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Jeanne.kingery@duke-energy.com
Jeanne W. Kingery
Associate General Counsel

VIA E-MAIL DELIVERY

August 4, 2020

Ohio Power Siting Board
Theresa White, Executive Director
Public Utilities Commission of Ohio
180 E. Broad Street
Columbus, Ohio 43215

RE: Case No. 16-253-GA-BTX (Opinion, Order and Certificate; Condition No. 34)

Dear Ms. White:

This communication serves as confirmation, pursuant to Condition No. 34 of the Opinion, Order and Certificate issued by the Ohio Power Siting Board (hereafter "OPSB") that, at least two weeks prior to the preconstruction conference, Duke Energy Ohio, Inc., (Duke Energy Ohio) shall file notice with the OPSB so that welding qualifications, welding procedures, and nondestructive testing procedures may be reviewed in advance.

Duke Energy Ohio sets forth this communication to certify our adherence with Condition No. 34 of the OPSB's Opinion, Order and Certificate pertaining to Case No. 16-253-GA-BTX.

Sincerely,

/s/ Jeanne W. Kingery

Jeanne W. Kingery
Associate General Counsel

Table of Contents

1. Purpose

The purpose of this procedure is to provide steps for calculating the heat sink capacity of an operating pipeline that will have in-service welding performed on it.

NOTE: *Measuring the heat sink capacity determines the cooling conditions of the pipe. Knowing the cooling conditions of the pipe will help to control the risk of hydrogen cracking in the weld.*

2. Governing Code and References

N/A

3. State Specific Requirements

N/A

4. Environmental Information

Refer to the Environmental Health and Safety Handbook or contact Duke Environmental Support at 1-800-527-3853.

5. Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

6. Task Summary

This procedure provides the necessary steps to calculate the heat sink capacity of an operating pipeline that would assist in the selection of the appropriate in-service welding procedure.

7. Safety Requirements

At Duke Energy, Health and Safety is a Core Company Value. Employees are responsible for maintaining the highest regard for safety while planning and conducting work. Employees are also responsible for ensuring a safe work environment exists for themselves, their coworkers, and their surrounding community.

Icon Key:

NOTE: *This icon raises awareness to important non-safety related information.*

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8. Definitions/Acronyms

Hydrogen Cracking – A condition, also known as hydrogen embrittlement, where the presence of hydrogen in a weld, on top of the weld having both a tensile stress acting on it and a crack susceptible microstructure, causes the weld to crack.

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9. Tools, Materials, and Equipment

- Oxy-acetylene torch
- Contact pyrometer

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10. Procedures/Process

Step	Action	Answer
1	Determine the direction of flow.	☐
2	Draw six, 2-inch circles on the pipeline with any means that will not disappear at elevated temperatures. The circles may be on the same side of the pipe or on opposite sides of the pipe. If the pipe outside diameter is less than 2.375 inches, mark an area that has a 2 inch length that is parallel to the pipeline axis.	☐

3	Start with the downstream area and quickly heat the area with an oxy-acetylene torch to a temperature between 300°C (572°F) and 325°C (617°F) using a circular motion. If the pipe outside diameter is less than 2.375 inches than heat the area with a linear motion. It is important to start with short heating times and then increase the heating time until the temperature of the pipe reaches between 300°C (572°F) and 325°C (617°F) with a heating time between 15 to 20 seconds. The heating time can be controlled by the tip used to heat the area so smaller tips shall be used when heating small diameter, thinner walled pipe. Quickly remove the torch, apply a contact pyrometer to the center of the heated region, and measure the time that it takes for the pipe wall to cool from 250°C (482°F) to 100°C (212°F) using a stopwatch. Record the cooling time and then repeat at the next upstream area until six valid cooling times are recorded. If the pipe is still warm from the previous measurements, wait until normal temperature is restored.	**CT1**				
		CT2				
		CT3				
		CT4				
		CT5				
		CT6				
4	Calculate the average heat sink capacity time from the six recorded times.	**Ave.**				
5	Is the average time listed in Step 4 higher than the recorded heat sink time recorded on the in-service welding procedure?	Yes	☐	No	☐	

11. Contact

Gas Engineering

12. Signature

Reviewed and Approved by:

Randy L Bost

Randy L Bost (Apr 30, 2019)

13. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this procedure: • CM-PL-4000 *Appendix N: Heat Sink Capacity Measurement.*	Members of Work Process Integration Team
1	05/01/2019	• Revised the "WHO" section, added Gas Engineering, Gas Field Operations, and Technical Field Operations	Work Process Integration Team

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1. Purpose

The purpose of this procedure is to provide a method for reducing or eliminating magnetization of pipelines that will be welded together.

CAUTION: *Welding onto magnetized pipe can result in arc blow. Arc blow can affect the welder's ability to deposit a satisfactory weld leading to increased repairs.*

The magnetic field tends to be higher in the weld joint root opening, therefore, the greatest risk of arc blow will be when depositing the root pass. Magnetism is measured in Gauss and shall be measured with a Gauss meter probe (Hall-effect Gauss Meter).

The Gauss level produced when joining two pipe sections together is generally ten (10) times higher than with the pipe sections separated. For example, two pipe sections averaging eight (8) Gauss will result in a magnetism of eighty (80) Gauss when butted together. The effect the magnetism has on the welding arc is dependent on the strength of the field. The relative field strength and associated welding problems are:

- 20 Gauss and below – Welding can take place without concern.
- 21 – 30 Gauss – The welding arc may be affected by magnetism.
- 31 – 100 Gauss – The welding arc will likely be affected by magnetism, but may be manageable by the welder depending on their level of skill, amperage, arc length, diameter, and joint design.
- 100 Gauss and above – The welding arc will be affected by magnetism and demagnetization efforts need to be taken to reduce the magnetic field.
- 150 – 300 Gauss – Serious weld defects are likely, including weld induced cracked welds.
- 300 Gauss and above – Welding will seem almost impossible at times combined with severe weld defects.

2. Governing Code and References

N/A

3. State Specific Requirements

N/A

4. Environmental Information

Refer to the Environmental Health and Safety Handbook or contact Duke Environmental Support at 1-800-527-3853.

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5. Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

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6. Task Summary

This procedure provides the necessary steps to demagnetize pipe for welding.

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7. Safety Requirements

At Duke Energy, Health and Safety is a Core Company Value. Employees are responsible for maintaining the highest regard for safety while planning and conducting work. Employees are also responsible for ensuring a safe work environment exists for themselves, their coworkers and their surrounding community.

Icon Key:

CAUTION: *This icon identifies possible safety hazards and/or serves as a reminder to take necessary precautions.*

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8. Definitions/Acronyms

Gauss – Unit of measurement of "magnetic induction" or "magnetic flux density".

Gauss Meter – Instrument for measuring electromagnetic fields, measured in Gauss units.

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9. Tools, Materials, and Equipment

- Gauss Meter
- Welding Cable

- Welding Power Supply
- Commercially available demagnetization equipment (optional)

10. Procedures/Process

The demagnetizing procedure is based on using a welding power supply to alter the magnetic field; however, there is commercially available equipment specifically for demagnetization, which can be used in place of the following procedure. In most cases, the use of purpose built demagnetization equipment will result in demagnetization that is more effective with less guesswork on the part of the welder and inspector.

Step	Action
1	Align the weld joint per the requirements of the welding procedure.
2	Insert the Gauss meter probe into the weld joint and measure the magnetism around the entire circumference.
3	If the magnetism level is less than 100 Gauss around the circumference, stop this procedure and continue with welding. (If welding problems arise that appear to be caused by magnetism, steps 5-9 can be followed to reduce the level of magnetism).
4	If the magnetism is more than 100 Gauss at any place around the circumference, follow steps 5-9 to reduce the magnetic field to 30 Gauss or less prior to welding.
5	Make approximately 10 wraps of welding cable 3 to 6 inches (up to ½ the pipe diameter) from the weld joint on the pipeline side as shown in Appendix A. The wraps shall be laid side by side around the magnetized pipe and connected to the terminals of the welding machine.
6	Set the welding power supply on direct current (DC) only and adjust the amperage to the minimum setting. Start the welding power supply, insert the Gauss meter probe into the weld joint, and measure the magnetic field around the circumference. If the magnetism has increased, switch the welding machine terminals and repeat step 6.
7	While continuously checking the magnetic field, increase the welding current on the power supply until the readings around the circumference are 30 Gauss or less.

	a. Depending on the extent of the magnetism and how it was created, it may not be possible to get the entire circumference of the weld joint to the desired Gauss level at the same time. In this case, welding shall only be done in the areas of the weld joint where the Gauss level is acceptable and then the welding machine current level adjusted for other areas until the weld is complete. Make sure the welding procedure is still followed, including time between passes. b. At some point around the circumference, the polarity of the magnetic field may switch, requiring the terminals of the welding machine to be switched to obtain the desired effect.
8	Weld the root pass around the circumference where the magnetism is below 30 Gauss while continuing to demagnetize the pipe. In other words, one welding machine is used to weld and one is used to demagnetize the pipe.
9	Once the root pass and hot pass are complete, the magnetic field will likely be reduced to an extent where the remaining passes can be welded without further demagnetization. However, in cases where magnetism is severe, the process shall be repeated during subsequent passes as necessary to complete the weld.

11. Contact

Gas Engineering

12. Appendices

Appendix A: Pipe Demagnetizing with a Welding Power Supply Procedure Schematic

13. Signature

Reviewed and approved by:

Randy L Bost

Randy L Bost (Apr 30, 2019)

14. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this procedure: • CM-PL-4000 *Appendix M: Demagnetization of Pipe*	Members of Work Process Integration Team
1	05/01/2019	• Revised the "WHO" section, added Gas Engineering, Gas Field Operations, and Technical Field Operations	Work Process Integration Team

Appendix: A Pipe Demagnetizing with a Welding Power Supply Procedure Schematic

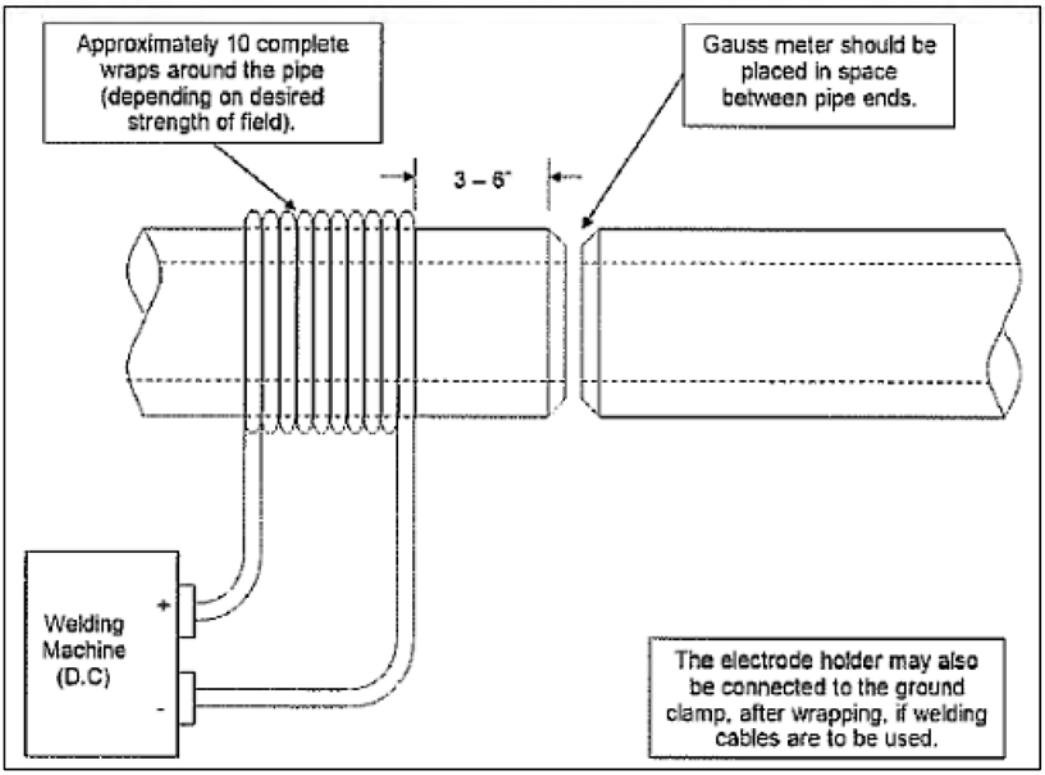


Table of Contents

Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 1-1 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

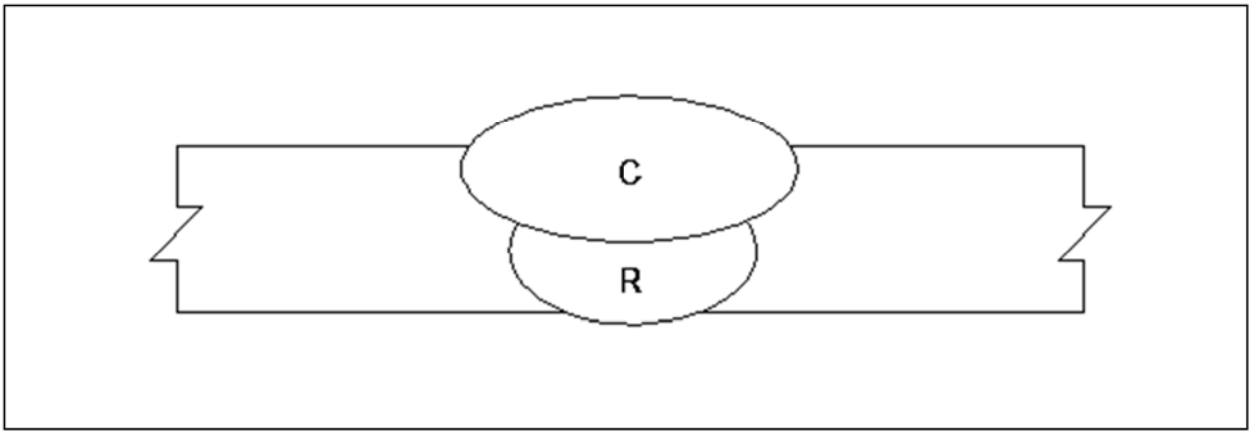
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.154" thick API 5L X42 to 2.375" diameter, 0.154" thick API 5L X42
Joint Design: No land, 1/16" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 31 minutes between root and hot pass
Preheat Temperature: Ambient (58°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 8 CFH and the flow rate of the oxygen was 20 CFH

