American Welding Society
Nashville Section

Welding Procedure Development
AWS & ASME
Welding Procedures
Welding Procedure Specification (WPS)

- Written document that provides direction to the welder for making production welds in accordance with Code requirements.
- Rules for qualification of procedures vary by referencing Code:
  - Qualified by testing (ASME, AWS)
  - Pre-qualified (AWS)
  - Standard Welding Procedure Specification (AWS)
AWS Standard Welding Procedure Specification (SWPS)

- Procedures that have been qualified by the Welding Research Council accepted and published by AWS for use as a qualified welding procedure
- ASME and NBIC accepted procedures are listed in the appendix of the applicable Code
Welding Procedure Qualification (PQR)

- A test that is performed to demonstrate that the contractor can make satisfactory welds as specified in the Welding Procedure Specification
- Mechanical testing is required and NDE may be required, depending on the Code being qualified to
- Impact testing may be required by the referencing Code (i.e., ASME Sect VIII)
Welder Performance Qualification Test (WPQT)

- Performance test which determines the welders' ability to make acceptable production welds under a given set of conditions (essential variables)
  - Process
  - Joint type
  - Base metal
  - Filler metal
  - Position
  - Gas
  - Electrical characteristics
Which Comes First

PQR

WPQT

WPS

PQR
Which Comes First

- To frame a house you need to know the size of the foundation.
- To build a foundation you need to know the size and shape of the house.
Which Comes First

- The roof does not have to cover the house but should be fully supported by the framing.
The Welding House

- The WPS and the PQR are developed concurrently
  - Rough draft the WPS to determine how to do the PQR(s)
  - More than one PQR may be required to fully support the WPS (e.g., thickness range)
  - Welder qualification tests should be designed to not exceed the limits of the WPS but do not need to meet all of the limits of the WPS
AWS B2.1

- Specification for Welding Procedure and Performance Qualification
  - Base metals categorized in M number format
    Similar to ASME P numbers
  - Similar to ASME Section IX
ASME B&PV Code

- ASME B&PV Code Section IX contains the guidelines for welding procedure and welder qualification
  - Requires procedure qualification for all welding procedures except when the contractor has adopted one of the AWS Standard Welding Procedure Specifications
Many AWS Codes allow the use of Pre-qualified Welding Procedures

- Pre-qualified procedures are written documents that define welding parameters for the welder and are within defined limits set by the referencing Code (e.g., AWS D1.1)
- Welding procedures that exceed the limits for pre-qualification must be qualified by testing
Develop the WPS

- Process(es)
- Material(s)
- Material thickness
- Joint design
- Filler metal
- Weld deposit thickness

- Positions
- Pre-heat
- Post heat
- Shielding gas
- Electrical characteristics
- Technique
Qualify or Not to Qualify

- Does the Code allow use of a pre-qualified procedure?
- Does the planned WPS stay within the limits of a pre-qualified procedure?
  - Process, joint type, material, filler metal, position, deposit thickness
What is in the WPS

- The WPS should describe all essential, non-essential and when required by the referencing Code supplementary essential variables for each welding process
Essential Variables

- Essential variables are those variables in which a change, as described in the specific variables, is considered to affect the mechanical properties of the weldment.

- If there is a change in the essential variable the procedure must be re-qualified.
Supplementary Essential Variables

- Supplementary essential variables are required for metals for which other Sections or Codes specify notch-toughness testing and are in addition to essential variables for each process
  - This means that when ASME Section VIII (which requires qualification to Section IX) also requires notch toughness testing on a material, the supplementary essential variables become essential variables for that WPS
  - A change in either essential or supplementary essential variables requires re-qualification of the procedure
Nonessential Variables

- Nonessential variables are those in which a change, as described in the specific variables, may be made in the WPS without re-qualification.
Qualifying a procedure

- Determine what the required essential and if applicable supplementary essential variables are for:
  - Process
  - Joints
  - Base metals
  - Filler metals
  - Positions
  - Pre & post weld heat treatment
  - Gas
  - Electrical Characteristics
  - Technique
## SMAW Variables (ASME Sect IX)

