



September 22, 2020

Ms. Tanowa M. Troupe Ohio Power Siting Board PUCO Docketing Division 180 East Broad Street, 11<sup>th</sup> Floor Columbus, OH 43215-3716

Re: Case No. 16-253-GA-BTX

Staff Report Condition No. 34-revised

Dear Ms. Troupe:

On August 4, 2020, Duke Energy Ohio, Inc. (Duke Energy Ohio) filed its welding qualifications, welding procedures, and nondestructive testing procedures, in compliance with condition 34 of the Opinion, Order, and Certificate in this case. Upon recent review, we have discovered that not all pages were included with the August 4, 2020, filing.

Duke Energy Ohio files herewith a complete copy of its welding qualifications, welding procedures, and nondestructive testing procedures so that they may be reviewed prior to the preconstruction conference.

If you have any questions, please do not hesitate to contact me.

Sincerely,

/s/ Jeanne W. Kingery

Jeanne W. Kingery Associate General Counsel

cc: Theresa White, Executive Director

Ashton Holderbaum



## Duke Energy NGBU Procedure Qualification Records

### **Welding Procedure**

WEL-PR-1020

**Revision Number: 1.0** 

Effective Date: 05-01-2019

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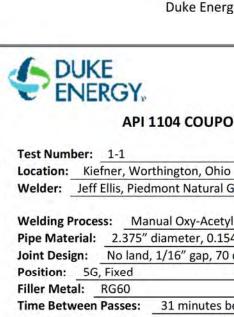


## Duke Energy NGBU Procedure Qualification Records

### **Welding Procedure**

| WEL-PR-1020         |  |
|---------------------|--|
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| ΛDI    | 1104 | COUPON  | TEST | REDORT |
|--------|------|---------|------|--------|
| $\sim$ | TIVT | COULDIA | ILJI | KLIOKI |

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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

Welding Direction: Uphill

31 minutes between root and hot pass

Root

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

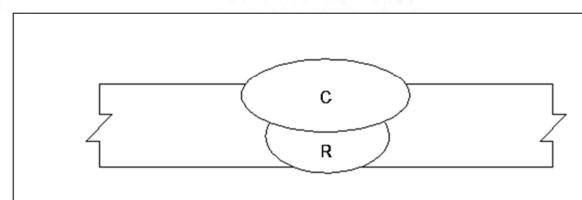
Cap

| Pass:                      |
|----------------------------|
| AWS Classification:        |
| Manufacture:               |
| <b>Electrode Diameter:</b> |
| Current/Polarity:          |
| <b>Current Range:</b>      |
| Voltage Range:             |
| Travel Cased Dance :       |

Comments:

| Travel | Speed | Range, | ipm: |
|--------|-------|--------|------|

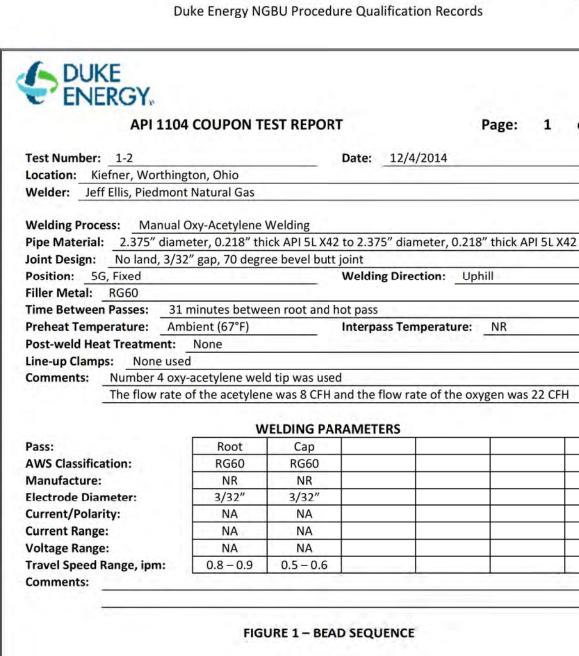
| KG60  | NGOU  |  |
|-------|-------|--|
| NR    | NR    |  |
| 3/32" | 3/32" |  |
| NA    | NA    |  |
| NA    | NA    |  |
| NA    | NA    |  |
| 00 12 | 1.2   |  |