WELDING PARAMETERS

Pass:	Root	Cap				
AWS Classification:	RG60	RG60				
Manufacture:	NR	NR				
Electrode Diameter:	3/32"	3/32"				
Current/Polarity:	NA	NA				
Current Range:	NA	NA				
Voltage Range:	NA	NA				
Travel Speed Range, ipm:	0.9 – 1.3	1.3				

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 1-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:	W1 RB1	W1 RB2						
Type:	Root	Root						
Results:	Pass (1)	Pass						

NICK-BREAK TEST

Coupon Number:	W1 NB1	W1 NB2		
Results:	Pass (1)	Pass		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 1-2 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

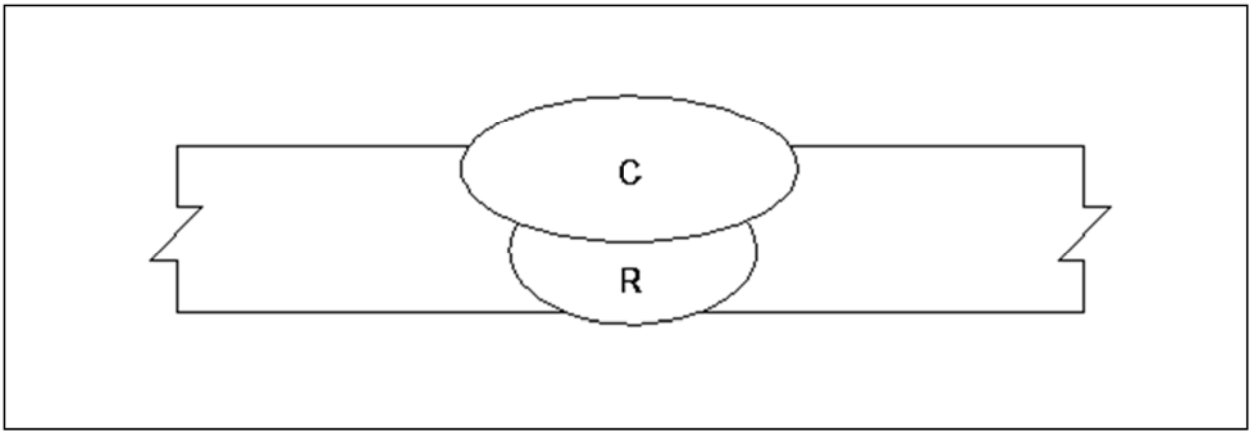
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42
Joint Design: No land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 31 minutes between root and hot pass
Preheat Temperature: Ambient (67°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 4 oxy-acetylene weld tip was used
The flow rate of the acetylene was 8 CFH and the flow rate of the oxygen was 22 CFH

WELDING PARAMETERS

Pass:	Root	Cap				
AWS Classification:	RG60	RG60				
Manufacture:	NR	NR				
Electrode Diameter:	3/32"	3/32"				
Current/Polarity:	NA	NA				
Current Range:	NA	NA				
Voltage Range:	NA	NA				
Travel Speed Range, ipm:	0.8 – 0.9	0.5 – 0.6				

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 1-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:	W1 RB1	W1 RB2						
Type:	Root	Root						
Results:	Pass	Pass (1)						

NICK-BREAK TEST

Coupon Number:	W1 NB1	W1 NB2		
Results:	Pass	Pass		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 1-3 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

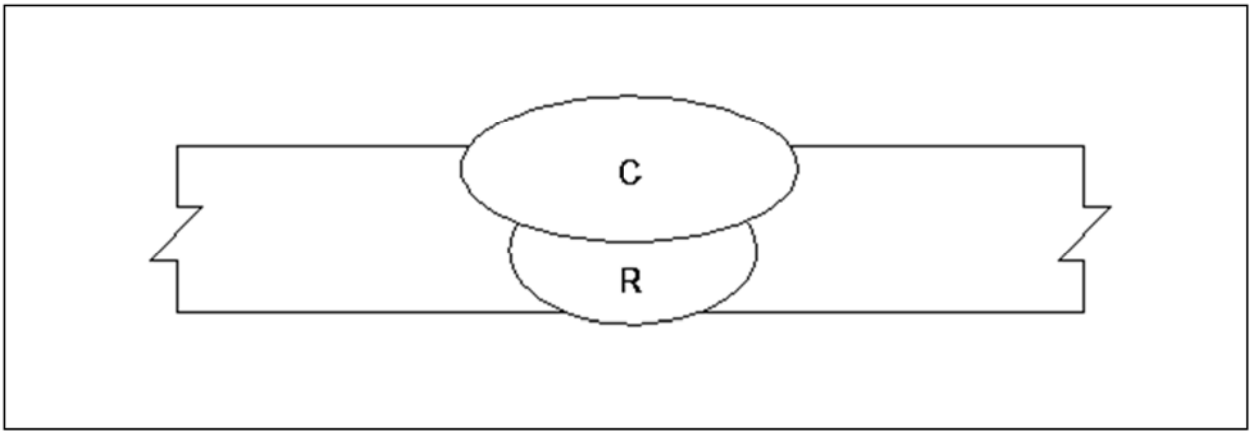
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.154" thick API 5L X52 to 2.375" diameter, 0.154" thick API 5L X52
Joint Design: No land, 1/16" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 30 minutes between root and hot pass
Preheat Temperature: Ambient (61°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 7 CFH and the flow rate of the oxygen was 18 CFH

WELDING PARAMETERS

Pass:	Root	Cap				
AWS Classification:	RG60	RG60				
Manufacture:	NR	NR				
Electrode Diameter:	3/32"	3/32"				
Current/Polarity:	NA	NA				
Current Range:	NA	NA				
Voltage Range:	NA	NA				
Travel Speed Range, ipm:	0.9 – 1.3	0.9				

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 1-3 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W3 T1			
Coupon Width:	1.070 inch			
Coupon Thickness:	0.155 inch			
Coupon Area:	0.166 $inch^2$			
Maximum Load:	14,204 lb			
Tensile Strength:	85,565 psi			
Fracture Location:	Base Metal			

BEND TEST

Coupon Number:	W3 RB1	W3 RB2						
Type:	Root	Root						
Results:	Pass	Pass						

NICK-BREAK TEST

Coupon Number:	W3 NB1	W3 NB2		
Results:	Pass	Pass		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 1-4 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

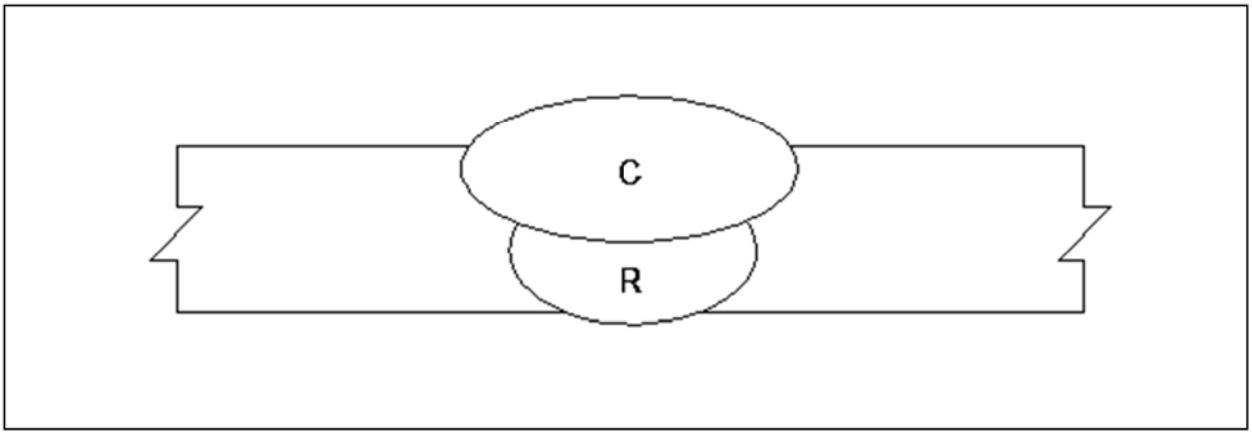
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.218" thick API 5L X52 to 2.375" diameter, 0.218" thick API 5L X52
Joint Design: No land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 32 minutes between root and hot pass
Preheat Temperature: Ambient (70°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 4 oxy-acetylene weld tip was used
The flow rate of the acetylene was 10 CFH and the flow rate of the oxygen was 20 CFH

WELDING PARAMETERS

Pass:	Root	Cap				
AWS Classification:	RG60	RG60				
Manufacture:	NR	NR				
Electrode Diameter:	3/32"	3/32"				
Current/Polarity:	NA	NA				
Current Range:	NA	NA				
Voltage Range:	NA	NA				
Travel Speed Range, ipm:	0.6 – 0.9	0.6				

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 1-4 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W4 T1			
Coupon Width:	0.957 inch			
Coupon Thickness:	0.218 inch			
Coupon Area:	0.209 $inch^2$			
Maximum Load:	16,355 psi			
Tensile Strength:	78,251 lb			
Fracture Location:	Weld (1)			

BEND TEST

Coupon Number:	W4 RB1	W4 RB2						
Type:	Root	Root						
Results:	Pass	Pass						

NICK-BREAK TEST

Coupon Number:	W4 NB1	W4 NB2		
Results:	Pass	Pass		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) The fracture surface passed the requirements of API 1104 5.6.3.3

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 2-1 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

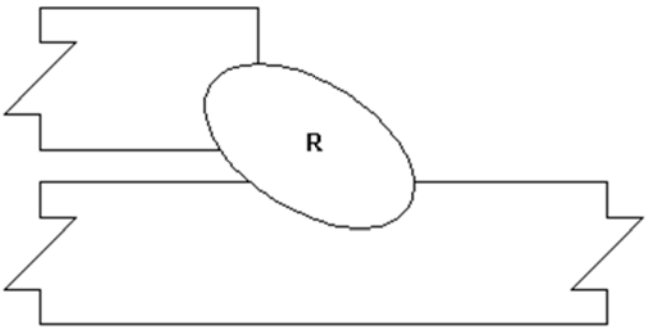
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.154" thick API 5L X42 to 2.375" diameter, 0.154" thick API 5L X42
Joint Design: Lap fillet joint with 1/16" gap
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 30 minutes between root and hot pass
Preheat Temperature: Ambient (66°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 8 CFH and the flow rate of the oxygen was 20 CFH

WELDING PARAMETERS

Pass:	Root					
AWS Classification:	RG60					
Manufacture:	NR					
Electrode Diameter:	3/32"					
Current/Polarity:	NA					
Current Range:	NA					
Voltage Range:	NA					
Travel Speed Range, ipm:	0.8					

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 2-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W5 NB1	W5 NB2	W5 NB3	W5 NB4
Results:	Pass	Pass	Pass (1)	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 2-2 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

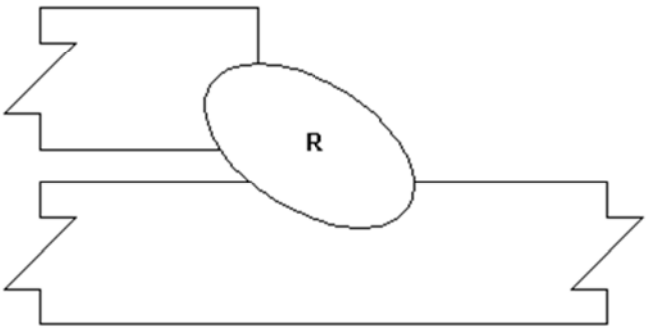
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42
Joint Design: Lap fillet joint with 1/16" gap
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 32 minutes between root and hot pass
Preheat Temperature: Ambient (59°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 8 CFH and the flow rate of the oxygen was 20 CFH

WELDING PARAMETERS

Pass:	Root					
AWS Classification:	RG60					
Manufacture:	NR					
Electrode Diameter:	3/32"					
Current/Polarity:	NA					
Current Range:	NA					
Voltage Range:	NA					
Travel Speed Range, ipm:	0.4 – 0.5					

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 2-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W6 NB1	W6 NB2	W6 NB3	W6 NB4
Results:	Pass	Pass	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 2-3 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

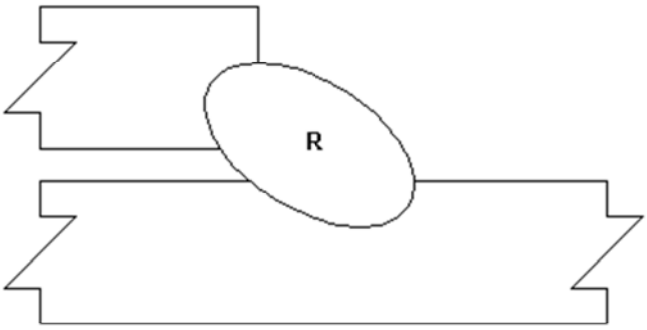
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.154" thick API 5L X52 to 2.375" diameter, 0.154" thick API 5L X52
Joint Design: Lap fillet joint with 1/16" gap
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 32 minutes between root and hot pass
Preheat Temperature: Ambient (64°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 10 CFH and the flow rate of the oxygen was 22 CFH

WELDING PARAMETERS

Pass:	Root					
AWS Classification:	RG60					
Manufacture:	NR					
Electrode Diameter:	3/32"					
Current/Polarity:	NA					
Current Range:	NA					
Voltage Range:	NA					
Travel Speed Range, ipm:	0.8 – 0.9					

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 2-3 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W7 NB1	W7 NB2	W7 NB3	W7 NB4
Results:	Pass	Pass	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 2-4 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

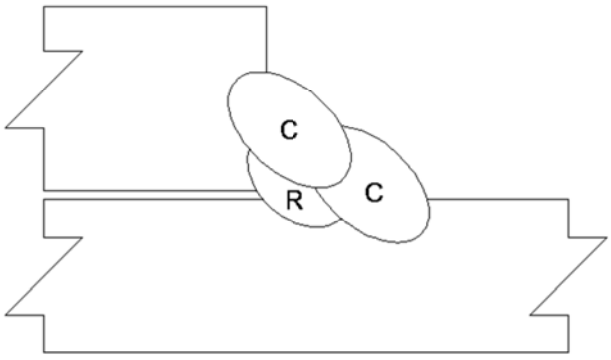
Welding Process: Manual Oxy-Acetylene Welding
Pipe Material: 2.375" diameter, 0.218" thick API 5L X52 to 2.375" diameter, 0.218" thick API 5L X52
Joint Design: Lap fillet joint with 1/16" gap
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: RG60
Time Between Passes: 34 minutes between root and hot pass
Preheat Temperature: Ambient (67°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments: Number 3 oxy-acetylene weld tip was used
The flow rate of the acetylene was 10 CFH and the flow rate of the oxygen was 20 CFH