### Procedure Qualifications

#### QW-253

**Welding Variables Procedure Specifications (WPS)**
- Shielded Metal-Arc (SMAW)

<table>
<thead>
<tr>
<th>Paragraph</th>
<th>Brief of Variables</th>
<th>Essential</th>
<th>Supplementary Essential</th>
<th>Nonessential</th>
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<td>QW-402 Joints</td>
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<tr>
<td></td>
<td>Backing</td>
<td>X</td>
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<td>Root spacing</td>
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<td>QW-403 Base Metals</td>
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<tr>
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<td>T/Limits Impact</td>
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<td></td>
<td>T/Limits &gt; 8 in.</td>
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<td></td>
<td>t Pass &gt; 1/8 in.</td>
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<td></td>
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<td>Increase &gt; 100°F (IP)</td>
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<td>QW-407 PWHT</td>
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<td>PWHT (T &amp; T range)</td>
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<td>QW-409 Electrical Characteristics</td>
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<td>I &amp; E range</td>
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<td>String/weave</td>
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<td>Method cleaning</td>
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<td>Method back gouge</td>
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<td>Manual or automatic</td>
<td></td>
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<tr>
<td></td>
<td>Peening</td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

**Legend:**
- Addition = Increase/greater than
- Deletion = Decrease/less than
- Uphill
- Downhill
- Forehand
- Backhand
- Change
The welding variables table refers to the paragraph in the welding data section of the Code.

- These paragraphs give rules for specific applications (specific variables).
Welding Data
(ASME Sect IX)

QW-403.7 For the multipass processes of shielded metal-arc, submerged-arc, gas tungsten-arc, and gas metal-arc, the maximum thickness qualified for 1½ in. (38 mm) and over thickness $T$ of the test coupon of QW-451.1 shall be 8 in. (203 mm) for the conditions shown in QW-451.1. For thicknesses greater than 8 in. (203 mm), the maximum thicknesses of base metal and deposited weld metal qualified is $1.33T$ or $1.33t$, as applicable.

QW-403.8 A change in base metal thickness beyond the range qualified in QW-451, except as otherwise permitted by QW-202.4(b).

QW-403.9 For single-pass or multipass welding in which any pass is greater than ½ in. (13 mm) thick, an increase in base metal thickness beyond 1.1 times that of the qualification test coupon.
Planning the PQR

- Plan your PQR to give you the greatest possibility of success!
  - Base metal and filler metal grouping
  - Thickness limitations
  - Multiple processes require addressing essential variables for both processes
  - Note that position is not an essential variable unless notch toughness testing has been required, take advantage of that
Base Metal

- Assigned P numbers (M or S) so that similar base metals may be qualified by testing one base metal in the same P number (essential variable)

- Group numbers may be assigned within a P number to further differentiate (supplementary essential variable)
  - SA-106 Grade B > P-No.1, Group-No.1
    » 60 KSI min specified tensile
  - SA-106 Grade C > P-No.1, Group-No.2
    » 70 KSI min specified tensile
Filler Metals

- **F number**
  - Electrodes and weld rods are grouped to reduce the number of welding procedure and performance qualifications where it can be logically done

- **A number**
  - Classification of ferrous weld metal analysis

- **Product Form**
  - Flux cored
  - Bare (solid) or metal cored
  - powder
Preheat

- Decrease > 100°F
  - Essential variable
- Increase > 100 °F
  - Supplementary essential variable
Post Weld Heat Treatment

- PWHT
  - Essential variable
- PWHT (Time & Temp range)
  - Supplementary essential variable
- Base metal thickness (T) limits
  - Essential variable
QW-407.1 A separate PQR is required for each of the following conditions.

- For P-Nos. 1,3,4,5,6,9,10 & 11
  - No PWHT
  - PWHT below the lower transformation temp
  - PWHT above the upper transformation temp
    » normalizing
  - PWHT above the upper transformation temp followed by HT below the lower transformation temp
    » Normalizing or quenching followed by tempering
  - PWHT between the upper and lower transformation temp
QW-407.1 cont’d

- For all other materials
  - No PWHT
  - PWHT within a specified temperature range
Test Plate or Pipe Joint

- 1G position when possible (Flat)
- Plan sequence of weld passes if multi pass
- Back grind and PT if two sided weld
- Grind stops and starts
PQR Test Coupons

- Root or Side Bend
- Reduced Tensile
- Face or Side Bend
- Reduced tensile
- Discard
- Discard
- Face or Side Bend
- Face or Side Bend
Two Birds With 1 Stone