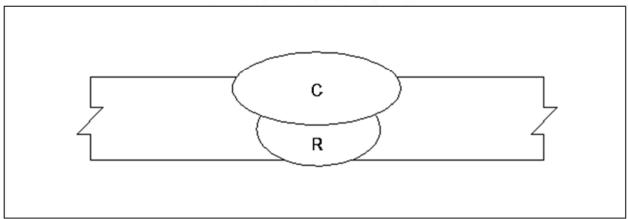


| Test Number:                       | 1-1        |   |                |   |                                 | Page:  | 2    | of        | 2   |
|------------------------------------|------------|---|----------------|---|---------------------------------|--------|------|-----------|-----|
|                                    |            | τ                                       | ENSILE STRE    | NGTH TEST                               |                                 |        |      |           |     |
| Coupon Number:                     |            |   |                |   |                                 |        |      |           |     |
| Coupon Width:<br>Coupon Thickness: |            |   |                |   |                                 | 1      |      |           | _   |
| Coupon Area:                       | 7          |   |                |   |                                 | $\neg$ |      |           | _   |
| Maximum Load:                      |            |   |                |   |                                 |        |      |           |     |
| Tensile Strength:                  |            |   |                |   |                                 |        |      |           |     |
| Fracture Location:                 |            |   |                |   |                                 |        |      |           |     |
|                                    |            |   | BEND           | ΓEST                                    |                                 |        |      |           |     |
| Coupon Number: [                   | W1 RB1     | W1 RB2                                  |                |   |                                 |        |      |           |     |
| Гуре:                              | Root       | Root                                    | 1              |   |                                 |        |      |           |     |
| Results:                           | Pass (1)   | Pass                                    |                |   |                                 |        |      |           |     |
|                                    |            |   | NICK-BRE       | AK TEST                                 |                                 |        |      |           |     |
| Coupon Number:                     | W1         | NB1                                     | W1 NE          |   |                                 |        |      |           |     |
| Results:                           | Pas        | s (1)                                   | Pass           | TILLE                                   |                                 |        |      |           |     |
|                                    |            | CH                                      | IARPY TOUG     | HNESS TEST                              |                                 |        |      |           |     |
| Coupon Number:                     |            |   |                |   |                                 |        |      |           |     |
| Depth:                             |            |   |                |   |                                 |        |      |           |     |
| Width:<br>Notch Location:          |            |   |                |   |                                 |        |      |           |     |
| Test Temperature:                  |            |   |                |   |                                 |        |      |           | _   |
| mpact Energy:                      |            |   |                |   |                                 |        |      |           | _   |
| % Shear:                           |            |   |                |   |                                 |        |      |           | _   |
| ateral Expansion:                  | 4          |   |                |   |                                 |        |      |           |     |
| Comments: (1)                      | ndications | were present                            | t but were wit | hin the accept                          | table limits of                 | API 11 | 104  |           |     |
| _ \_/-/                            |            | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | P. Wilde       | an contra                               |                                 |        |      |           |     |
| Test Type:                         |            |   | OTHER          |   |                                 |        |      |           |     |
| Daniel Land                        |            |   |                |   |                                 |        |      |           | _   |
|                                    |            | 2,57, 50                                |                | TIVELU                                  |                                 |        |      | 77.6.7    |     |
| We certify that the te             |            |   |                |   | test welds we<br>1st Edition of |        |      | welded, a | ınd |
|                                    |            |   |                | A 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 |                                 |        | 7100 |           |     |
| Date: 12/4/2014                    |            |   |                |   |                                 |        |      |           |     |