WELDING PARAMETERS

Pass:	Root	Cap				
AWS Classification:	RG60	RG60				
Manufacture:	NR	NR				
Electrode Diameter:	3/32"	3/32"				
Current/Polarity:	NA	NA				
Current Range:	NA	NA				
Voltage Range:	NA	NA				
Travel Speed Range, ipm:	0.4 – 0.5	0.6 – 0.8				

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 2-4 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W8 NB1	W8 NB2	W8 NB3	W8 NB4
Results:	Pass	Pass (1)	Pass	Pass (1)

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 3-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

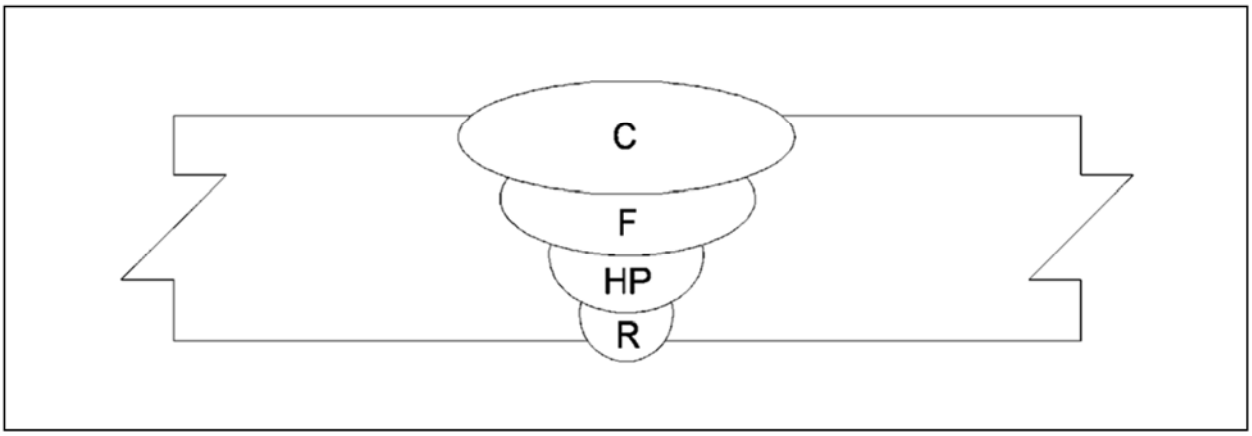
Welding Process: Manual SMAW
Pipe Material: 2.375" diameter, 0.154" thick API 5L X42 to 2.375" diameter, 0.154" thick API 5L X42
Joint Design: 1/16" land, 1/16" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010
Time Between Passes: 30 minutes between root and hot pass
Preheat Temperature: Ambient (68°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E6010	E6010	E6010		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	1/8"	1/8"	1/8"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	102 – 105	100 – 101	95 – 100	90		
Voltage Range:	27 – 28	30 – 31	30 – 31	30 – 31		
Travel Speed Range, ipm:	6.4 – 6.8	9.1 – 9.5	11.1 – 13.1	8.1 – 8.4		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 3-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:	W9 RB1	W9 RB2						
Type:	Root	Root						
Results:	Pass	Pass						

NICK-BREAK TEST

Coupon Number:	W9 NB1	W9 NB2		
Results:	Pass	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 3-2 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

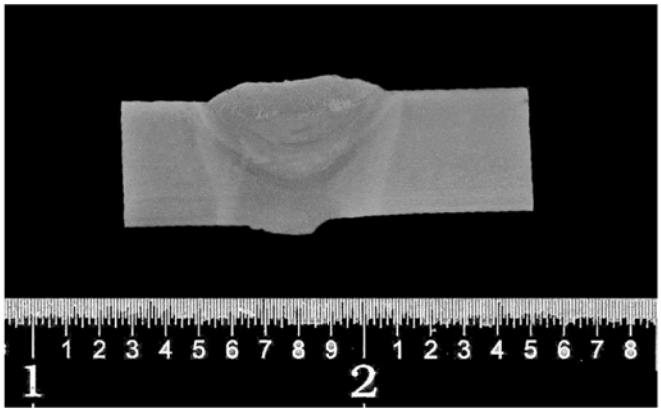
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X42 to 12.75" diameter, 0.375" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 1 hour, 2 minutes between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E7010-P1	E7010-P1	E7010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	75 – 77	100 – 110	105 – 112	100 – 105		
Voltage Range:	24 – 27	25 – 28	25 – 29	25 – 29		
Travel Speed Range, ipm:	3.5 – 5.7	4.1 – 5.5	3.1 – 4.4	2.9 – 4.8		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 3-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W10 T1	W10 T2		
Coupon Width:	0.970 inch	1.039 inch		
Coupon Thickness:	0.382 inch	0.374 inch		
Coupon Area:	0.371 $inch^2$	0.389 $inch^2$		
Maximum Load:	30,872 lb	31,569 lb		
Tensile Strength:	83,213 psi	81,155 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W10 FB1	W10 FB2	W10 RB1	W10 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass	Pass (1)	Pass				

NICK-BREAK TEST

Coupon Number:	W10 NB1	W10 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 3-3 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

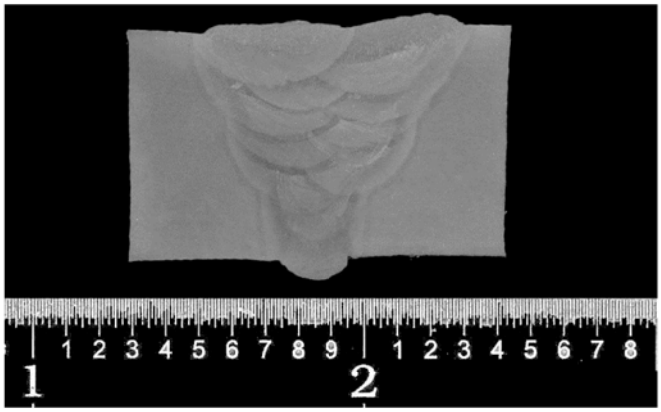
Welding Process: Manual SMAW
Pipe Material: 10.75" diameter, 0.844" thick API 5L X42 to 10.75" diameter, 0.844" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 2 hours, 25 minutes between root and hot pass
Preheat Temperature: Ambient (59°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E7010-P1	E7010-P1	E7010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	107 – 113	134 – 141	120 – 143	108 – 115		
Voltage Range:	24 – 26	26 – 31	26 – 30	27 – 29		
Travel Speed Range, ipm:	5.1 – 8.8	7.2 – 14.3	4.5 – 10.7	4.0 – 8.3		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 3-3 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W11 T1	W11 T2		
Coupon Width:	1.167 inch	1.133 inch		
Coupon Thickness:	0.870 inch	0.826 inch		
Coupon Area:	1.015 $inch^2$	0.936 $inch^2$		
Maximum Load:	71,300 lb	72,600 lb		
Tensile Strength:	70,200 psi	77,600 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W11 SB1	W11 SB2	W11 SB3	W11 SB4				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass (1)	Pass (1)	Pass (1)				

NICK-BREAK TEST

Coupon Number:	W11 NB1	W11 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 4-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

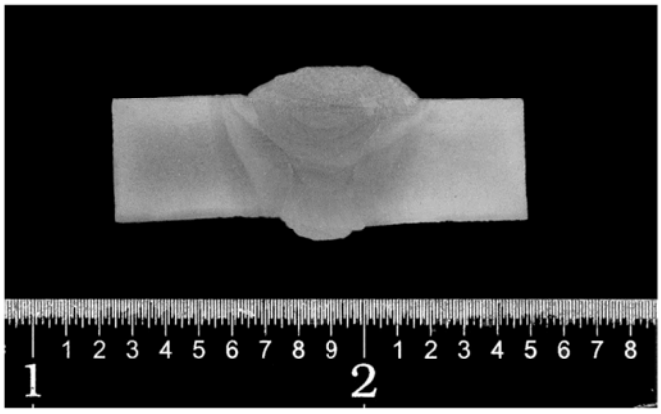
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X60 to 12.75" diameter, 0.375" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 1 hour, 52 minutes between root and hot pass
Preheat Temperature: Ambient (73°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E7010-P1	E7010-P1	E7010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	75 – 76	96 – 100	95 – 98	93 – 95		
Voltage Range:	24 – 26	24 – 27	25 – 28	27 – 29		
Travel Speed Range, ipm:	3.5 – 5.2	3.4 – 5.4	4.4 – 5.3	3.4 – 5.5		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 4-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W12 T1	W12 T2		
Coupon Width:	1.067 inch	1.023 inch		
Coupon Thickness:	0.367 inch	0.368 inch		
Coupon Area:	0.392 $inch^2$	0.376 $inch^2$		
Maximum Load:	35,340 lb	31984 lb		
Tensile Strength:	90,154 psi	85,065 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W12 FB1	W12 FB2	W12 RB2	W12 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass	Pass	Pass				

NICK-BREAK TEST

Coupon Number:	W12 NB1	W12 NB2		
Results:	Pass	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 4-2 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

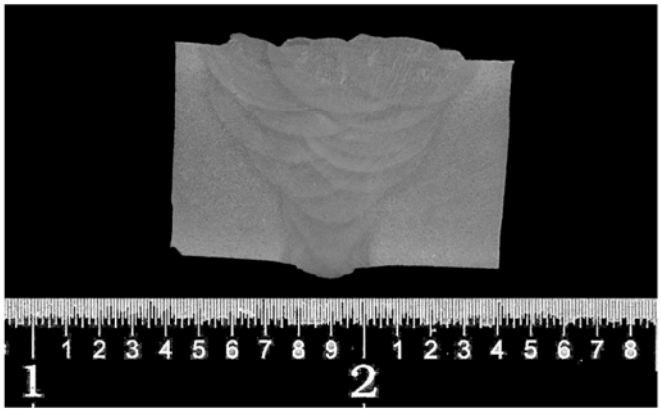
Welding Process: Manual SMAW
Pipe Material: 10.75" diameter, 0.875" thick API 5L X60 to 10.75" diameter, 0.875" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 18 hours 30 minutes between root and hot pass
Preheat Temperature: Ambient (60°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E7010-P1	E7010-P1	E7010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	78 – 79	107 – 118	107 – 119	105 – 116		
Voltage Range:	24 – 26	26 – 30	20 – 31	27 – 31		
Travel Speed Range, ipm:	3.9 – 4.8	5.2 – 7.2	2.4 – 6.7	2.7 – 5.1		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 4-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W13 T1	W13 T2		
Coupon Width:	1.144 inch	1.128 inch		
Coupon Thickness:	0.905 inch	0.912 inch		
Coupon Area:	1.035 $inch^2$	1.029 $inch^2$		
Maximum Load:	89060 lb	87,130 lb		
Tensile Strength:	86,000 psi	84,700 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W13 SB1	W13 SB2	W13 SB3	W13 SB4				
Type:	Side	Side	Side	Side				
Results:	Pass (1)	Pass (1)	Pass	Pass (1)				

NICK-BREAK TEST

Coupon Number:	W13 NB1	W13 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 4-3 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

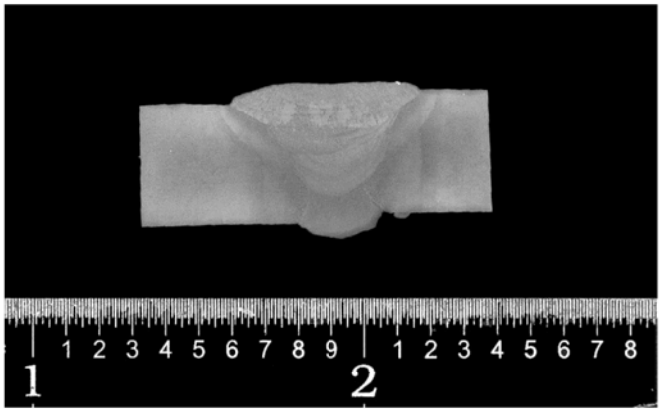
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X60 to 12.75" diameter, 0.375" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 4 hours, 22 minutes between root and hot pass
Preheat Temperature: Ambient (68°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	68 – 76	98 – 100	99 – 109	92 – 107		
Voltage Range:	22 – 26	24 – 27	24 – 26	24 – 28		
Travel Speed Range, ipm:	2.9 – 5.2	3.8 – 5.5	4.7 – 7.3	3.1 – 5.4		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 4-3 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W14 T1	W14 T2		
Coupon Width:	1.215 inch	1.102 inch		
Coupon Thickness:	0.374 inch	0.370 inch		
Coupon Area:	0.454 $inch^2$	0.408 $inch^2$		
Maximum Load:	40,575 lb	37,168 lb		
Tensile Strength:	89,373 psi	91,097 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W14 FB1	W14 FB2	W14 RB2	W14 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass (1)	Pass (1)	Pass (1)	Pass (1)				

NICK-BREAK TEST

Coupon Number:	W14 NB1	W14 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 4-4 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

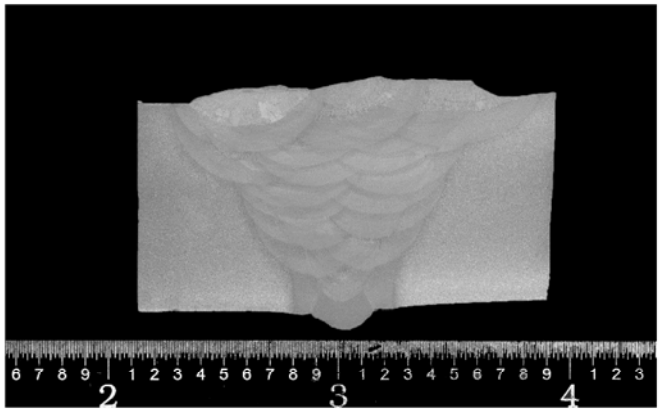
Welding Process: Manual SMAW
Pipe Material: 10.75" diameter, 0.875" thick API 5L X60 to 10.75" diameter, 0.875" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 6 hours, 27 minutes between root and hot pass
Preheat Temperature: Ambient (64°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	99 – 108	132 – 136	121 – 152	105 – 116		
Voltage Range:	24 – 25	25 – 27	25 – 29	27 – 31		
Travel Speed Range, ipm:	7.6 – 11.5	8.2 – 12.6	2.4 – 6.7	4.6 – 14.5		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 4-4 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W15 T1	W15 T2		
Coupon Width:	1.121 inch	1.087 inch		
Coupon Thickness:	0.897 inch	0.879 inch		
Coupon Area:	1.006 inch2	0.955 $inch^2$		
Maximum Load:	76,800 lb	83,800 lb		
Tensile Strength:	76,400 psi	87,700 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W15 SB1	W15 SB2	W15 SB3	W15 SB4				
Type:	Side	Side	Side	Side				
Results:	Pass (1)	Pass (1)	Pass (1)	Pass				

