Welding Procedure Specification’s (WPS)
Presented By John Lucas
Welding Engineer
UTI Corporation
What Is Welding?

AWS defines welding as:

“The art and science of joining metals by using the intrinsic adhesive and cohesive forces of attraction that exist within metals”.

Welding, Brazing, Soldering

Does not include mechanical fastening such as bolts, rivets, screws, etc.
When Did Welding Begin?

Pressure Welding of Noble Metals
   Over 2,000 years ago

Forge Welding
   Blacksmiths
   Over 1,000 years ago

Modern Welding
   1880’s
Interesting Fact

Temperature Of The Sun?
9,941°F

Temperature Of The Arc?
12,632°F
WELDING PROCEDURES

• What Is a Welding Procedure?
• Why Have Welding Procedures?
• Who Should Have Welding Procedures?
• What Information Should Procedures Contain?
• How do we know If Our Procedures Are Good?
What Is A Welding Procedure?

• A document that contains important variables on how to make the weld in question.
# Welding Procedure Specification

**Client:** Mobil  
**Project:** 221010Gatee  
**REF.No.:** WPS 6 R1

**Procedure Description:** 12" Heavy Wall Offshore Tie-in  
**Material:** AS3679.1 Grade 250 API 5L X65  
**Diameter:** 168.3  
**Thickness:** 13.3

**Position:** 6G  
**Clamp Type:** Internal  
**Preheat °C (Min):** 100  
**Interpass °C (Max):** 300

<table>
<thead>
<tr>
<th>Process</th>
<th>ROOT SMAW</th>
<th>HOT PASS SMAW</th>
<th>FILL &amp; CAP SMAW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Welding Process</td>
<td>Vertical Down</td>
<td>Vertical Down</td>
<td>Vertical Down</td>
</tr>
<tr>
<td>Welding Direction</td>
<td>Lincoln SA70+</td>
<td>Lincoln SA70+</td>
<td>Bohler BVD90M</td>
</tr>
<tr>
<td>Polarity</td>
<td>DC -ve</td>
<td>DC +ve</td>
<td>DC -ve</td>
</tr>
<tr>
<td>Shielding Gas</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Purge Gas</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Pass No</th>
<th>Filler Size (mm)</th>
<th>Amps</th>
<th>Volts</th>
<th>Speed (mm/sec)</th>
<th>Heat Input (kJ/mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3.2mm</td>
<td>70-130</td>
<td>18-33</td>
<td>33-66</td>
<td>0.4-6.8</td>
</tr>
<tr>
<td>2</td>
<td>4.0mm</td>
<td>110-210</td>
<td>18-38</td>
<td>29-68</td>
<td>0.6-1.3</td>
</tr>
<tr>
<td>FILL</td>
<td>4.0mm</td>
<td>145-260</td>
<td>16-27</td>
<td>16-70</td>
<td>0.6-2.2</td>
</tr>
<tr>
<td>CAP</td>
<td>4.8mm</td>
<td>130-230</td>
<td>16-26</td>
<td>18-53</td>
<td>0.6-1.7</td>
</tr>
</tbody>
</table>

## NOTES

1. API Std 1104BP1094-SP-PL-3010R1
2. Clamp removal gage; 100% completion of root (external clamp may be used in the event of a breakdown – removed after 50% minimum completion of the root)
3. Time lapse between root and second pass: 16 Minutes
4. Time lapse between second pass and 1st fill: 12 Minutes
5. Minimum number of passes before pipe movement: 2 passes
6. Minimum number of passes before break in welding: 3 passes
7. Minimum Number of welders: Root & second pass: 2, Fill & Cap: 1
8. Method of cleaning: Grinder / Wire brush
9. Method of Preheat: Gas Torch
10. Qualification reference number: 48280/PP/WP6 R1

**Weld Preparation**

**Pass Location**

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**Company Welding Engineer Approved** .................................................. **Approved for Client** ..................................................
Why Have Welding Procedures?

• Required By Code
• Proves To Engineers & Regulators You Know What You Are Doing
• Helps To Produce Quality Welds
Who Should Have Welding Procedures?

• Manufacturing
  • Automotive
  • Heavy Equipment
• Pipeline Industry
• Construction
What Information Should I Include?
Important Information

• Governing Code
  • API, AWS, ASME, ISO
  • Foreign Codes
Important Information

- Material Parameters
  - Spec & Grade
  - Wall Thickness
  - Size (Diameter)
  - Yield/Tensile Strength
  - Metallurgical Concerns
Important Information

• Welding Process
  • GMAW (MIG), GTAW (TIG), SMAW (STICK)
  • Automated Or Not?
Important Information

• Process Parameters
  • Volts, Amps, Travel Speed
  • Travel Direction
  • Polarity
  • Wire Welding Transfer Mode
    • Globular, Spray, Short Circuit, Plasma
    • Flux Core or Shielding Gas
  • Number of Passes
  • Number of Welders
  • Electrodes
    Size
    Group Number = 1, 2, 3, etc.
    AWS Specification = A5.1, A5.5, etc.
Important Information

- Pre/Post Weld Heat Treatment
  - Temps
  - Time
  - Cooling Rates
  - Heat Input
  - Time Interval Between Passes
Important Information

• Joint Design
  • Material Thickness
  • Joint Type
  • Bevel Angles
  • Root Opening Dimension
  • Backer Rods
  • Etc.

[Diagram of welding symbols and their location significance]
Important Information

• Filler Metals

E 6010

E = Electrode
60 = Tensile Strength (60,000 psi)
1 = All Position
0 = Type Of Coating & Polarity
Cellulose, Low Hydrogen, Potassium, etc.
Important Information

• Cleanliness
  • Joint Cleaning
  • Coating Removal
  • How to Remove Coatings

• Joint Fit Up
  • Line Up Clamps
  • Internal or External
Procedure Qualification Record

- Lab Report
- Parameters/Materials
- Info Made for Each Pass
- Ambient Conditions
Procedure Qualification Record

Testing Reports
Welder Qualification

• Three Welder Testing Procedures
  
  API 1104
  Field Welding

  ASME Section 9
  Fab Shop Welding

  Part 192-Appendix C
  Low Stress
  12 Inch And Less Pipe
Welder Qualification

• Initial Test
  • Initial Test = Destructive

• 6 Month Retest
  • Non Destructive
  • Compressor Station & Components
    » Part 192.229
    » Destructive Only

• If a Welder Performs a Procedure Qualification, Is The Welder Also Qualified?
Weld Quality
Weld Quality

- Lack of Fusion
Weld Quality

• Lack of Penetration
Weld Quality

- Porosity
Weld Quality

• Under Cut
Welding Safety
• Eye Safety
  • Wear a Hood

• Skin Safety
  • Burns
    » Wear Sun Screen - SPF 45

• White Wall Effect
Conclusion

• Comments Or Questions?