- The Procedure Qualification and Welder Qualification can be done at the same time
  - Plate 1G
  - Pipe 6G
- Tests required for Procedure Qualification
  - Bend
  - Tensile
  - Notch Toughness if required by referencing Code
Read The Notes!
# Required Testing for PQR (ASME Sect IX)

## QW-450 SPECIMENS

**QW-451** Procedure Qualification Thickness Limits and Test Specimens

### QW-451.1

**GROOVE-WELD TENSION TESTS AND TRANSVERSE-BEND TESTS**

<table>
<thead>
<tr>
<th>Thickness of Test Coupon Welded, in.</th>
<th>Range of Thickness $T$ of Base Metal Qualified, in. [Notes (1) and (4)]</th>
<th>Thickness $t$ of Deposited Weld Metal Qualified, in. [Notes (1) and (4)]</th>
<th>Type and Number of Tests Required (Tension and Guided-Bend Tests) [Note (4)]</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Less than $\frac{1}{2}^\text{in.}$</strong></td>
<td>$T$ &lt;br&gt; 2$T$</td>
<td>2$t$</td>
<td>Tension &lt;br&gt;Side Bend &lt;br&gt;Face Bend &lt;br&gt;Root&lt;br&gt;</td>
</tr>
<tr>
<td><strong>$\frac{1}{16}$ to $\frac{3}{8}^\text{in.}$ incl.</strong>&lt;br&gt;Over $\frac{3}{8}$ but less than $\frac{3}{4}$&lt;br&gt;$\frac{3}{4}$ to less than $1\frac{1}{2}$&lt;br&gt;$1\frac{1}{2}$ and over</td>
<td>$\frac{3}{16}$ &lt;br&gt;2$T$&lt;br&gt;$\frac{3}{16}$ &lt;br&gt;2$T$&lt;br&gt;$\frac{3}{16}$ &lt;br&gt;$8$ (2)&lt;br&gt;$\frac{3}{16}$ &lt;br&gt;$8$ (2)</td>
<td>$2t$&lt;br&gt;$2t$&lt;br&gt;$2t$ when $t &lt; \frac{3}{4}$&lt;br&gt;$2t$ when $t \geq \frac{3}{4}$&lt;br&gt;$2$ (5)&lt;br&gt;$2$ (5)&lt;br&gt;$2$ (5)&lt;br&gt;$2$ (5)&lt;br&gt;$2$ (5)&lt;br&gt;$2$ (5)&lt;br&gt;</td>
<td>2&lt;br&gt;Note (3)&lt;br&gt;Note (3)&lt;br&gt;2&lt;br&gt;...&lt;br&gt;...&lt;br&gt;...&lt;br&gt;...&lt;br&gt;...&lt;br&gt;...&lt;br&gt;</td>
</tr>
</tbody>
</table>

### NOTES:

1. See QW-401 (.2, .3, .6, .9, .10), QW-404.32, and QW-407.4 for further limits on range of thickness qualified. Also, see QW-202 (.2, .3, .4) for allowable exceptions.
2. For the welding processes of QW-403.7 only; otherwise per Note (1) or 2$T$, or 2$t$, whichever is applicable.
3. Four side-bend tests may be substituted for the required face- and root-bend tests, when thickness $T$ is $\frac{3}{8}$ in. and over.
4. For combination of welding procedures, see QW-200.4.
5. See QW-151 (.1, .2, .3) for details on multiple specimens when coupon thicknesses are over 1 in.
Pre-qualified WPS

- May be written to perform a specific weld within a limited range of variables
  - One joint design (i.e., V-Groove with backing)
  - Material thickness limited or un-limited
  - Process (i.e., SMAW)
  - Position may be limited or all position
  - Current and voltage range limited

- May be written to perform multiple welds, taking advantage of a broad range of materials, joint types, positions, etc.
AWS D1.1 Pre-qualified WPS

---

**WELDING PROCEDURE SPECIFICATION (WPS)**

- **PREQUALIFIED**: Yes
- **QUALIFIED BY TESTING**: Yes
- **PROCEDURE QUALIFICATION RECORDS (PQR)**: Prequalified

**Company Name**: Guy’s Welding

**Welding Process(es)**: SMAW

**Supporting PQR No.(s)**: SM-CS-1-1

**Identification #**: SM-CS-1-1

**Revision**: 0

**Authorized by**:
- **Type**: Manual
  - **Semi-Automatic**: No
  - **Automatic**: No

**Position**:
- **Position of Groove**: All
- **Vertical Progression**: Up

**ELECTRICAL CHARACTERISTICS**
- **Transfer Mode (GMAW)**: Short-Circuiting
- **Current**: AC
  - **DCEP**: DCEP
  - **DCEN**: No
  - **Pulsed**: No