NICK-BREAK TEST

Coupon Number:	W15 NB1	W15 NB2		
Results:	Pass	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 5-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

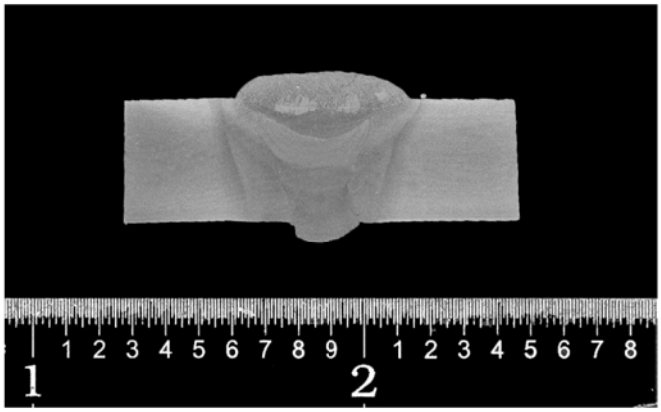
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X65 to 12.75" diameter, 0.375" thick API 5L X65
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 5 hours, 15 minutes between root and hot pass
Preheat Temperature: Ambient (64°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fills	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	106 – 113	141 – 145	131 – 137	114 – 119		
Voltage Range:	24 – 26	25 – 27	26 – 28	25 – 28		
Travel Speed Range, ipm:	7.0 – 11.2	8.0 – 11.4	5.7 – 8.5	4.3 – 6.0		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 5-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W16 T1	W16 T2		
Coupon Width:	1.029 inch	1.073 inch		
Coupon Thickness:	0.370 inch	0.377 inch		
Coupon Area:	0.381 $inch^2$	0.405 $inch^2$		
Maximum Load:	32,841 lb	33,019 lb		
Tensile Strength:	86,196 psi	81,530 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W16 FB1	W16 FB2	W16 RB1	W16 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass	Pass (1)	Pass				

NICK-BREAK TEST

Coupon Number:	W16 NB1	W16 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 6-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

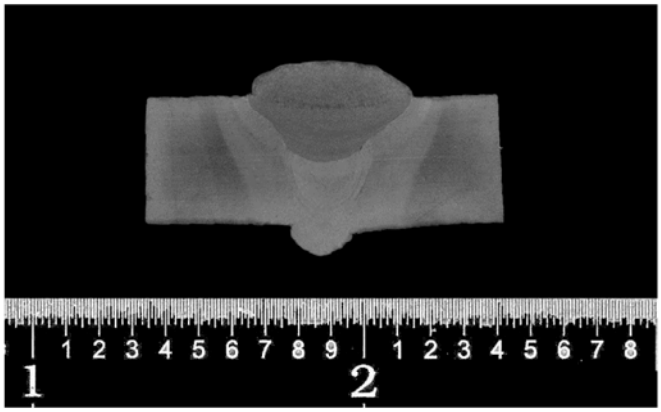
Welding Process: Manual SMAW
Pipe Material: 24" diameter, 0.375" thick API 5L X70 to 24" diameter, 0.375" thick API 5L X70
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 24 hours between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fills	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	102 – 114	139 – 141	126 – 142	111 – 132		
Voltage Range:	22 – 25	26 – 27	25 – 28	20 – 29		
Travel Speed Range, ipm:	6.1 – 11.3	5.9 – 8.7	4.8 – 9.3	4.4 – 7.5		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 6-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W17 T1	W17 T2	W17 T3	W17 T4
Coupon Width:	1.015 inch	0.953 inch	1.041 inch	1.084 inch
Coupon Thickness:	0.382 inch	0.383 inch	0.386 inch	0.382 inch
Coupon Area:	0.388 $inch^2$	0.365 $inch^2$	0.402 $inch^2$	0.414 $inch^2$
Maximum Load:	34,230 lb	32,731 lb	35,591 lb	35,871 lb
Tensile Strength:	88,222 psi	89,675 psi	88,535 psi	86,646 psi
Fracture Location:	Base Metal	Base Metal	Base Metal	Base Metal

BEND TEST

Coupon Number:	W17FB1	W17FB2	W17FB3	W17FB4	W17RB1	W17RB2	W17RB3	W17RB4
Type:	Face	Face	Face	Face	Root	Root	Root	Root
Results:	Pass (1)	Pass	Pass	Pass	Pass (1)	Pass	Pass	Pass

NICK-BREAK TEST

Coupon Number:	W17 NB1	W17 NB2	W17 NB3	W17 NB4
Results:	Pass (1)	Pass	Pass (1)	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 7-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

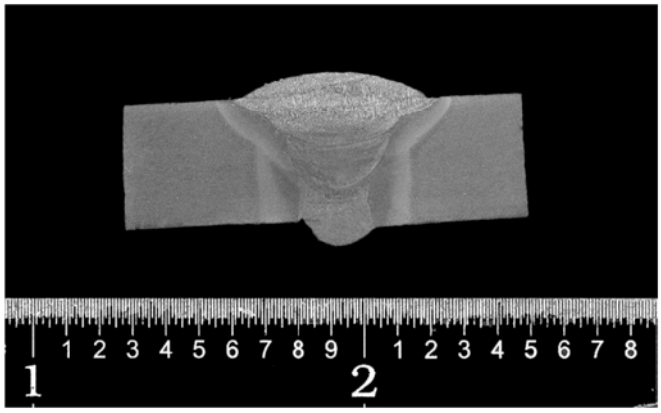
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X42 to 12.75" diameter, 0.375" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: E7016 root, E7018 remainder
Time Between Passes: 2 hours, 55 minutes between root and hot pass
Preheat Temperature: Ambient (62°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E7016	E7018	E7018	E7018		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	3/32"	1/8"	1/8"	1/8"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	76 – 84	97 – 108	111 – 115	99 – 111		
Voltage Range:	20 – 25	20 – 22	21 – 23	20 – 22		
Travel Speed Range, ipm:	2.5 – 5.2	3.4 – 5.9	3.0 – 4.3	2.3 – 4.4		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 7-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W18 T1	W18 T2		
Coupon Width:	1.028 inch	1.016 inch		
Coupon Thickness:	0.374 inch	0.381 inch		
Coupon Area:	0.384 $inch^2$	0.387 $inch^2$		
Maximum Load:	29,486 lb	29,733 lb		
Tensile Strength:	76,787 psi	76,829 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W18 FB1	W18 FB2	W18 RB1	W18 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass	Pass	Pass				

NICK-BREAK TEST

Coupon Number:	W18 NB1	W18 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 7-2 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

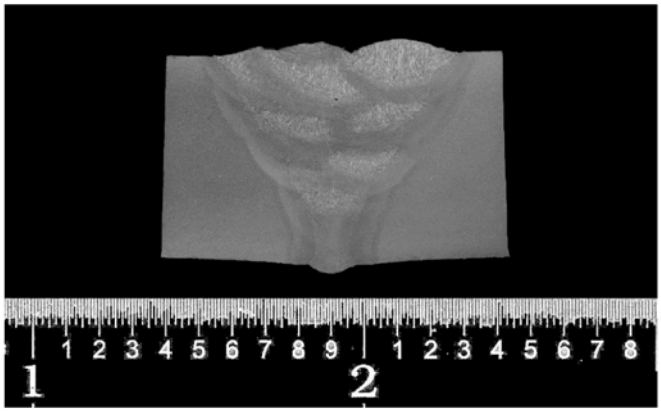
Welding Process: Manual SMAW
Pipe Material: 10.75" diameter, 0.844" thick API 5L X42 to 10.75" diameter, 0.844" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: E7016 root, E7018 remainder
Time Between Passes: 22 hours, 55 minutes between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E7016	E7018	E7018	E7018		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	3/32"	1/8"	1/8"	1/8"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	79 – 82	104 – 110	110 – 119	109 – 119		
Voltage Range:	21 – 24	22 – 23	21 – 24	21 – 23		
Travel Speed Range, ipm:	2.6 – 4.3	2.9 – 4.8	2.1 – 4.8	2.3 – 4.9		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 7-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W19 T1	W19 T2		
Coupon Width:	0.991 inch	0.980 inch		
Coupon Thickness:	0.863 inch	0.866 inch		
Coupon Area:	0.855 $inch^2$	0.849 $inch^2$		
Maximum Load:	66,240 lb	67,470 lb		
Tensile Strength:	77,500 psi	79,500 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W19 SB1	W19 SB2	W19 SB3	W19 SB4				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass (1)	Pass	Pass				

NICK-BREAK TEST

Coupon Number:	W19 NB1	W19 NB2		
Results:	Pass	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 8-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

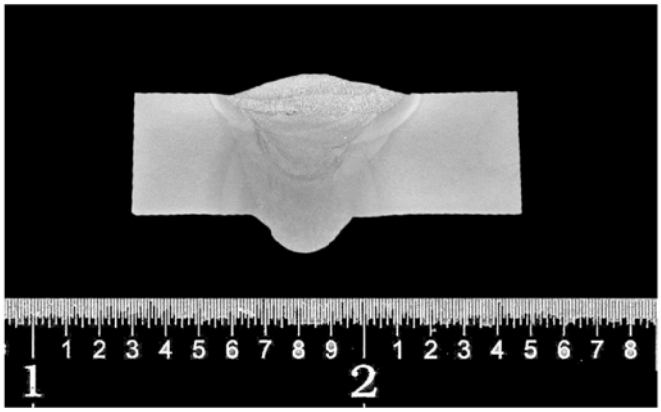
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X60 to 12.75" diameter, 0.375" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: E7016 root, E7018 remainder
Time Between Passes: 1 hour, 22 minutes between root and hot pass
Preheat Temperature: Ambient (64°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E7016	E7018	E7018	E7018		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	3/32"	1/8"	1/8"	1/8"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	78 – 89	96 – 102	106 – 109	100 – 118		
Voltage Range:	20 – 28	20 – 22	20 – 23	20 – 24		
Travel Speed Range, ipm:	2.5 – 6.0	3.7 – 5.3	3.2 – 4.5	2.6 – 6.5		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 8-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W20 T1	W20 T2		
Coupon Width:	1.067 inch	1.046 inch		
Coupon Thickness:	0.369 inch	0.370 inch		
Coupon Area:	0.394 $inch^2$	0.387 $inch^2$		
Maximum Load:	34,143 lb	33,609 lb		
Tensile Strength:	86,656 psi	86,845 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W20 FB1	W20 FB2	W20 RB1	W20 RB2				
Type:	Face	Face	Root	Root				
Results:	Pass	Pass (1)	Pass	Pass (1)				

NICK-BREAK TEST

Coupon Number:	W20 NB1	W20 NB2		
Results:	Pass (1)	Pass (1)		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 8-2 **Date:** 12/4/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

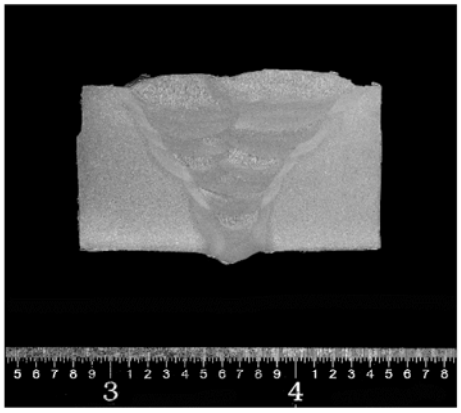
Welding Process: Manual SMAW
Pipe Material: 10.75" diameter, 0.875" thick API 5L X60 to 10.75" diameter, 0.875" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 70 degree bevel butt joint
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: E7016 root, E7018 remainder
Time Between Passes: 8 hours, 3 minutes between root and hot pass
Preheat Temperature: Ambient (43°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E7016	E7018	E7018	E7018		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	3/32"	1/8"	1/8"	1/8"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	68 – 75	101 – 108	120 – 137	120 – 130		
Voltage Range:	20 – 23	20 – 22	20 – 23	20 – 22		
Travel Speed Range, ipm:	2.7 – 4.3	2.6 – 4.4	2.0 – 5.0	2.0 – 4.1		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 8-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:	W21 T1	W21 T2		
Coupon Width:	1.120 inch	1.041 inch		
Coupon Thickness:	0.886 inch	0.887 inch		
Coupon Area:	0.992 $inch^2$	0.923 $inch^2$		
Maximum Load:	87,487 lb	77,811 lb		
Tensile Strength:	88,192 psi	84,302 psi		
Fracture Location:	Base Metal	Base Metal		

BEND TEST

Coupon Number:	W21 SB1	W21 SB2	W21 SB3	W21 SB4				
Type:	Side	Side	Side	Side				
Results:	Pass (1)	Pass	Pass (1)	Pass				

NICK-BREAK TEST

Coupon Number:	W21 NB1	W21 NB2		
Results:	Pass	Pass		

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 12/4/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 9-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

