Welding of Large Diameter Pipelines: Design, Processes, Procedures Specifications for Welding Steel Water Pipe
Field Welding of Steel Pipe Joints

Nash Williams, Owner

National Welding Corporation
Steel Pipe Installation: Open Cut

- Stab depth should be marked generally 2”-3”
- Pipe is laid Bell onto Spigot
- Pipe is engaged at about a 10 degree angle.
- Tack weld made at Field Top which serves as hinge.
- Pipe lowered to proper grade and pulled into alignment. Stab is limited to 1” min. and no closer that 1” to bell tangent.
Steel Pipe Assembly

Fitting Tools for Stabbing Lap-welded Joints

[Images showing fitting tools for steel pipe assembly, labeled as Spoon and Spacer Bar]
Water Treatment Plant Installation

Stabbing Lap-Welded Joints
Field Connection to Existing Pipe

Butt Strap Installation & Welding
Most Common Welding Methods

Semi Automatic (FCAW)  Manual Welding (SMAW)
Manual Welding Process (Stick)

Shielded Metal Arc Welding (SMAW)

Welding Stinger

Welding Machine
Semi-Automatic Process

Flux Core Arc Welding (FCAW) – ‘Dual-Shield’

Wire Gun

Wire Feeder
Welding Procedure Submittals

Per AWS D.1.1 or ASME Section VIII

• Welding Procedure Qualification Record (PQR)
  – Welding Parameters followed during weld test (actual amperage voltage and travel speed)

• Welding Procedure Specification (WPS)
  – Developed from the PQR; factors in ranges allowed by code (AWS and ASME).

• Welder Qualification Record (WQR)
  – Uses WPS to verify welder performance
Procedure Qualification Record (PQR)

**NATIONAL WELDING CORPORATION**

**PROCEDURE QUALIFICATION RECORD PQR**

**COMPANY NAME:** NATIONAL WELDING CORPORATION  
**PROCEDURE QUALIFICATION RECORD NO.:** NRC-0964 (ES)  
**PROCEDURE QUALIFICATION SPECIFICATION NO.:** NRC-0964  
**DATE:** 2/18/02

**JOINT DESIGN USED**

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**POSITION:**

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**BASE METALS**

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<tr>
<th>Material Specification</th>
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**WELDING PROCEDURE**

**Welder's Name:** Name Williams  
**Tests conducted by:** Quality Testing and Inspection  
**Number Test:** 10960402-02  
**Approval:** NA  
**Certified by:** NA  
**Date:** August 1,2002
Welding Procedure Specification (WPS)
Welder Qualification Record (WQR)

### NATIONAL WELDING CORPORATION

**Welders Qualification Record (WQR)**

**NAME:**

**IDENTIFICATION NO.:** 2/12/2022

**PROCESS/TYPE:** FCAW-ES/NOMI-1 AUTOMATIC

**QUALIFICATION RANGE:**

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<td>POSITIONED WELD</td>
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<td>30 UF</td>
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<tr>
<td>BACKING (USE OF)</td>
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<td>THICKNESS PLATE</td>
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<td>3/16 IN</td>
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<td>FILLET METAL</td>
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**Welders Continuity Log**

**Welder Name:** Dustin Brain

**Sticker Number:** 465

**Foreman:**

**Identification No.:** 147263222

**Welder Active:** Yes

**Active Date:** 2-5-2020

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<th>PROCESS</th>
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<td>Palo Verde Generating Station, Phoenix, AZ</td>
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Notes:
- Dustin Brain has been welding continuously for National Welding since hiring on February 12, 2008.

**National Welding Corporation**

**Date:** April 30, 2010
Procedure Qualification Tests

Guided Bend

Tensile
Procedure Qualification Tests

Charpy (Notch Tough) Test
Procedure Qualification Tests

Acceptable Indication

Unacceptable Indication
“Defect”

Macro Etch
Bell and Spigot Fillet Weld

Single Fillet Welding
Fillet Weld Inspection Methods

- Visual (see AWS Table 6.1 handout)
- Magnetic Particle (MT)
- Air Test at 40 psi (for double fillet welds)
- Vacuum Box
- Dye Penetrant
- U.T. or R.T. not effective.

DOUBLE FILLET WELD

Air Test Hole
Fillet Weld Inspection

Visual Inspection (VT)

Table 6.1
Visual Inspection Acceptance Criteria (see 6.5)

<table>
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<tr>
<th>Discontinuity Category and Inspection Criteria</th>
<th>Sincerely Loaded</th>
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<tr>
<td>0.1 Crack, Porosity</td>
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<td>0.2 Weld-Base Metal Fusion</td>
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<td>0.3 Crack, Cross Section</td>
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<td>0.4 Welded Joints</td>
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Figure 5.4—Acceptable and Unacceptable Weld Profiles (see 5.24)
Fillet Weld Inspection
Magnetic Particle (MT) and Air Leak Test
Fillet Weld Inspection

Vacuum Box Inspection and Dye Penetrant

Illustration from AWWA C-206

Note: Dye Penetrant is used to find surface cracks. Dye Penetrant is no longer recommended by AWWA C-206 for field weld inspection due to the process introducing contaminants which could adversely affect linings and coatings.
Butt Weld Inspection Methods

Magnetic Particle (MT) or Ultrasonic Testing (UT)

• Magnetic Particle (MT)
  – Also utilized for fillet weld inspection

• Ultrasonic Testing (UT)
  – Can be performed immediately after the joint has cooled from welding.
  – Only requires access to one side of the joint.
  – Radiographic Testing (RT) is not addressed in AWWA C206
Weld After Backfill
Typical Joint Coatings

- Weld After Backfill is a sequence used to improve overall installation rate for steel pipe.
- Pipe is laid and welded outside (if required).
- Joint coating is applied, usually a shrink sleeve or mortar diaper.
- Pipe is backfilled.
- The inside weld is made later.
Inside Welding Access

Inside 30” pipe

Inside 48” pipe
Top Issues of Concern

• **Issue:** Welding subcontractor or welders are inexperienced with production welding of steel pipe.
  
  Remedy: Specifications should require the welding subcontractor to be qualified for the project, such as requiring a minimum experience of three separate projects exceeding 60” dia. x 5000’ long and must provide a statement of qualification acceptable to the Owner/Engineer.

• **Issue:** Welding Subcontractor may compensate individual welders by piece work which can severely impact quality.

  Remedy: Make sure a reputable company is performing the welding and/or disallow piece work compensation for individual welders.

• **Issue:** Inadequate or no inspection

  Remedy: Welded steel joints should be inspected by a qualified inspector in accordance with AWWA C206 to verify conformance to the Specification and Specification should dictate the method of inspection.
QUESTIONS?