
- ✓ Welder’s Name
- ✓ Testing Authority Name & Signature
- ✓ Manufacturer or Contractor’s Representative
Title, Date, Signature

Examples of welding that is not prequalified:

- ✓ Vertical downward progression
- ✓ Open root CJP without backing and back gouge

Procedure Qualification Record (PQR) # <u>231</u>						
Test Results						
TENSILE TEST						
Specimen No.	Width	Thickness	Area	Ultimate Tensile Load, lb	Ultimate Unit Stress, psi	Character of Failure and Location
231-1	0.75"	1.00"	0.75"	52 500	70 000	Ductile
231-3	0.75"	1.00"	0.75"	52 275	69 700	Ductile
GUIDED BEND TEST						
Specimen No.	Type of Bend	Result	Remarks			
231-2	Side	Pass				
231-4	Side	Pass	Small (<1/16") opening acceptable			
231-6	Side	Pass				
231-5	Side	Pass				
VISUAL INSPECTION Appearance <u>acceptable</u> Undercut <u>acceptable</u> Piping porosity <u>none</u> Convexity <u>none</u> Test date <u>12-3-2002</u> Witnessed by <u>D. Davis</u>				Radiographic-ultrasonic examination RT report no.: <u>D231</u> Result <u>passed</u> UT report no.: _____ Result _____		
Other Tests _____				FILLET WELD TEST RESULTS Minimum size multiple pass _____ Maximum size single pass _____ Macroetch _____ Macroetch _____ 1. _____ 3. _____ 1. _____ 3. _____ 2. _____ 2. _____		
All-weld-metal tension test Tensile strength, psi <u>83,100</u> Yield point/strength, psi <u>72,600</u> Elongation in 2 in, % <u>28</u> Laboratory test no. <u>PW 231</u>				Welder's name <u>W. T. Williams</u> Clock no. <u>261</u> Stamp no. _____ Tests conducted by <u>RED Inc. & ABC Testing</u> Laboratory _____ Test number <u>PQR 231</u> Per <u>D. Miller</u>		
We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (<u>2002</u>) <i>Structural Welding Code—Steel</i> . (year)						
Signed <u>RED Inc.</u> Manufacturer or Contractor By <u>R. M. Boncrack</u> Title <u>Q.C. Mgr.</u> Date <u>12-15-2002</u>						



STEP 3 – DEVELOP WELDER CERTIFICATIONS (QUALIFICATION TEST RECORD):

A welder certification or qualification test record is written verification that a welder has produced welds meeting a prescribed standard of welder performance.

A welder certification should include the following:

- ✓ Company Name
- ✓ Welding Procedure No.
- ✓ Identification No.
- ✓ Revision No.
- ✓ Date
- ✓ Authorizing Individual & Date
- ✓ Variables
- ✓ Visual Inspection Results
- ✓ Fillet or Bend Test Results
- ✓ Radiographic Test Results (in lieu of mechanical testing)
- ✓ Testing Authority Name & Signature