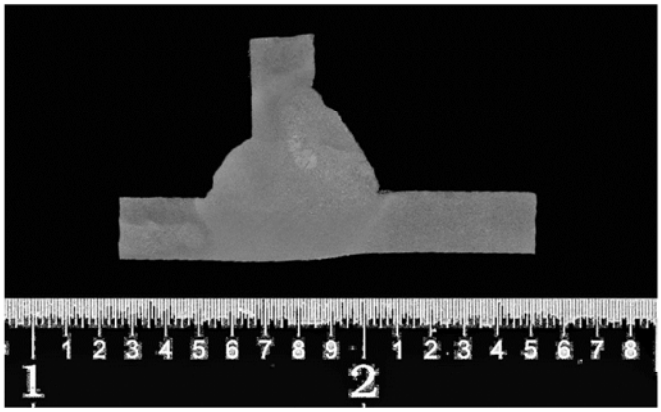
Welding Process: Manual SMAW
Pipe Material: 2.375" diameter, 0.154" thick API 5L X42 to 2.375" diameter, 0.154" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010
Time Between Passes: 17 hours, 10 minutes between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Cap			
AWS Classification:	E6010	E6010	E6010			
Manufacture:	Lincoln	Lincoln	Lincoln			
Electrode Diameter:	1/8"	1/8"	1/8"			
Current/Polarity:	DCEP	DCEP	DCEP			
Current Range:	65 – 71	85 – 89	84 – 90			
Voltage Range:	24 – 26	25 – 28	25 – 28			
Travel Speed Range, ipm:	2.2 – 3.4	5.4 – 10.7	4.0 – 5.6			

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 9-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W22 NB1	W22 NB2	W22 NB3	W22 NB4
Results:	Pass	Pass	Pass	Pass (1)

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 9-2 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

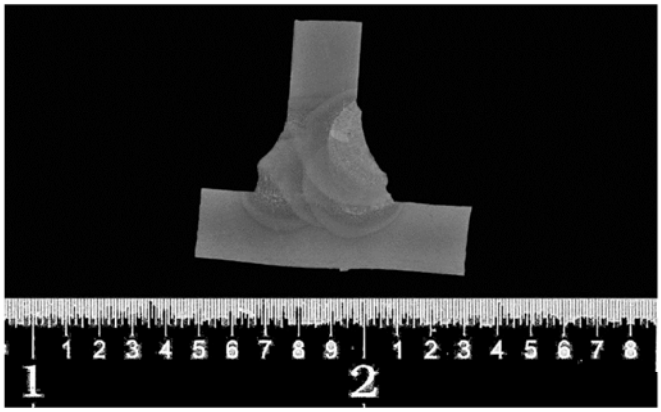
Welding Process: Manual SMAW
Pipe Material: 6.625" diameter, 0.280" thick API 5L X42 to 6.625" diameter, 0.280" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 18 hours, 11 minutes between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Cap			
AWS Classification:	E6010	E7010-P1	E7010-P1			
Manufacture:	Lincoln	Lincoln	Lincoln			
Electrode Diameter:	1/8"	5/32"	5/32"			
Current/Polarity:	DCEP	DCEP	DCEP			
Current Range:	85 – 95	110 – 111	110 – 113			
Voltage Range:	24 – 28	26 – 28	26 – 28			
Travel Speed Range, ipm:	2.9 – 4.5	4.0 – 6.4	3.5 – 6.4			

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 9-2 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W23 NB1	W23 NB2	W23 NB3	W23 NB4
Results:	Pass	Pass	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 10-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

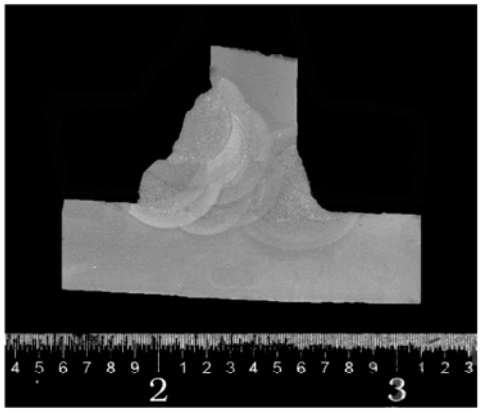
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X60 to 12.75" diameter, 0.375" thick API 5L X60
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E7010-P1 remainder
Time Between Passes: 44 hours, 39 minutes between root and hot pass
Preheat Temperature: Ambient (52°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E7010-P1	E7010-P1	E7010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	83 – 106	113 – 120	110 – 118	100 – 115		
Voltage Range:	25 – 33	25 – 28	25 – 29	26 – 30		
Travel Speed Range, ipm:	3.2 – 5.5	3.4 – 5.5	3.7 – 6.8	3.2 – 7.0		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 10-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W24 NB1	W24 NB2	W24 NB3	W24 NB4
Results:	Pass (1)	Pass	Pass (1)	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 10-3 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

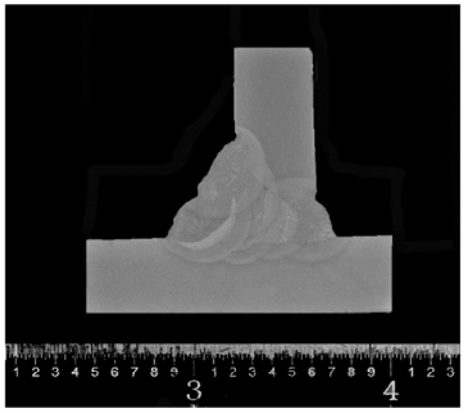
Welding Process: Manual SMAW
Pipe Material: 12.75" diameter, 0.375" thick API 5L X60 to 12.75" diameter, 0.375" thick API 5L X60
Joint Design: 3/32" land, 1/16" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 20 hours, 18 minutes between root and hot pass
Preheat Temperature: Ambient (74°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	75 – 98	115 – 123	117 – 133	116 – 122		
Voltage Range:	23 – 30	24 – 27	23 – 27	25 – 28		
Travel Speed Range, ipm:	3.2 – 5.5	3.4 – 5.6	3.8 – 9.3	3.3 – 6.2		

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 10-3 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W26 NB1	W26 NB2	W26 NB3	W26 NB4
Results:	Pass (1)	Pass	Pass (1)	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 11-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

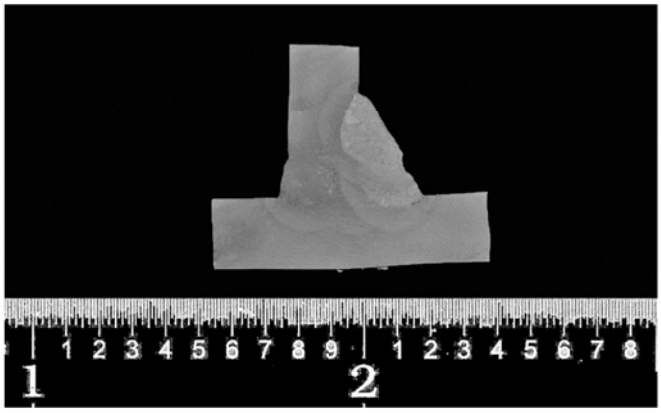
Welding Process: Manual SMAW
Pipe Material: 6.625" diameter, 0.280" thick API 5L X65 to 6.625" diameter, 0.280" thick API 5L X65
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 3 hours, 14 minutes between root and hot pass
Preheat Temperature: Ambient (61°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Cap			
AWS Classification:	E6010	E8010-P1	E8010-P1			
Manufacture:	Lincoln	Lincoln	Lincoln			
Electrode Diameter:	1/8"	5/32"	5/32"			
Current/Polarity:	DCEP	DCEP	DCEP			
Current Range:	82 – 89	113 – 122	118 – 121			
Voltage Range:	25 – 29	24 – 28	24 – 26			
Travel Speed Range, ipm:	3.7 – 4.8	4.7 – 6.9	4.9 – 6.7			

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 11-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W28 NB1	W28 NB2	W28 NB3	W28 NB4
Results:	Pass	Pass (1)	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments: (1) Indications were present but were within the acceptable limits of API 1104

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 12-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeff Ellis, Piedmont Natural Gas

Welding Process: Manual SMAW
Pipe Material: 24" diameter, 0.375" thick API 5L X70 to 2.375" diameter, 0.700" thick F70
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Downhill
Filler Metal: E6010 root, E8010-P1 remainder
Time Between Passes: 24 hours between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Fill	Cap		
AWS Classification:	E6010	E8010-P1	E8010-P1	E8010-P1		
Manufacture:	Lincoln	Lincoln	Lincoln	Lincoln		
Electrode Diameter:	1/8"	5/32"	5/32"	5/32"		
Current/Polarity:	DCEP	DCEP	DCEP	DCEP		
Current Range:	88 – 106	106 – 109	117 – 145	114 – 124		
Voltage Range:	23 – 27	28 – 29	25 – 28	24 – 27		
Travel Speed Range, ipm:	5.1 – 14.9	8.2 – 9.6	6.6 – 10.6	5.3 – 6.9		

Comments:

FIGURE 1 – BEAD SEQUENCE

DUKE ENERGY

Test Number: 12-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W29 NB1	W29 NB2	W29 NB3	W29 NB4
Results:	Pass	Pass	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

DUKE ENERGY

API 1104 COUPON TEST REPORT

Test Number: 13-1 **Date:** 10/16/2014
Location: Kiefner, Worthington, Ohio
Welder: Jeremy Didion, Apeks Fabrication

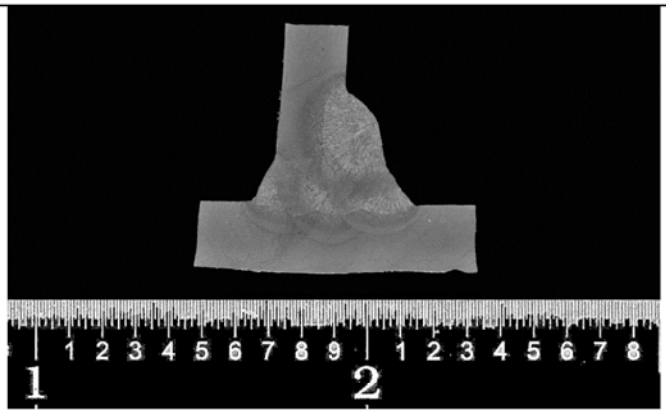
Welding Process: Manual SMAW
Pipe Material: 6.625" diameter, 0.280" thick API 5L X42 to 6.625" diameter, 0.280" thick API 5L X42
Joint Design: 3/32" land, 3/32" gap, 45 degree bevel branch groove
Position: 5G, Fixed **Welding Direction:** Uphill
Filler Metal: E7016 root, E7018 remainder
Time Between Passes: 3 hours, 15 minutes between root and hot pass
Preheat Temperature: Ambient (65°F) **Interpass Temperature:** NR
Post-weld Heat Treatment: None
Line-up Clamps: None used
Comments:

WELDING PARAMETERS

Pass:	Root	Hot Pass	Cap			
AWS Classification:	E7016	E7018	E7018			
Manufacture:	Lincoln	Lincoln	Lincoln			
Electrode Diameter:	3/32"	1/8"	1/8"			
Current/Polarity:	DCEP	DCEP	DCEP			
Current Range:	75 – 81	99 – 102	100 – 104			
Voltage Range:	21 – 25	20 – 22	20 – 22			
Travel Speed Range, ipm:	2.7 – 5.6	2.2 – 3.6	2.4 – 4.9			

Comments:

FIGURE 1 – BEAD SEQUENCE



DUKE ENERGY

Test Number: 13-1 **Page:** 2 of 2

TENSILE STRENGTH TEST

Coupon Number:				
Coupon Width:				
Coupon Thickness:				
Coupon Area:				
Maximum Load:				
Tensile Strength:				
Fracture Location:				

BEND TEST

Coupon Number:								
Type:								
Results:								

NICK-BREAK TEST

Coupon Number:	W30 NB1	W30 NB2	W30 NB3	W30 NB4
Results:	Pass	Pass	Pass	Pass

CHARPY TOUGHNESS TEST

Coupon Number:						
Depth:						
Width:						
Notch Location:						
Test Temperature:						
Impact Energy:						
% Shear:						
Lateral Expansion:						

Comments:

OTHER TESTS

Test Type:

Results:

We certify that the statements in this record are correct and that the test welds were prepared, welded, and tested in accordance with the requirements of the 21st Edition of API 1104.

Date: 10/16/2014

Test Conducted By: Jim Winigman, Kiefner

Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:

1. **Signature**

Reviewed and approved by:

Randy L Bost

Randy L Bost (Apr 30, 2019)

2. Revision Log

The table below documents the history of each revision issued and identifies the following: Revision Number, Date, Summary of Changes (including reason for change, and a list of Legacy Duke/Piedmont Documents used to integrate this document), Responsible Party (person or group facilitating changes).

Rev #	Date	Summary of Changes	Responsible Party
0	03/31/2019	• Initial Issue Legacy Documents incorporated into this procedure: • CM-PL-4000 *PNG Welding Manual Attachment 2 – Piedmont Natural Gas Procedure Qualification Records* • PQR *Legacy Duke documents* • Contributing JIP PQRs that correspond to WPS' (old #) *14 – 27*	Members of Work Process Integration Team
1	05/01/2019	• Revised the "WHO" section, added Gas Engineering, Gas Field Operations, and Technical Field Operations • Legacy Documents incorporated into this procedure: PQRs Belonging to WPS' 1-13 (Attachment 1 of CM-PL-4000)	Work Process Integration Team

OQ Test and Performance Evaluation Form

Covered Task: ***TNDTW001*** Description: ***NDT-Radiographic Testing***

ID#: _____ Vendor Company: _____

Individual: _____ DOB: _____ Resource Center: _____

Verification of Training

This section **MUST** be completed if:

- This is an Initial Evaluation, or,
- The individual's qualification has been expired for more than 90 days, or
- The individual has lost their qualification due to poor performance or incident, or
- There has been a significant change that impacts the way the task is performed

Training Method: ☐ CBT (Computer Based Training) ☐ Shadowing ☐ ILT (Instructor Lead Training) ☐ Other _____

I acknowledge that this training was verified and in accordance with the learning objectives identified for this Covered Task.

*Evaluator/Instructor***PLEASE PRINT NAME* *ID Number* *Date*

Pre-Evaluation Testing

Testing Method: ☐ Written ☐ CBT (Computer Based Training)

☐ Passed Pre-evaluation has been successfully completed by scoring **80% or greater**.

☐ Failed The individual listed above has **FAILED** the pre-evaluation test by scoring **less than 80%**.

*Test Administrator ***PLEASE PRINT NAME* *ID Number* *Date*

Performance Evaluation

Evaluation Reason: ☐ Initial ☐ Subsequent ☐ Incident ☐ Poor Performance

Evaluation Method: ☐ Field Evaluation ☐ Simulated Evaluation

Qualified: ☐ Yes Individual listed above has performed the evaluation steps in accordance to NGBU Policies and Procedures.

Qualified: ☐ No The individual listed above has **FAILED** to perform the evaluation steps in accordance to NGBU Policies and Procedures. Please attach completed **Qualification Suspension Form** and email to address below.