**BASE METALS**
- **Material Spec**: Any Group 1 Mat of ANSI/AWS D1.1 Table 3.1

**FILLER METALS**
- **AWS Specification**: A5.1 and A5.5
- **AWS Classification**: EXX10, EXX18, EXX18W

**SHIELDING**
- **Flux**: N/A
- **Gas**: N/A
- **Composition**: N/A
- **Flow Rate**: N/A
- **Contact Tube to Work Distance**: N/A
- **Interspace Cleaning**: Chip, grind and wire brush

**PREHEAT**
- **Preheat Temp., Min**: 50 F
- **Interpass Temp., Min**: 50 F
- **Max**: 750 F

**POSTWELD HEAT TREATMENT**
- **Temp**: Not permitted
- **Time**: N/A

**WELDING PROCEDURE**

<table>
<thead>
<tr>
<th>Pass or Weld Layer(s)</th>
<th>Process</th>
<th>Class</th>
<th>Diam.</th>
<th>Type &amp; Polarity</th>
<th>Amps or Wire</th>
<th>Volts</th>
<th>Travel Speed</th>
<th>Joint Details</th>
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</thead>
<tbody>
<tr>
<td>All</td>
<td>SMAW</td>
<td>EXX18</td>
<td>3/32&quot;</td>
<td>DCEP</td>
<td>70 - 110</td>
<td>17 - 30</td>
<td>3-6 ipm</td>
<td>All prequalified joints listed in ANSI/AWS D1.1 Figures 3.3 &amp; 3.4 within limits of this WPS</td>
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<tr>
<td>All</td>
<td>SMAW</td>
<td>EXX18</td>
<td>1/8&quot;</td>
<td>DCEP</td>
<td>90 - 150</td>
<td>17 - 30</td>
<td>3-6 ipm</td>
<td>Typical joints shown in standard drawing #1</td>
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<td>SMAW</td>
<td>EXX18</td>
<td>5/32&quot;</td>
<td>DCEP</td>
<td>120 - 190</td>
<td>17 - 30</td>
<td>3-6 ipm</td>
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<td>DCEP</td>
<td>110 - 170</td>
<td>17 - 30</td>
<td>3-6 ipm</td>
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</table>

Form prepared by Guy Mullee Weld Tech Consulting

AWS CWI 92121061

April 1999 Rev 1
AWS D1.1 Pre-qualified WPS

WELDING PROCEDURE SPECIFICATION (WPS)

PREQUALIFIED [ ] QUALIFIED BY TESTING

or PROCEDURE QUALIFICATION RECORDS (PQR) [ ]

Company Name: Guy’s Welding
Welding Process(es): SMAW
Supporting PQR No.(s): Prequalified

Identification #: SM-CS-1-1
Revision: 0
Authorized by: 
Type: Manual [ ] Semi-Automatic [ ] Automatic [X]
Machine: [ ]

Position: All
Position of Groove: Up [X] Down [ ]
Vertical Progression: All

ELECTRICAL CHARACTERISTICS

Transfer Mode (GMAW): Short-Circuiting [ ] Spray [ ] Pulsed [ ]
Current: AC [ ] DCEP [X] DCEN [ ]
Other: [ ]
Tungsten Electrode (GTAW):
Size: N/A
Type: N/A

TECHNIQUE

Stringer or Weave Bead: Stringer only
Multi-pass or Single Pass (per side): Multi and Single
Number of Electrodes: Single
Electrode Spacing: Longitudinal N/A
Lateral N/A
Angle N/A

Contact Tube to Work Distance: N/A
Peening Not permitted
Interpass Cleaning: Chip, grind and wire brush

POSTWELD HEAT TREATMENT

Temp: Not permitted
Time N/A

Preheat
Preheat Temp., Min: 70°F if ambient temperature is below 32°F
Interpass Temp., Min: 70°F if ambient temp is below 32°F
Max: 750°F

