**WELDING PROCEDURE SPECIFICATION**

WPS: 3002-xxxx-HY80/HSLA-100  
REV. NO.: 2  
DATE: 8/18/2016  
**APPLICABILITY**

WELDING PROCESS: GMAW and GMAW  
CODE: ASME IX and AWS D1.1  
OTHER:

SUPPORTING PQR: 3002-HY80/HS100-1  
3002-xxxx-HSLA100-45

JOINT: This WPS shall be used in conjunction with the General Welding Standards (GWS) and Welding Fabrication Procedure (WFP) sections and criteria for joint details, repairs, NDE, inspection, etc.

Weld Joint Type: Butt/Fillet  
Class: Full & Partial Penetration & Fillets

See GWS 1-06 and WFP's for joint details.

Root Opening: 1/8 - 1/2  
Back: Metal

Backgrind Root: Required on double sided welds  
Back Mat.: Mild Steel

Bkgrd Method: Arc, Grind or Machine  
GTAW Flux: N/A  
Back: N/A

FILLER METALS:

A No: 10  
F No: 6 and 6  
Class: ER100S-1 and ER100S-1  
SFA Class: 5.28 and 5.28  
Size: .062, .062, .062, .062

Insert: N/A  
Insert Type: N/A

Weld Metal Thickness Ranges:

AWS Root Pass: .0625 thru .0190  
ASME Root Pass: .062 thru .190

ASME Balance: 0.062 thru 8.00

BASE MATERIAL:

Spec.: HY 80  
Grade: to Spec.: HSLA 100

Qualified Pipe Dia. Range: >=  
AWS: 24

Qualified Thickness Range:  
AWS: 0.125 thru 99.99  
ASME: 0.187 thru 8

QUALIFIED POSITIONS:

AWS: 1G  
ASME: 1G, 2G  
Vert. Prog.: N/A

Preheat Min. Temp.: 225  
GAS: Shielding: Argon/O2 or Argon/O2

Interpass Max. Temp.: 275 °F  
Gas Composition: 98 / 2 / %  
98 / 2 / %

Preheat Maintenance: 225 °F  
Gas Flow Rate cfh: 40 to 75  
40 to 75

PWHT: Time @ °F Temp.: N/A  
Backflow Gas Comp: N/A  
N/A %

Temperature Range: N/A °F to N/A °F  
Backflow Gas Flow cfh:  
N/A%

WELDING CHARACTERISTICS:

Current: DCEP and DCEP  
Tungsten Type: N/A  
Transfer Mode: Spray

Ranges: Amps: 260 to 403  
Tungsten Dia: N/A to N/A  
Pulsing Mode:

Volts: 22 to 32  
Oscillation: N/A

Fuel Gas: N/A  
Flame: N/A  
Braze Temp °F: N/A to N/A

WELDING TECHNIQUE: For fabrication specific requirements such as fitup, cleaning, grinding, PWHT and inspection criteria, refer to Volume 2, Welding Fabrication Procedures.

Technique: Semi-Automatic  
Cleaning Method: Wire brush, grind, machine

Single or Multi Pass: M  
Stringer or Weave Bead (S/W): S or S  
Oscillation: N/A

GMAW Gun Angle: 0 * to 15 *  
Forehand or Backhand for GMAW: Forehand

No Pass > 1/2": True  
GMAW/FCAW Tube to Work Distance (in): 0.625 - 0.75

Maximum K/J Heat Input: = 75 KJ/in  
Travel Speed: 5 to 12 IPM  
Gas Cup Size: 3/4
PROCEDURE QUALIFIED FOR:
Charpy "V" Notch: Yes Nil-Ductile Transition Temperature: No Dynamic Tear: Yes

Comments: Note 1.) DT qualified with avg. 610 ftlbs @ 0°F. Note 2.) Charpy Impact qualified with avg. 107 ftlbs @ -60°F

Rev 2 Added more impact data from PQR run for Welder Qual

<table>
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<tr>
<th>Weld Layer</th>
<th>Manual Process</th>
<th>Filler Metals</th>
<th>Size</th>
<th>Amp Range</th>
<th>Volt Range</th>
<th>Travel/ipm</th>
<th>Nozzle Angle</th>
<th>Other</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>GMAW ER100S-1</td>
<td>.062</td>
<td>260  to 290</td>
<td>22 to 25</td>
<td>5 to 7</td>
<td>0 to 15</td>
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<tr>
<td>2</td>
<td>GMAW ER100S-1</td>
<td>.062</td>
<td>280  to 310</td>
<td>24 to 27</td>
<td>6 to 8</td>
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<tr>
<td>3</td>
<td>GMAW ER100S-1</td>
<td>.062</td>
<td>300  to 330</td>
<td>26 to 29</td>
<td>7 to 9</td>
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<tr>
<td>4</td>
<td>GMAW ER100S-1</td>
<td>.062</td>
<td>310  to 340</td>
<td>28 to 30</td>
<td>8 to 10</td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

REM. * Weld layers are representative only - actual number of passes and layer sequence may vary.

Use of LANL Welding Procedures and Welder Qualifications for non-LANL work shall be at the sole risk and responsibility of the Subcontractor, and the Subcontractor shall indemnify and save LANL and the Government harmless from any and all claims, demands, actions or causes of action, and for any expense or loss by the reason of Subcontractor's and their employees possession and use of LANL procedures and qualifications.

APPROVAL: Signatures on file at ES-DE DATE: 8/18/2016