*Evaluator Signature ***PLEASE PRINT & SIGN* *ID Number* *Date*

*Individuals' Signature ***PLEASE PRINT & SIGN* *ID Number* *Date*

Please sign and e-mail completed form and certifications to: OQPEF@duke-energy.com
Only ***LEGIBLE***, fully completed and signed forms will be accepted. You must verify all ID#'s are correct.

New 4/3/2020

Evaluation Steps Complete **NGBU Pre-Job Brief Form or Lone Worker Form**	**Satisfactory**	**Unsatisfactory**	**Evaluation Criteria:** **DOT: 192.241 / 192.243** **WEL-ST-1060** **API-1104 21st Edition** **SNT-TC-1A NDT Level II** Subsequent Qualification Interval: 36 Months
1. Successful completion of Radiographic Testing Training and Certification.	❑	❑	Must be certified at a minimum of Radiographic Level II Certification.
2. Perform Radiographic Testing			Follows steps outlined in Radiographic testing technique
3. Individual demonstrated proper use of any applicable safety equipment and/or safety procedures	❑	❑	Individual has available / utilizes all procedures and safety equipment
4. Individual identified two task specific AOC's Examples include ❑ Unable to retract radiation source ❑ Unauthorized person(s) entering radiation area ❑ Uncontrolled ignition of gas ❑ Material defects ❑ Any potential hazard people, property or environment	❑	❑	Follows procedures as outlined in NGBU Procedure manuals and/or training classes/instruction.
5. Individual verbalized appropriate reaction to the task specific AOC's ❑ Make area safe ❑ Report ❑ Repair if qualified	❑	❑	Individual has identified and described the Abnormal Operating Condition(s) that could be encountered while performing covered task.

Attach NDT Testing Certifications with this document

Table of Contents*

**Please consult Table 2 in WEL-ST-1000 Duke Energy NGBU Welding Standard for details summarizing each welding procedure prior to locating the procedure in this document.*

Who

- Gas Engineering
- Major Projects
- Gas Field Operations
- Technical Field Operations

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 10 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 1-1, 1-2, 1-3, 1-4

Welding Process: Manual Oxy-Acetylene Welding

Pipe or Fitting Material: API 5L X52 or less or equivalent material

Pipe or Fitting Diameter: 2.375 inch or less **Pipe or Fitting Wall Thickness:** 0.218 inch or less

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

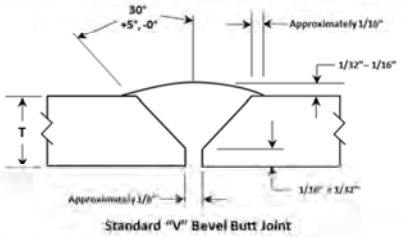
Comments: The weld should be allowed to air cool prior to inspection

Number 0 to Number 4 oxy-acetylene welding tips are permitted and should be based on wall thickness

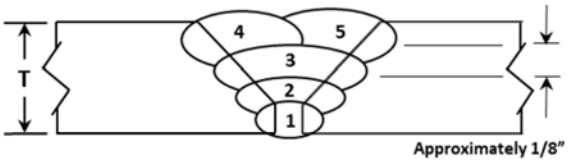
WELDING PARAMETERS

Pass:	All		
AWS Classification:	RG60 or RG65		
Rod Diameter:	3/32"	1/8"	5/32"
Welding Gas:	Oxygen/Acetylene	Oxygen/Acetylene	Oxygen/Acetylene
Acetylene Flow Rate, CFH:	2 – 25	2 – 25	2 – 25
Gas Pressure, psi:	3 – 10 / 3 – 7	3 – 10 / 3 – 7	3 – 10 / 3 – 7
Flame Type:	Neutral	Neutral	Neutral
Travel Speed Range, ipm:	0.5 – 2.0	0.5 – 2.0	0.5 – 2.0

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Standard "V" Bevel Butt Joint



Approved (SME): _____ **Date:** _____

Approved (Dir. of Eng.): **Date:**

DUKE ENERGY.

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 20 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 2-1, 2-2, 2-3, 2-4

Welding Process: Manual Oxy-Acetylene Welding

Pipe or Fitting Material: API 5L X52 or less or equivalent material

Pipe or Fitting Diameter: 2.375 inch or less

Pipe or Fitting Wall Thickness: 0.218 inch or less for run pipe with slightly larger diameter permitted for the expanded pipe end

Joint Design: Socket welds, Figure 1

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the shall be cleaned between passes with power or hand tools

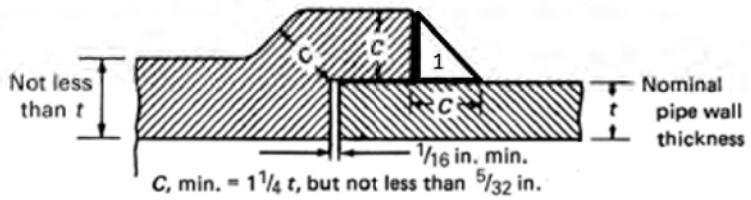
Comments: The weld should be allowed to air cool prior to inspection

Number 0 to Number 4 oxy-acetylene welding tips are permitted and tip selection should be based on wall thickness

WELDING PARAMETERS

Pass:	All		
AWS Classification:	RG60 or RG65		
Rod Diameter:	3/32"	1/8"	5/32"
Welding Gas:	Oxygen/Acetylene	Oxygen/Acetylene	Oxygen/Acetylene
Acetylene Flow Rate, CFH:	2 – 25	2 – 25	2 – 25
Gas Pressure, psi:	3 – 10 / 3 – 7	3 – 10 / 3 – 7	3 – 10 / 3 – 7
Flame Type:	Neutral	Neutral	Neutral
Travel Speed Range, ipm:	0.5 – 2.0	0.5 – 2.0	0.5 – 2.0

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved (SME): _____ **Date:** _____

Approved (Dir. of Eng.): **Date:**

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 30 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 3-1, 3-2, 3-3, 1-X42-179, 2-X42-154, 12-X42-219, 20-GRB-250

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** All

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 250°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

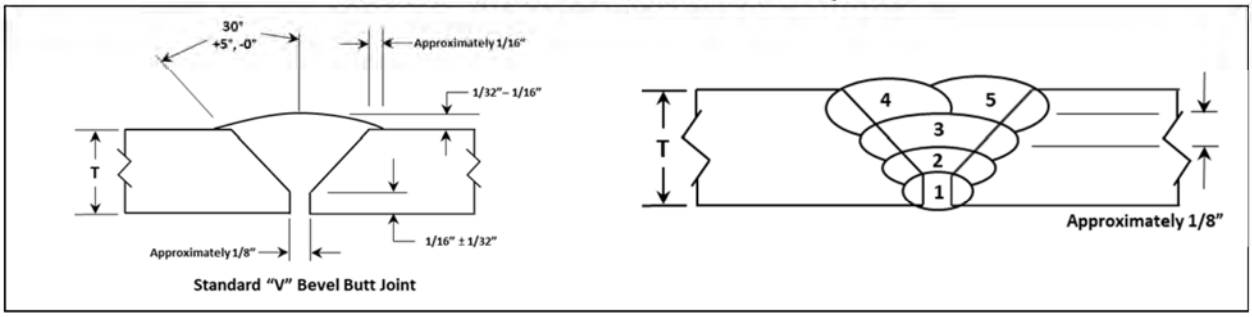
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	All (including backwelding*)			All (including backwelding*)		
AWS Classification:	E6010			E7010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	19 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 40 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 4-1, 4-2, 4-3, 4-4, 12-X60-375, 12-X52-375, 16-X60-312

Welding Process: Manual SMAW

Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 250°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

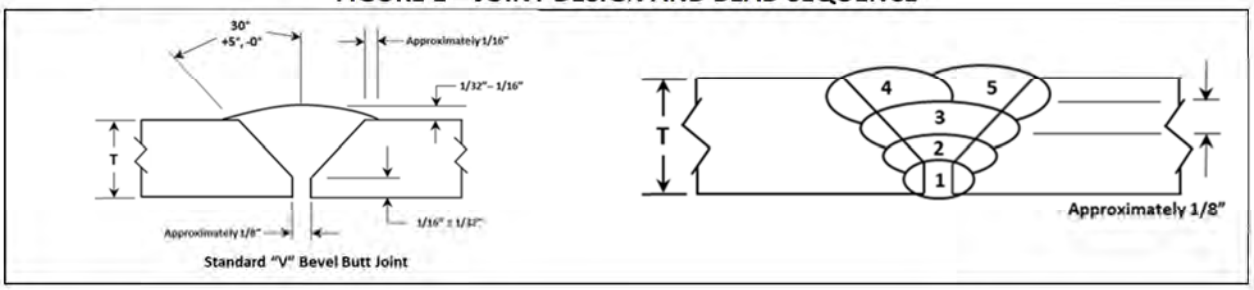
Comments: The weld should be allowed to air cool prior to inspection
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	Root or All			Remainder (including backwelding*)		
AWS Classification:	E6010			E7010 or E8010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 140	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	18 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 50 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 5-1, 16-X65-375

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

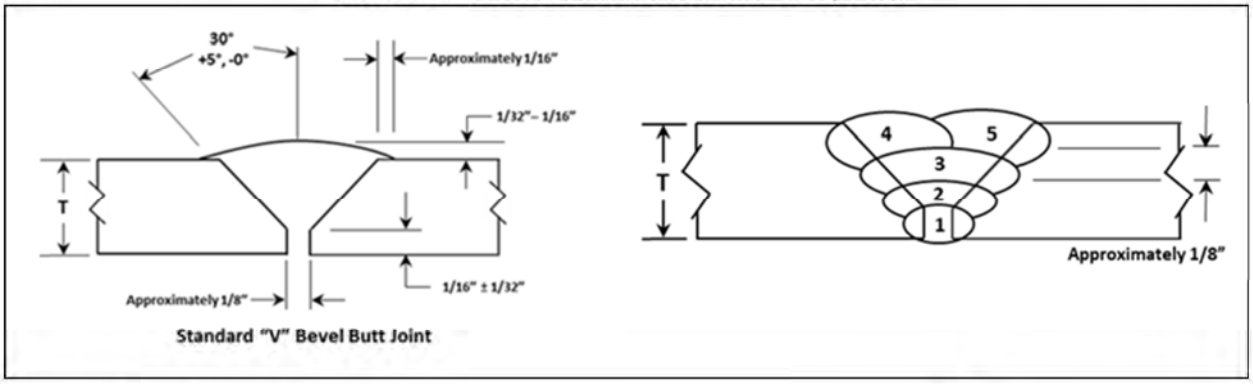
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder (including backwelding*)		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 60 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 6-1

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X70 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

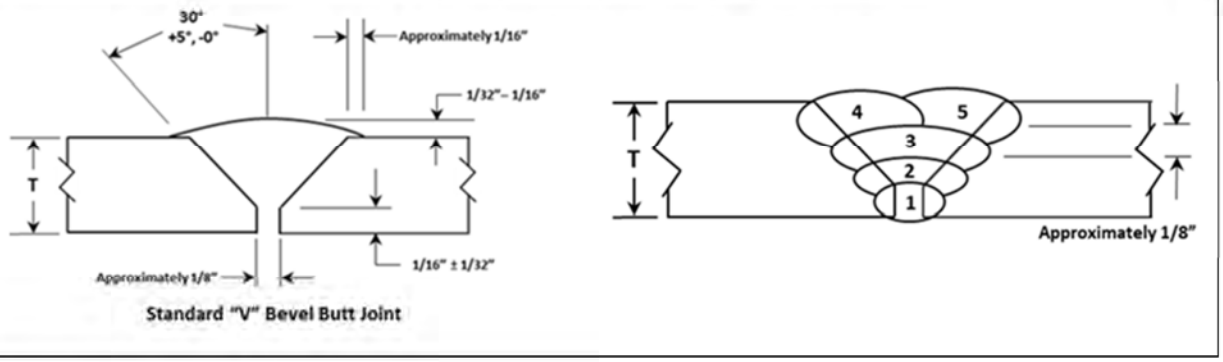
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder (including backwelding*)		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 125	100 – 165	65 – 120	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

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WPS Number: 70 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 7-1, 7-2

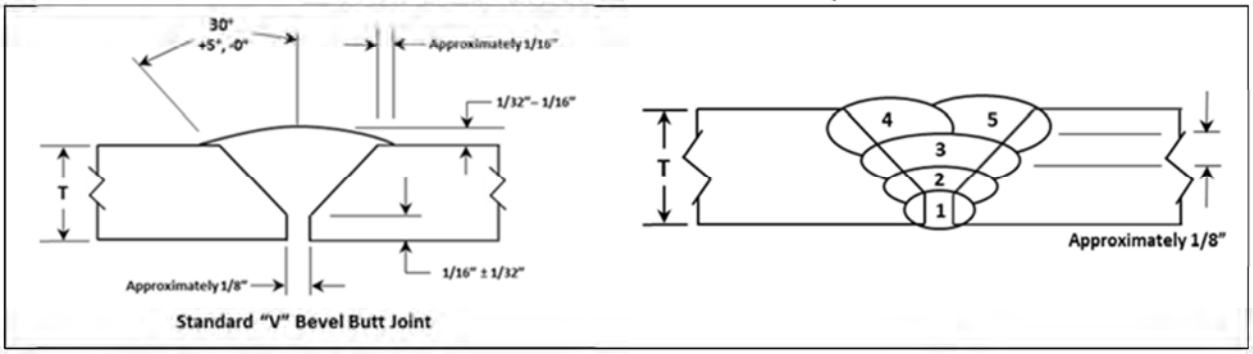
Welding Process: Manual SMAW
Pipe or Fitting Material: API 5L X42 or less or equivalent material
Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater
Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited
Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Uphill or Horizontal
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 200°F by any suitable means
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional) (including backwelding*)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

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WPS Number: 80 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 8-1, 8-2

Welding Process: Manual SMAW

Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch or greater

Joint Design: Figure 1 and additional butt groove designs permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences and the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Uphill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F or the wall thickness is 1.5 inch or greater the joint shall be heated to 200°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

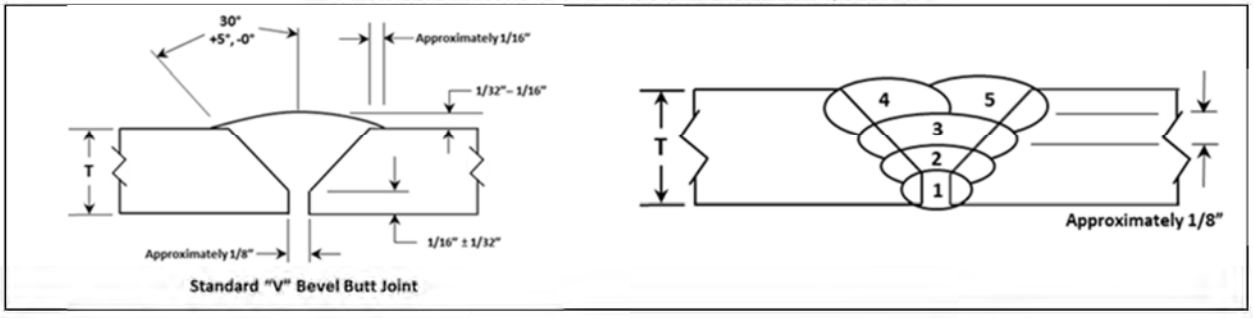
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional) (including backwelding*)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

*Backwelding allowed on 20" OD and larger only.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

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WPS Number: 90 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 9-1, 9-2, F12-X42-219

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X42 or less or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.75 inch or less

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard.