WELDING PROCEDURE

Pass or Layer(s) | Process | Class | Diam. | Type & Polarity | Amps or Wire Feed Speed | Volts | Travel Speed |
--- | --- | --- | --- | --- | --- | --- | --- |
All | SMAW | E7018 | 3/32" | DCEP | 70-110 | 17-30 | 3-6 ipm |
All | SMAW | E7018 | 1/8" | DCEP | 90-150 | 17-30 | 3-6 ipm |
All | SMAW | E6013 | 5/32" | DCEP | 120-190 | 17-30 | 3-6 ipm |

Joint Details for B-U2a

Form prepared by Guy Mulee Weld Tech Consulting
AWS CWI 92121061
April 1999 Rev 1
AWS D1.1 Pre-qualified joint design

![Diagram of Single-V-groove weld (2) Butt joint (B)]

<table>
<thead>
<tr>
<th>Welding Process</th>
<th>Joint Designation</th>
<th>Base Metal Thickness (U = unlimited)</th>
<th>Groove Preparation</th>
<th>Permitted Welding Positions</th>
<th>Gas Shielding for FCAW</th>
<th>Notes</th>
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<td>Root Opening</td>
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<td></td>
<td>R = 1/4</td>
<td>α = 45°</td>
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<td>R = 3/8</td>
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<td>F, V, OH</td>
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<td>Root Opening</td>
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<td>R = 3/16</td>
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<td>α = 45°</td>
<td>F, V, OH</td>
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<td></td>
<td>R = 1/4</td>
<td>α = 30°</td>
<td>F</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>R = 5/8</td>
<td>α = 20°</td>
<td>F</td>
<td>N</td>
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Figure 3.4 (Continued)—Prequalified Complete Joint Penetration (CJP) Groove Welded Joint Details (see 3.13)

Notes
Notes

88/Prequalification of WPSs

Notes for Figures 3.3 and 3.4

Notes:
A: Not prequalified for gas metal arc welding using short circuiting transfer nor GTAW. Refer to Annex A.
B: Joint is welded from one side only.
C: Backgouge root to sound metal before welding second side.
D: SMAW detailed joints may be used for prequalified GMAW (except GMAW-S) and FCAW.
E: Minimum weld size (E) as shown in Table 3.4. S as specified on drawings.
J: If fillet welds are used in statically loaded structures to reinforce groove welds in corner and T-joints, these shall be equal to 1/4 T1, but need not exceed 3/8 in. Groove welds in corner and T-joints of cyclically loaded structures shall be reinforced with fillet welds equal to 1/4 T1, but not more than 3/8 in.
M: Double-groove welds may have grooves of unequal depth, but the depth of the shallower groove shall be no less than one-fourth of the thickness of the thinner part joined.
Mp: Double-groove welds may have grooves of unequal depth, provided these conform to the limitations of Note E. Also the weld size (E) applies individually to each groove.
N: The orientation of the two members in the joints may vary from 135° to 180° for butt joints, or 45° to 135° for corner joints, or 45° to 90° for T-joints.
V: For corner joints, the outside groove preparation may be in either or both members, provided the basic groove configuration is not changed and adequate edge distance is maintained to support the welding operations without excessive edge melting.
Z: Weld size (E) is based on joints welded flush.
### Table 3.1

**Prequalified Base Metal—Filler Metal Combinations for Matching Strength**

<table>
<thead>
<tr>
<th>Steel Specification</th>
<th>Minimum Yield Point/Strength</th>
<th>Tensile Range</th>
<th>Filler Metal Requirements</th>
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<td>ksi</td>
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<td>58–80</td>
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<td>60 min</td>
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<td>240</td>
<td>60 min</td>
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<td>Grade B</td>
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<td>235</td>
<td>58–71</td>
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<td>60 min</td>
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<td>ASTM A131</td>
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<td>58–71</td>
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<td>Grades A, B, CS, D, DS, E</td>
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<td>240</td>
<td>60 min</td>
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## Pre-qualified pre-heat table

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<th>Minimum Preheat Interpass Temperature</th>
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<td>Thickness of Thickest Part at Point of Welding</td>
<td>Minimum Preheat Interpass Temperature</td>
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<td>mm</td>
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(continued)
Notes: In joints involving base metals of different groups, either of the following filler metals may be used: (1) that which matches the higher strength base metal, or (2) that which matches the lower base metal and produces a low-hydrogen deposit. Preheating shall be in conformance with the requirements applicable to the higher strength group.