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| TENSILE STRENGTH TEST  Coupon Number: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  BEND TEST  Coupon Number: Type: Results:  NICK-BREAK TEST  Coupon Number: Pass Pass (1)  NICK-BREAK TEST  Coupon Number: 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:   |  | 1-2        |              |                 |                | Page              | e: 2 o | f 2      |
|--|--|------------|--------------|-----------------|----------------|-------------------|--------|----------|
| Coupon Width: Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  BEND TEST  Coupon Number: Type: Root Root Root Pass Pass (1)  NICK-BREAK TEST  Coupon Number: W1 NB1 W1 NB2 Results: Pass Pass Pass (2)  NICK-BREAK TEST  Coupon Number: Pass Pass Pass (3)  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  |  |            | т            | ENSILE STREN    | STH TEST       |                   | V      |          |
| Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  BEND TEST  Coupon Number: Type: Results:  NICK-BREAK TEST  Coupon Number: Pass Pass (1)  NICK-BREAK TEST  Coupon Number: Pass 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  |  |            | 1            |                 |                |                   |        |          |
| Coupon Area:  Maximum Load: Fensile Strength: Fracture Location:  BEND TEST  Coupon Number: Results:  NICK-BREAK TEST  Coupon Number: Pass Pass (1)  NICK-BREAK TEST  Coupon Number: Pass Pass Pass (2)  CHARPY TOUGHNESS TEST  Coupon Number: Depth: Width: Width: Width: Wotch Location: Fest Temperature: Impact Energy: K Shear: Lateral Expansion:  Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS   |  |            |              |                 |                |                   |        |          |
| Maximum Load:  Pensile Strength:  Practure Location:    BEND TEST  |  |            |              |                 |                |                   |        |          |
| BEND TEST  Coupon Number: W1 RB1 W1 RB2   Pass Pass (1)   W1 NB2   Pass Pass    |  |            |              |                 |                |                   |        |          |
| BEND TEST  Soupon Number:   W1 RB1   W1 RB2  |  |            |              |                 |                |                   |        |          |
| BEND TEST  Coupon Number: W1 RB1 W1 RB2 Root Root Results: Pass Pass (1)  NICK-BREAK TEST  Coupon Number: W1 NB1 W1 NB2 Results: Pass Pass Results: Pass Pass Results: Pas | 지역하는데 이 개인가 투어들어?  |            |              |                 |                |                   |        |          |
| Coupon Number:  Vype: Root Root Pass Pass (1)  NICK-BREAK TEST  Coupon Number: Results:  NICK-BREAK TEST  Coupon Number: Results:  CHARPY TOUGHNESS TEST  COUPON Number: Results: ROOTHER TESTS  CHARPY TOUGHNESS TEST  COUPON Number: Results: ROOTHER TESTS  | racture Location:  |            |              |                 |                |                   |        |          |
| Results:  Root Root Root Root Root Root Root Roo   |  |            |              | BEND TE         | ST             |                   |        |          |
| NICK-BREAK TEST  Coupon Number: W1 NB1 W1 NB2 Pass Pass  CHARPY TOUGHNESS TEST  Coupon Number: Depth: W1 NB1 W1 NB2  Coupon Number: Depth: D | Coupon Number:   | W1 RB1     |              |                 |                |                   |        |          |
| NICK-BREAK TEST  Coupon Number: W1 NB1 W1 NB2 Pass Pass  CHARPY TOUGHNESS TEST  Coupon Number: Pass Pass  Coupon Number: Pass Pass Pass Pass Pass Pass Pass Pas  | ype:   | Root       |              | 1               |                |                   |        |          |
| Coupon Number: W1 NB1 W1 NB2 Pass Pass  CHARPY TOUGHNESS TEST  Coupon Number: Pepth: P | lesults:   | Pass       | Pass (1)     |                 |                |                   |        |          |
| Coupon Number: W1 NB1 W1 NB2 Pass Pass  CHARPY TOUGHNESS TEST  Coupon Number: Pepth: Pass Pass  Coupon Number: Pepth: Pass Pass  Coupon Number: Pepth: Pass Pass  Coupon Number: Pass Pass  CHARPY TOUGHNESS TEST  Coupon Number: Pass Pass  Coupon Number: Pass Pass Pass  Coupon Number: Pass Pass Pass  Coupon Number: Pass Pass Pass Pass  Coupon Number: Pass Pass Pass Pass Pass Pass Pass Pas   |  |            |              | NUCK DDEAK      | TECT           |                   |        |          |
| CHARPY TOUGHNESS TEST  Coupon Number: Depth: Width: Notch Location: Test Temperature: Impact Energy: Shear: Inateral Expansion:  Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:   | ounon Number:  | \\/1       | NR1          |                 | IESI           |                   | 1      |          |
| CHARPY TOUGHNESS TEST  Coupon Number: Depth: Vidth: Vidth: Vidth: Viest Temperature: Impact Energy: Viden:  |  |            |              |                 |                |                   |        |          |
| Jotch Location:  Jest Temperature:  Impact Energy:  John Shear:  John  | epth:  |            |              |                 |                |                   |        |          |
| rest Temperature: mpact Energy: 6 Shear: ateral Expansion:  Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:  |  |            |              |                 |                |                   |        |          |
| mpact Energy: 6 Shear: ateral Expansion:  Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:  |  |            | _            |                 |                |                   |        |          |
| 6 Shear: ateral Expansion:  Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:  |  |            |              |                 |                |                   |        |          |
| Comments: _(1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:   |  | -          |              | -               |                |                   |        |          |
| Comments: (1) Indications were present but were within the acceptable limits of API 1104  OTHER TESTS  Test Type:  |  | £          |              |                 |                |                   |        |          |
| OTHER TESTS  Test Type:  | ateral Expansion.  | <u></u>    | -            |                 |                |                   |        |          |
| est Type:  | comments: (1)  | ndications | were present | but were within | the accepta    | ble limits of API | 1104   |          |
| est Type:  |  |            |              | OTHER TE        | STS            |                   |        |          |
| end Albania  | est Type:  |            |              |                 |                |                   |        |          |
|  |  |            |              |                 |                |                   |        |          |
|  |  |            |              |                 |                |                   |        |          |
| We certify that the statements in this record are correct and that the test welds were prepared, welded  | We certify that the  |            |              |                 |                |                   |        | led, and |
| tested in accordance with the requirements of the 21st Edition of API 1104.  | The second secon |            |              | 4h              | ate of the 21c | + Edition of ADI  | 1104   |          |