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means.

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	All			All		
AWS Classification:	E6010			E7010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE

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API 1104 WELDING PROCEDURE SPECIFICATION

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WPS Number: 100 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 10-1, 10-3, F6-X60-280

Welding Process: Manual SMAW

Pipe or Fitting Material: Greater than API 5L X42 to less than API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

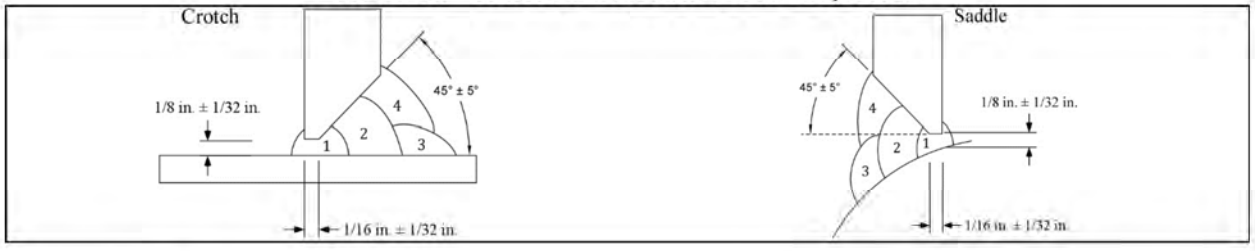
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection.
Electrodes with P1 designation are recommended

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E7010 or E8010		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 140	90 – 165	130 – 210
Voltage Range:	20 – 32	19 – 33	20 – 32	18 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 110 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 11-1, F8-X65-322

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X65 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill or Horizontal

Time Between Passes: 15 minutes between the root and second pass Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

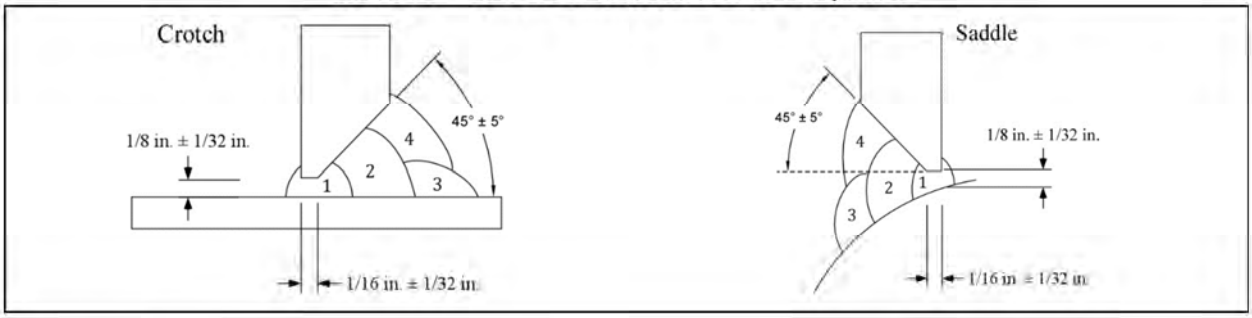
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 130	100 – 165	65 – 135	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 33	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 20	2 – 16	2 – 20	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 120 **Rev:** 1 **Date:** 10/01/2018

PQR-Number: 12-1

Welding Process: Manual SMAW

Pipe or Fitting Material: API 5L X70 or equivalent material

Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch

Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.

Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard

Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter

Position: All fixed **Welding Direction:** Downhill

Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.

Preheat Temperature: Minimum temperature of 250°F should be used

Post-weld Heat Treatment: None **Interpass Temperature:** N/A

Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard

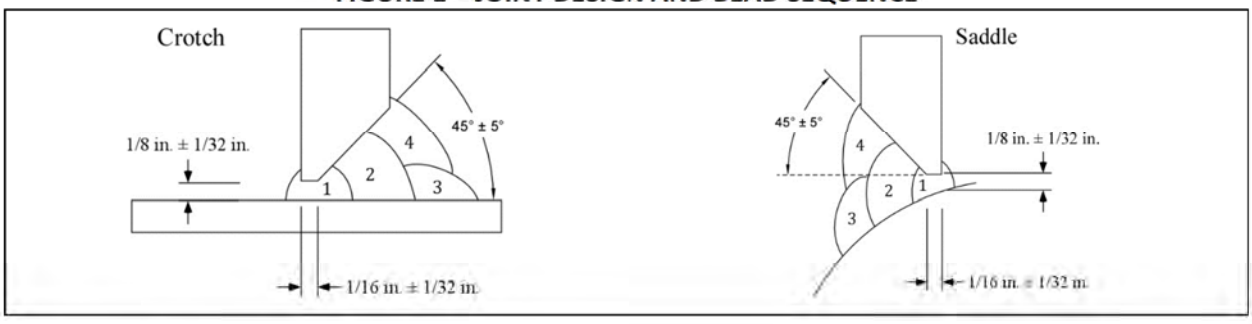
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools

Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root			Remainder		
AWS Classification:	E6010			E8010-P1		
Electrode Diameter:	3/32"	1/8"	5/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	50 – 70	65 – 125	100 – 165	65 – 130	90 – 165	130 – 210
Voltage Range:	20 – 32	20 – 33	20 – 32	20 – 32	20 – 32	20 – 32
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



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API 1104 WELDING PROCEDURE SPECIFICATION

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WPS Number: 130 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: 13-1

Welding Process: Manual SMAW
Pipe or Fitting Material: API 5L X42 or less or equivalent material
Pipe or Fitting Diameter: All **Pipe or Fitting Wall Thickness:** 0.188 inch to 0.75 inch
Joint Design: Figure 1, additional branch groove designs permitted by Welding Procedure Qualifier and fillet welds permitted by Welding Procedure Qualifier.
Number of Beads: Figure 1 is not intended to show all bead sequences, the number of beads will vary with wall thickness but a minimum of 3 passes should be deposited and the fillet weld size should comply with the Duke Energy NGBU Welding Standard
Technique: Beads may be stringer or weave beads with the maximum weave being 3 times the rod diameter
Position: All fixed **Welding Direction:** Uphill
Time Between Passes: 15 minutes between the root and second pass. Remaining passes should start before the end of the day. If you can't start before the end of the day, see WEL-ST-1010.
Preheat Temperature: None required unless the temperature is below 40°F the joint shall be heated to 200°F by any suitable means
Post-weld Heat Treatment: None **Interpass Temperature:** N/A
Line-up Clamps: None required but if used should comply with the Duke Energy NGBU Welding Standard
Cleaning: The surface shall be free from any detrimental conditions and the weld shall be cleaned between passes with power or hand tools
Comments: The weld should be allowed to air cool prior to inspection

WELDING PARAMETERS

Pass:	Root Only		All (Root Optional)			
AWS Classification:	E7016		E7018			
Electrode Diameter:	3/32"	1/8"	3/32"	1/8"	5/32"	3/16"
Current/Polarity:	DCEP	DCEP	DCEP	DCEP	DCEP	DCEP
Current Range:	55 – 90	75 – 120	70 – 110	90 – 160	130 – 210	180 – 300
Voltage Range:	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28	20 – 28
Travel Speed Range, ipm:	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16	2 – 16

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE

Approved (SME): _____ **Date:** _____
Approved (Dir. of Eng.): _____ **Date:** _____

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 140 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: N16-02081

Welding Process: SMAW
Pipe or Fitting Material: <API 5L (X42) thru **API 5L (X65)**
Pipe or Fitting Diameter: ≤2.375"
Pipe or Fitting Wall Thickness: **≤0.188"**
Joint Design and Bead Sequence: Single "V" Butt Weld / See Figure 1

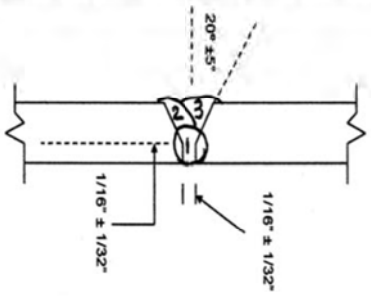
Position: Horizontal (Fixed) **Welding Direction:** Horizontal
Filler Metal: Group 1
Time Between Passes: **12 Minutes**
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Post-weld Heat Treatment: N/A **Interpass Temperature:** 80°F
Line-up Clamps: External
Cleaning: Grinding / Power Wire Brush

Comments:

WELDING PARAMETERS

Pass:	1	2	3			
AWS Classification:	A5.1	A5.1	A5.1			
Electrode Diameter:	1/8"	3/32"	3/32"			
Current/Polarity:	DCRP	DCRP	DCRP			
Current Range:	72 - 75	75 - 80	80 - 84			
Voltage Range:	20 - 22	22 - 24	24 -26			
Travel Speed Range, ipm:	6 - 12 IPM	4 - 8 IPM	4 - 8 IPM			

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved By: **Date:**

DUKE ENERGY

API 1104 WELDING PROCEDURE SPECIFICATION

Page: 1 of 1

WPS Number: 150 **Rev:** 1 **Date:** 10/01/2018
PQR-Number: N16-02081

Welding Process: SMAW
Pipe or Fitting Material: <API 5L (X42) **thru API 5L (X65)**
Pipe or Fitting Diameter: ≤2.375"
Pipe or Fitting Wall Thickness: **≤0.188"**
Joint Design and Bead Sequence: Fillet Weld / See Figure 1

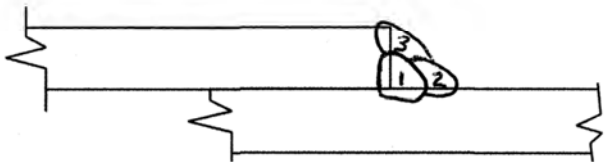
Position: Horizontal (Fixed) **Welding Direction:** Downhill
Filler Metal: Group 1
Time Between Passes: **12 Minutes**
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Post-weld Heat Treatment: N/A **Interpass Temperature:** 80°F
Line-up Clamps: External
Cleaning: Grinding / Power Wire Brush

Comments:

WELDING PARAMETERS

Pass:	1	2	3			
AWS Classification:	A5.1	A5.1	A5.1			
Electrode Diameter:	1/8"	3/32"	3/32"			
Current/Polarity:	DCRP	DCRP	DCRP			
Current Range:	72 - 75	75 - 80	80 - 84			
Voltage Range:	20 - 22	22 - 24	24 -26			
Travel Speed Range, ipm:	6 - 12 IPM	4 - 8 IPM	4 - 8 IPM			

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



Approved By: **Date:**

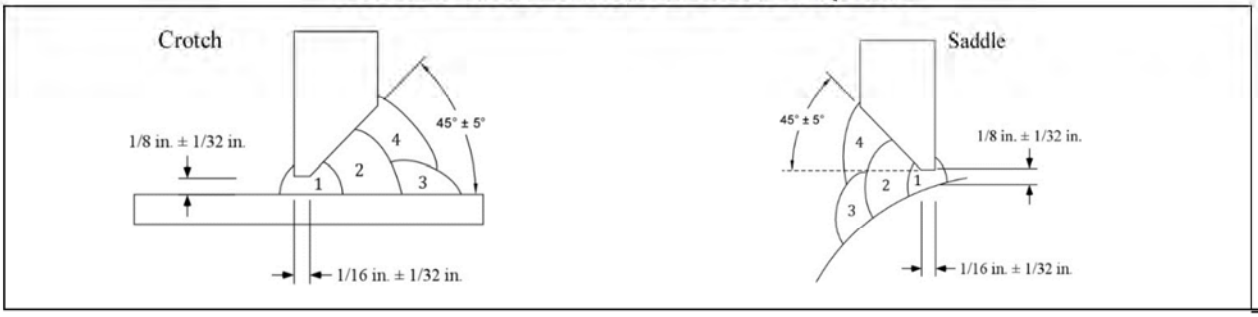
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 160 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 25CLH-B-1 and supporting verification welds 35LH, 35LH-BW, 48LH and 42LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness (2): 0.188 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 160 **Rev.:** 1 **Page:** 2 **of** 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Branch
Category I	CE (IIW) ≤ 0.35	CE (IIW) ≤ 0.48
Category II	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.48