When welds are to be stress-relieved, the deposited weld metal shall not exceed 0.05 percent vanadium. Only low-hydrogen electrodes shall be used when welding A36 or A709 Grade 36 steel more than 1 in. (25.4 mm) thick for cyclically loaded structures. Special welding materials and WPS (e.g., E80XX-X low-alloy electrodes) may be required to match the notch toughness of base metal (for applications involving impact loading or low temperature for atmospheric corrosion and weathering characteristics (see 3.7.3). The designation of ER70S-1B has been reclassified as ER80S-D2 in A5.28-79. Prequalified WPSs prepared prior to 1981 and specifying AWS A5.18, ER70S-1B, may now use AWS A5.28-79 ER8 when welding steels in Groups I and II.

Filler metals of alloy group B3, B3L, B4, B4L, B5, B5L, B6, B6L, B7, B7L, B8, B8L, or B9 in ANSI/AWS A5.5, A5.23, A5.28, or A5.29 are not prequalified for use in the as-welded condition. See Tables 2.3 and 2.5 for allowable stress requirements for matching filler metal. The heat input limitations of 5.7 shall not apply to ASTM A913 Grade 60 or 65.

Notes:
1. When the base metal temperature is below 32°F (0°C), the base metal shall be preheated to at least 70°F (21°C) and this minimum temperature maintained during welding.
2. For modification of preheat requirements for submerged arc welding with parallel or multiple electrodes, see 5.12.2.
3. See 5.12.2 and 5.6 for ambient and base-metal temperature requirements.
4. The heat input limitations of 5.7 shall not apply to ASTM A913 Grade 60 or 65.
Welder Qualification
Essential Variables

- Joints
  - With or without backing

- Base metal
  - Pipe diameter
  - P number
Welder Qualification

Essential Variables

- **Filler metal**
  - With or without
  - F number
  - Inserts
  - Solid or metal cored
  - “t” of deposit
  - “t” limits of short circuiting transfer
Welder Qualification

Essential Variables

- **Position**
  - Flat
  - Horizontal
  - Vertical
  - Overhead

- **Progression** – vertical welding
  - Up
  - Down
Welder Qualification

Essential Variables

- **Gas**
  - Deletion of inert backing gas

- **Electrical characteristics**
  - GMAW – transfer mode
  - GTAW – current or polarity
Welder Qualification

- Main controlling factors
  - Process
  - Filler metal
  - P number qualified

» It is your responsibility to ensure that the filler metal and base metal are suitable for the application
Welder Qualification
Base Metal

- Test on pipe or plate?
- Any P-No. 1 through 11, P-No. 34, or P-No. 41 through 47 qualifies for any P-No. 1 through 11, P-No. 34, or P-No. 41 through 47 base metal
- P-No. 21 through P-No. 25 (same)
- P-No. 51 through P-No. 53 or P-No. 61 through P-No. 62 (same)
Some cross qualification exists with F numbers for example:

- Any F6 qualifies for F6
- Any F21 – F25 qualifies for F21 – F25
- Any F34 or F41 – F47 qualifies for F34 & F41 - F47
Welder Qualification
F-Numbers

- SMAW electrode F numbers 1 – 4 are inter-related (ASME) and with or without backing applies
  - F4 without backing qualifies for F1, F2, F3 & F4 with backing and F4 without
  - F4 with backing qualifies for F1, F2, F3 & F4 with backing only
Welder Qualification
Weld Deposit “t”

- **ASME**
  - Up to and including 3/8” thick qualifies 2t
  - Over 3/8” qualifies 2t
  - 1/2” & over with minimum of 3 layers of weld metal qualifies for the maximum to be welded

- **AWS D1.1**
  - 1/8” ≤ t ≥ 3/8” qualifies for 2t
  - 3/8” < t < 1” qualifies for 2t
  - 1” and over qualifies for unlimited
Welder Qualification Position (ASME)

- **1G** plate qualifies
  - F plate & pipe 2 7/8” OD & over groove welds and F fillets

- **2G** plate qualifies
  - F & H plate & pipe 2 7/8” OD & over groove welds and F & H fillets
Welder Qualification Position (ASME)

- **3G plate qualifies**
  - F & V plate & pipe groove welds 24” OD & over and F, H, V fillets
  - F pipe 2 7/8” OD & over groove welds

- **4G plate qualifies**
  - F & O plate & pipe groove welds 24” OD & over and F, H, O fillets
  - F pipe 2 7/8” OD & over groove welds
Welder Qualification
Position (ASME)