WELDER, WELDING OPERATOR, OR TACK WELDER QUALIFICATION TEST RECORD			
Type of Welder _____	Name _____	Identification No. _____	
Welding Procedure Specification No. _____	Rev _____	Date _____	
Variables	Record Actual Values Used in Qualification	Qualification Range	1
Process/Type [Table 4.12, Item (1)] _____			
Electrode (single or multiple) [Table 4.12, Item (7)] _____			3
Current/Polarity _____			
Position [Table 4.12, Item (4)] _____			
Weld Progression [Table 4.12, Item (5)] _____			
Backing (YES or NO) [Table 4.12, Item (6)] _____			4
Material/Spec. _____	to _____		
Base Metal			
Thickness: (Plate) _____			
Groove _____			
Fillet _____			
Thickness: (Pipe/tube) _____			
Groove _____			
Fillet _____			2
Diameter: (Pipe) _____			
Groove _____			
Fillet _____			
Filler Metal (Table 4.12) _____			
Spec. No. _____			
Class _____			
F-No. [Table 4.12, Item (2)] _____			
Gas/Flux Type (Table 4.12) _____			
Other _____			
VISUAL INSPECTION (4.8.1)			
Acceptable YES or NO _____			
Guided Bend Test Results (4.30.5)			
Type	Result	Type	Result
_____	_____	_____	_____
Fillet Test Results (4.30.2.3 and 4.30.4.1)			
Appearance _____	Fillet Size _____		
Fracture Test Root Penetration _____	Macroetch _____		
(Describe the location, nature, and size of any crack or tearing of the specimen.)			
Inspected by _____	Test Number _____		
Organization _____	Date _____		
RADIOGRAPHIC TEST RESULTS (4.30.3.2)			
Film Identification Number	Results	Remarks	Film Identification Number
_____	_____	_____	_____
			5
Interpreted by _____	Test Number _____		
Organization _____	Date _____		
We, the undersigned, certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in conformance with the requirements of Clause 4 of AWS D1.1/D1.1M, (_____) Structural Welding Code—Steel. (year)			
Manufacturer or Contractor _____	Authorized By _____		
Form N-4	Date _____		

Areas of Interest for Telecom:

Test records should be for either SMAW (stick) or FCAW (wire) depending on the process **(1)** being used. Filler metal tensile strength should match the drawing requirements – stick E7018 or E8018; wire E71 or E81 **(2)**. **NOTE:** GTAW (gas tungsten arc welding or TIG) and GMAW (gas metal arc welding or MIG) are not typically appropriate for field welding in the telecom industry.

For welding in the telecom industry, the test positions **(3)** should be 3G for vertical welds (stiffener welds) with uphill progression and/or 4G for overhead groove welds (pole flanges, etc).

The material thickness qualification range should cover the range of materials being welded (example 1 ¼” thick stiffeners). **(4)**

Period of Effectiveness (AWS D1.1; 4.1.3) – The welder’s qualification shall be considered as remaining in effect indefinitely unless the welder is not engaged in a given process of welding for longer than 6 months Documentation of welder continuity should be maintained or recertification may be required. **(5)**

In order to become valid, the WPS must be approved and dated by the organization who authorized the WPS. **(6)**

WHAT CAN BE CHANGED BEFORE A RE-TEST OF THE WELDER IS REQUIRED?

Essential variables are those features which, if changed beyond certain limits, require that a welder be recertified. Per AWS D1.1, Table 4.12, some of the following essential variable changes require requalification:

- ✓ To a welding process (SMAW, FCAW, etc.) not qualified
- ✓ To an SMAW electrode with an F-number higher than the WPQR electrode F-number
- ✓ To a position not qualified (i.e. overhead)
- ✓ To a diameter or thickness not qualified
- ✓ To a vertical welding progression not qualified (i.e. uphill or downhill)
- ✓ The omission of backing material in the joint