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

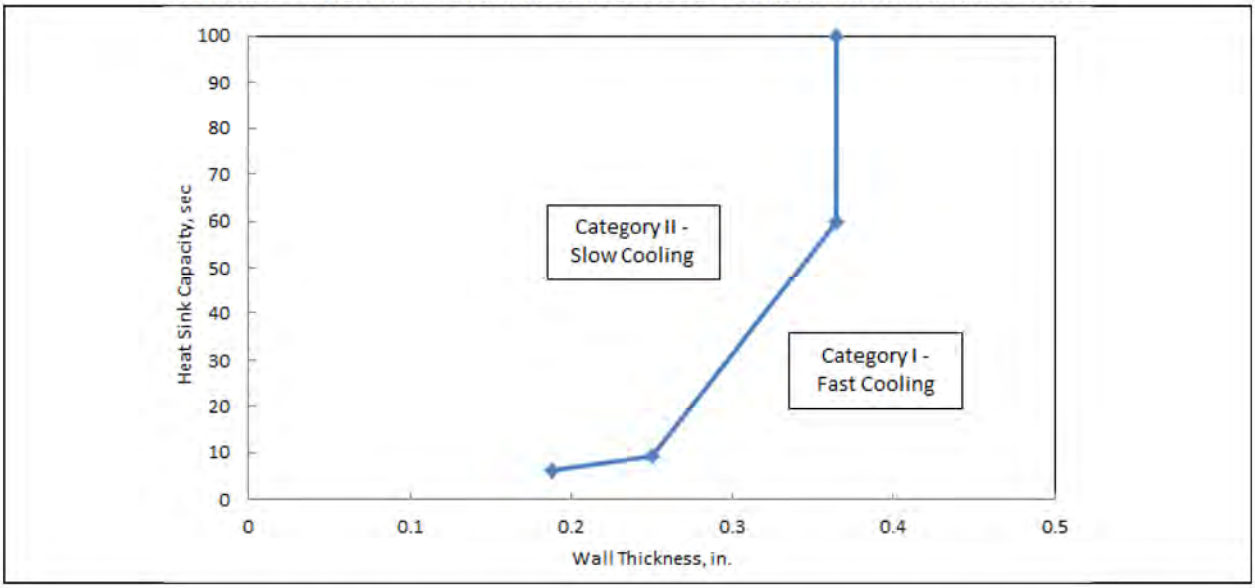
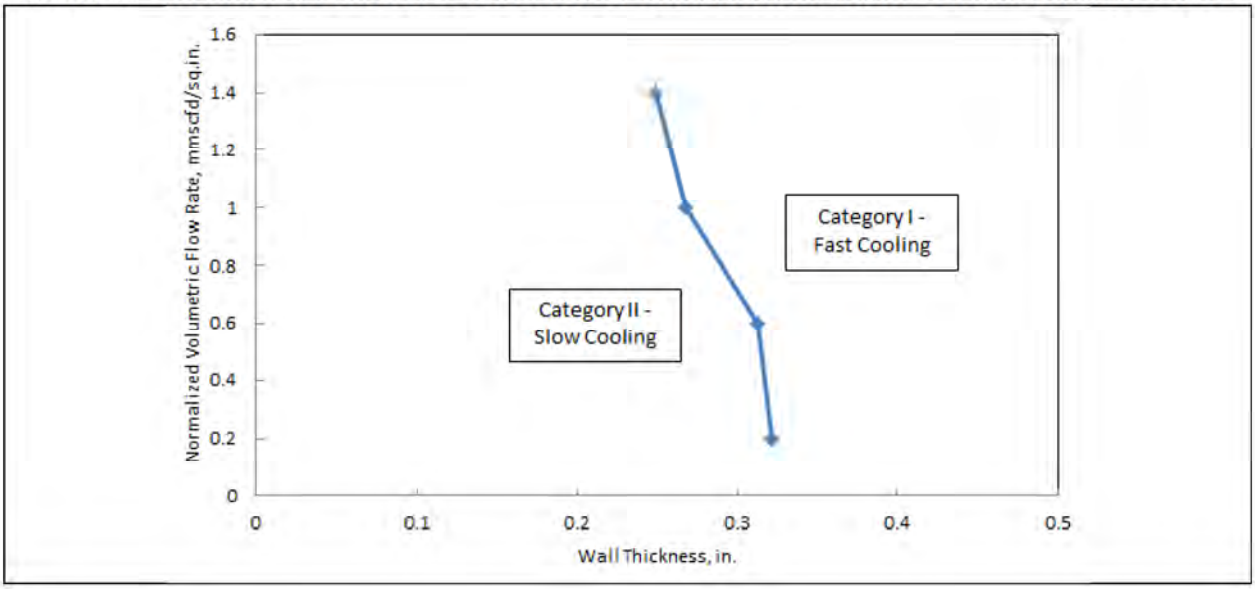


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW RATE



WPS Number: 160 **Rev.:** 1 **Page:** 3 **of** 3

WELDING PARAMETERS

Pass:	Root			
AWS Classification:	E7018 H4R	or	E7016 H4	
Electrode Diameter (in.) (3):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 7	2 – 11
Heat Input Min. (kJ/in.) (5):	25	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.37	0.61

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.) (3):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (4):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (4):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 10	2 – 15	2 – 21
Heat Input Min. (kJ/in.) (5):	25	25	25
Run-Out Ratio Max. (6):	0.37	0.61	0.94

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The risk of burn-through should be evaluated prior to welding if the pipe wall thickness is less than 0.25 in.

(3) Only 3/32 in. diameter electrodes are permitted when the pipe wall thickness is less than 0.25 in.

(4) The welding parameter ranges in the parentheses are recommended

(5) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(6) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: _____ **Date:** _____

Approved By: _____ **Date:** _____

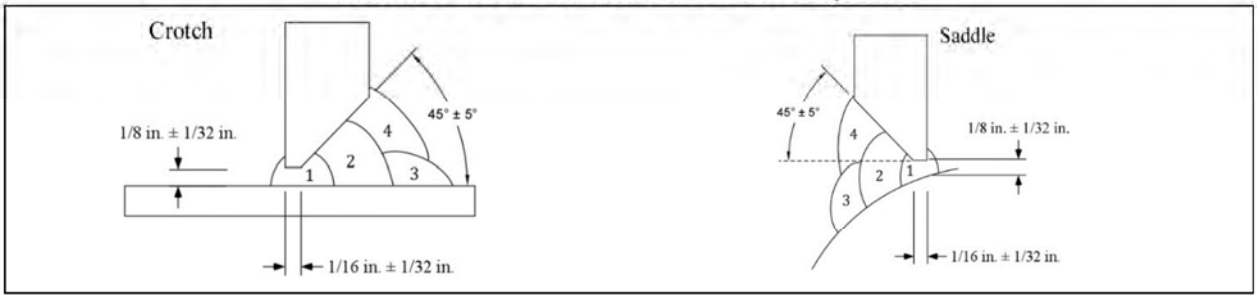
DUKE ENERGY

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 3**

WPS Number: 170 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: 40LH-B-1 and supporting verification welds 42LH, 42LH-BW and 50LH-O
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent
Pipe and Branch Material CE (1): Table 1
Pipe Wall Thickness: 0.250– 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.188– 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1, the figure is not intended to show all possible bead sequences, the last pass shall not contact the run pipe and minimum of three passes is required. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe O.D. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Table 1 and Figure 2 or Figure 3, flow rate and pressure are factors in thermal severity.

FIGURE 1 – JOINT DESIGN AND BEAD SEQUENCE



WPS Number: 170 **Rev.:** 1 **Page:** 2 of 3

TABLE 1 – PROCEDURE APPLICABILITY

Thermal Severity	Material CE (1)	
	Pipe	Branch
Category I	CE (IIW) ≤ 0.42	CE (IIW) ≤ 0.42
Category II	CE (IIW) ≤ 0.50	CE (IIW) ≤ 0.50

FIGURE 2 – THERMAL SEVERITY LEVEL BASED ON HEAT SINK CAPACITY TIME

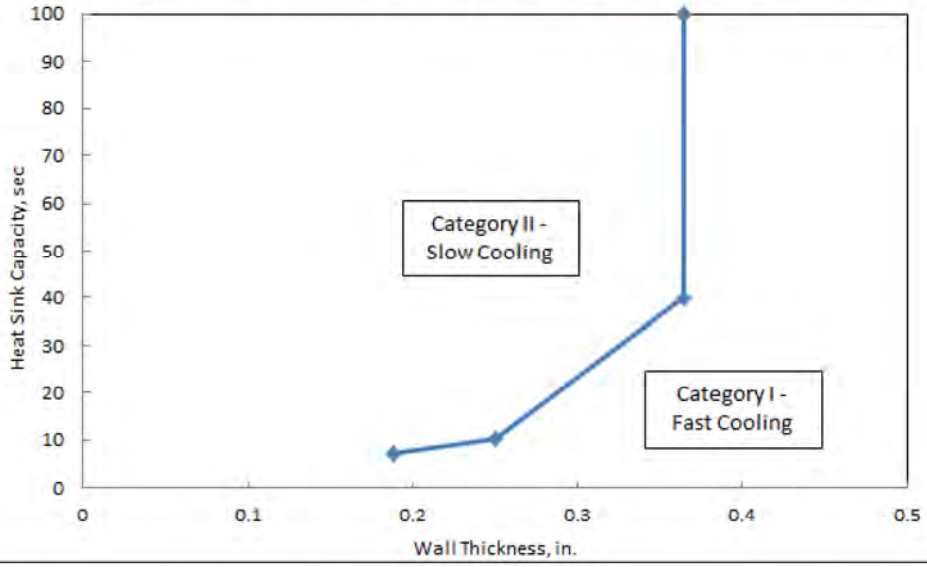
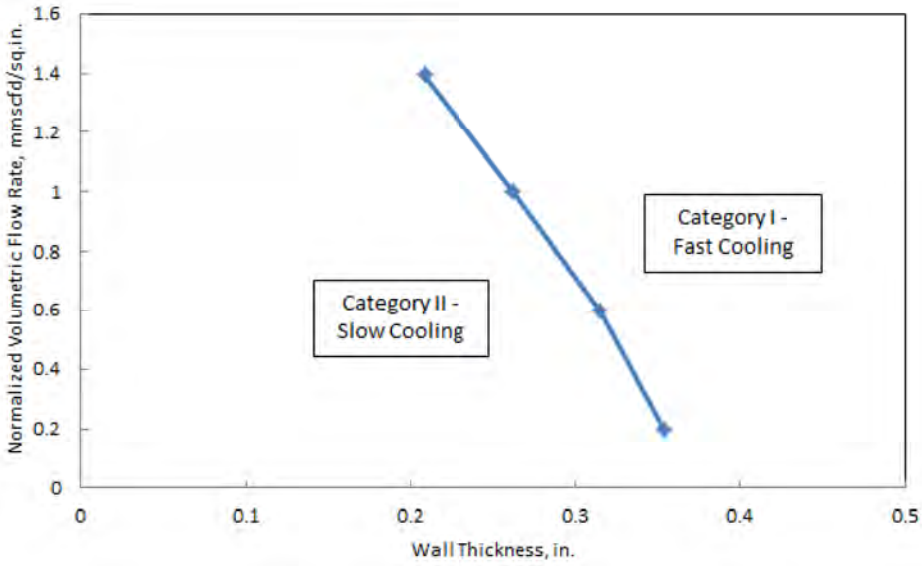


FIGURE 3 – THERMAL SEVERITY LEVEL BASED ON NORMALIZED METHANE VOLUMETRIC FLOW



WPS Number: 170 **Rev.:** 1 **Page:** 3 **of** 3

WELDING PARAMETERS

Pass:	Root			
AWS Classification:	E7018 H4R	or	E7016 H4	
Electrode Diameter (in.):	3/32	1/8	3/32	1/8
Current/Polarity:	DCEP	DCEP	DCEP	DCEP
Current Range (amps) (2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	44 – 96 (55 – 80)	60 – 144 (75 – 120)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 4	2 – 7
Heat Input Min. (kJ/in.) (3):	40	40	40	40
Run-Out Ratio Max. (4):	0.23	0.38	0.23	0.38

Pass:	Remainder		
AWS Classification:	E7018 H4R		
Electrode Diameter (in.):	3/32	1/8	5/32
Current/Polarity:	DCEP	DCEP	DCEP
Current Range (amps) (2):	48 – 132 (60 – 110)	68 – 192 (85 – 160)	88 – 264 (110 – 220)
Voltage Range (volts) (2):	14 – 34 (18 – 28)	14 – 34 (18 – 28)	14 – 34 (18 – 28)
Travel Speed Range (ipm):	2 – 6	2 – 9	2 – 13
Heat Input Min. (kJ/in.) (3):	40	40	40
Run-Out Ratio Max. (4):	0.23	0.38	0.59

Comment:

(1) C.E. (IIW) = %C + %Mn/6 + (%Cu + %Ni)/15 + (%Cr + %Mo + %V)/5

(2) The welding parameter ranges in the parentheses are recommended

(3) Heat input (kJ/in.) = (Current*Voltage*60)/(Travel Speed*1000)

(4) The run-out ratio is the maximum allowable weld length per length of electrode consumed to achieve the minimum required heat input level.

Prepared By: _____ **Date:** _____

Approved By: _____ **Date:** _____

DUKE ENERGY.

IN-SERVICE WELDING PROCEDURE SPECIFICATION **Page: 1 of 4**

WPS Number: 180 **Rev.:** 1 **Date:** 10/01/2018
PQR Number: TBLH-B-1 and supporting verification welds 50LH-2 and 50LH-BW
Standard: API 1104 Appendix B, 20th Edition and API 1104 Annex B, 21st Edition

Welding Process: Manual SMAW
Pipe and Branch Material SMYS: Less than or equal to API 5L X70 or equivalent, Table 1
Pipe and Branch Material CE (1): Less than or equal to 0.50 CE (IIW)
Pipe Wall Thickness (2): 0.157 – 0.75 in. **Pipe Diameter:** All diameters
Branch Wall Thickness: 0.157 – 0.75 in. **Branch Diameter:** All diameters
Joint Design: Figure 1, branch groove welds
Bead Sequence: Figure 1 or Figure 2, the figures are not intended to show all possible bead sequences, only the buttering layers shall contact the run pipe and minimum of three passes is required after the buttering layer. The root pass can be deposited from the branch pipe I.D or O.D.
Weld Size and Shape: Branch groove welds shall completely fill the groove beyond flush with the branch pipe OD. Fillet weld reinforcement in the crotch position shall meet the run pipe at approximately 45° or as specified by the fitting manufacturer.
Welding Technique: Stringer or weave beads
Position: Fixed **Welding Direction:** Uphill or horizontal
Time Between Passes: 10 minutes maximum between the completion of the root pass and the start of the second pass. 30 minutes maximum between all other passes.
Preheat Temperature: None required. Below 50°F, a 200°F minimum preheat is recommended for moisture removal.
Preheat Method: Any adequate method may be used to achieve and maintain the minimum preheat temperature.
Line-up Clamps: None required **Post-weld Heat Treatment:** None permitted
Cleaning: Weld beads shall be cleaned between passes using power tools or hand tools as required.
Pipeline Products: May include crude petroleum, petroleum products, fuel gases, carbon dioxide, and nitrogen. Consideration shall be given to the effect welding may have on other pipeline products.
Pipeline Operating Conditions: Any flow conditions