- 1G pipe
  - F groove & fillet
- 2G pipe
  - F & H groove & fillet
- 5G pipe
  - F, V & O groove & fillet
- 2G & 5G pipe or 6G pipe
  - All groove & fillet
Welder Qualification (ASME)

- Diameter limits based on OD of test coupon for groove welds
  - < 1” OD = size welded to unlimited
  - 1 < 2 7/8” OD = 1” OD to unlimited
  - 2 7/8” OD & over = 2 7/8” OD to unlimited

- Groove weld test qualifies fillets for all base material thickness, sizes and diameters
Welder Qualification

- Most testing can be done on carbon steel test coupons to save money
  - e.g., welder qualifications can be completed for most nickel alloys by using a filler from the F-41 through F-47 group welding a carbon steel test coupon
- 6G pipe position is the most economical test position
Weld it Right Co.
Rochester, N.Y 14619

WELDER OR WELDING OPERATOR PERFORMANCE QUALIFICATION (QW-484)

<table>
<thead>
<tr>
<th>Welder's name</th>
<th>john Doe</th>
<th>INS/SS number</th>
<th>101</th>
<th>Stamp no.</th>
<th>1</th>
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Welding Variables for Each Process (QW-350)

- Backing (metal, weld metal, welded from both sides, flux, etc.) (QW-402)
  - ASME P-No. to ASME P-No. (QW-403)
  - ( ) Plate
  - ( ) Pipe (enter diameter, if pipe)

- Filler metal specification (SFA): A5.18
- Filler metal F-no.:
- Consumable insert for GTAW or PAW:
- Weld deposit thickness for each welding process:
- Welding position (1G, 5G, etc.) (QW-405)
- Progression (uphill/downhill):
- Backing gas for GTAW, PAW, or GMAW; fuel gas for OFW (QW-408)
- GMAW Transfer mode (QW-409)
- GTAW welding current type/polarity:

Machine Welding Variables for the Process Used (QW-360)

- Direct/remote visual control:
- Automatic voltage control (GTAW):
- Automatic joint tracking:
- Welding position (1G, 5G, etc.):
- Consumable insert:
- Backing (metal, weld metal, welded from both sides, flux, etc.):

Actual Values

- With
  - P-No. 1 to P-No. 1
  - Groove 2 7/8" O.D. & over F only
  - Groove 24" O.D. & over
  - Fillet all dia.
  - ER70S-6
  - 6
  - None
  - 3/8”
  - 3G
  - Uphill
  - None
  - Short Circuting
  - N/A

Range Qualified

- With
  - P-No. 1-11, 34, 41-47
  - Groove 2 7/8" O.D. & over
  - ER70S-X
  - 6
  - Not Permitted
  - 0.412”
  - F & V
  - Uphill
  - None
  - Short Circuting
  - N/A

Notes:

Guided Bend Test Results

Guided Bend Tests Type

- ☑ QW-462.2 (Side) Results
- ☑ QW-462.3(a) Trans. R & F Type
- ☑ QW-462.3(b) (long. R & F) Results

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<tr>
<th>3G Root</th>
<th>Acceptable</th>
<th>3G Face</th>
<th>Acceptable</th>
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</table>

Visual examination results (QW-302.4) Acceptable

Radiographic test results (QW-304 and QW-305)
(For alternative qualification of groove welds by radiography)

Macro fusion test
- Fillet leg size
- Length and percent of defects
- Date of Test
- Lab Test No.

Welding test conducted by
- Guy Mulee

Mechanical tests conducted by
- Guy Mulee

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

Organization: Weld it Right Co.

Date: 1/11/2003

By Joe Welder

Form prepared by: Guy Mulee Weld Tech Consulting

AWS CWI 92121061

May 1999 Rev 1
Qualification by Workmanship Test

- Only permitted when allowed by the referencing document
- Requires completion of a workmanship test addressing typical production joints and conditions
- Primarily accepted on the basis of visual inspection
- Other tests or examinations may be required by the referencing document (e.g., macro examination)
Continued Qualification

- ASME, AWS (except D9.1) requires that the welder must satisfactorily weld using the process at least once each six months to remain qualified
  - D9.1 is 12 months

- Re-qualification may be done on pipe or plate in any position, material thickness or diameter to regain qualification for all positions, thickness, materials and diameters previously qualified for with that process