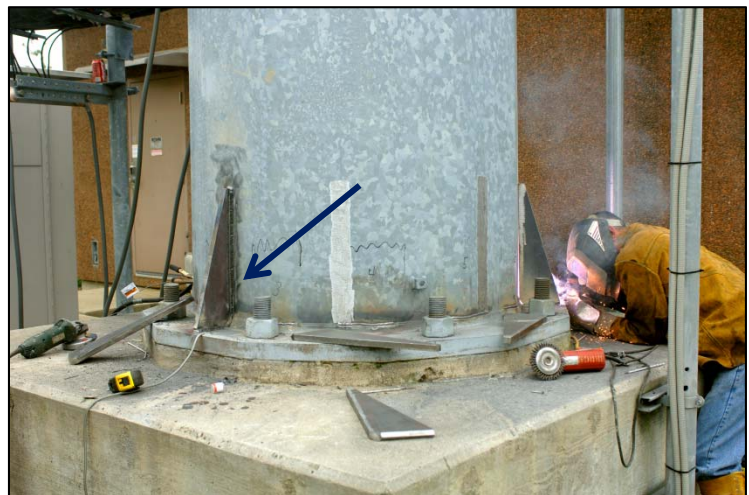
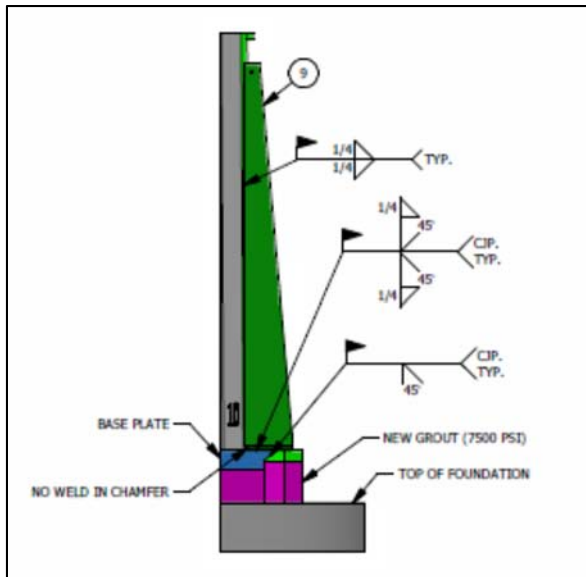
WHAT WELDS ARE TYPICALLY USED IN THE TELECOM INDUSTRY?

For monopole upgrades, we are welding high strength steel (typically A572 Grades 50, 60, 65) with SMAW (stick) or FCAW (wire). Weld filler material is typically E7018 or E8018; wire is typically E71 or E81. Positions are typically horizontal, vertical up, or overhead. Welds include fillets, partial penetration joints (PJP; single bevel groove and double bevel groove) and complete joint penetration (CJP; single bevel groove and double bevel groove).

Base Plate Stiffeners and/or Anchor Rod Brackets:

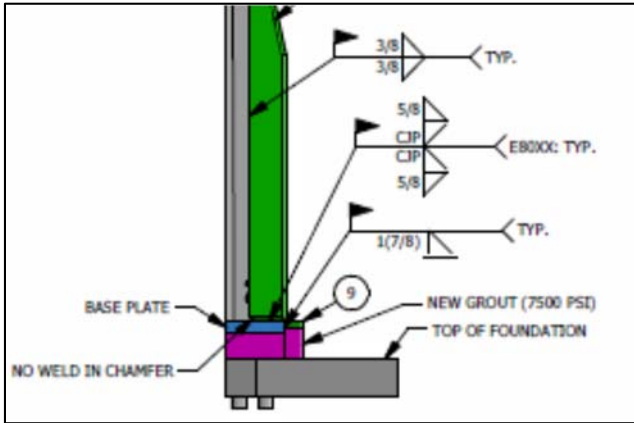
Vertical Fillet Welds

Horizontal Double Bevel Groove PJP Weld with Reinforcing Fillet Weld - *OR* - Horizontal Double Bevel Groove CJP Weld with Reinforcing Fillet Weld



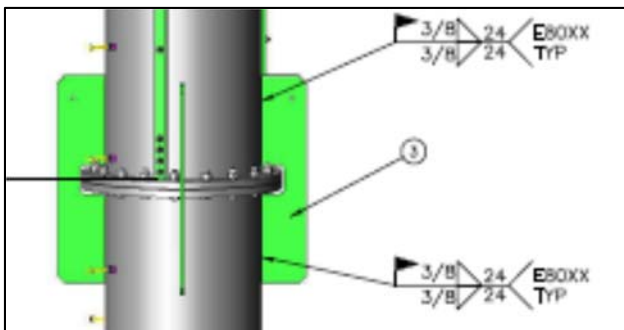
Base Plate Foot Pads:

Flat Single Bevel Groove PJP Weld - OR – Flat Single Bevel Groove CJP Weld



Bridge Stiffeners:

Vertical Fillet Welds & Horizontal Double Bevel Groove PJP Welds with Reinforcing Fillet Welds



Pole Top Flange for Extension:

Vertical Fillet Welds & Horizontal Single Bevel Groove CJP Welds with Reinforcing Fillet Welds