| / DU         | JKE    |           |
|--------------|--------|-----------|
| EN           | IER    | GY.       |
|              |        | API       |
| Test Number  | er:    | 1-3       |
| Location:    | Kiefn  | er, Wo    |
| Welder: J    | eff El | lis, Pied |
| Welding Pro  | ocess  | : Ma      |
| Pipe Materi  | al:    | 2.375"    |
| Joint Design | ı: Ī   | No land   |
| Position:    | 5G, F  | ixed      |
| Filler Motal | . D    | CEO       |

| AD | 1 1 | 104  | COL | IDON | TEST | REPORT |
|----|-----|------|-----|------|------|--------|
| AΡ | 1 1 | .104 | CUI | UPUN | IESI | REPURI |

Date: 12/4/2014

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orthington, Ohio

dmont Natural Gas

anual Oxy-Acetylene Welding

diameter, 0.154" thick API 5L X52 to 2.375" diameter, 0.154" thick API 5L X52

d, 1/16" gap, 70 degree bevel butt joint

Welding Direction: Uphill

30 minutes between root and hot pass **Time Between Passes:** 

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

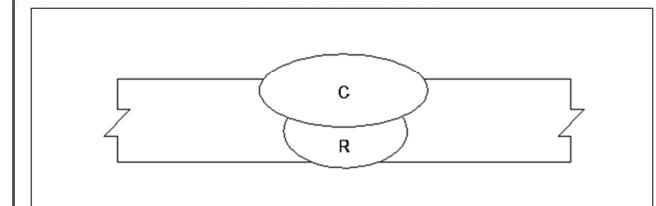
#### WELDING PARAMETERS

| Pass:                      |
|----------------------------|
| AWS Classification:        |
| Manufacture:               |
| <b>Electrode Diameter:</b> |
| Current/Polarity:          |
| <b>Current Range:</b>      |
| Voltage Range:             |
| Travel Cased Dance is      |

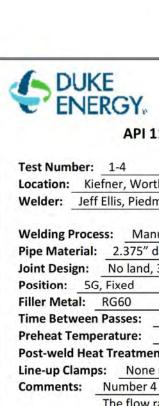
Comments:

| Travel | Speed | Range, | ipm: |
|--------|-------|--------|------|

| Root      | Cap   |  |  |
|-----------|-------|--|--|
| RG60      | RG60  |  |  |
| NR        | NR    |  |  |
| 3/32"     | 3/32" |  |  |
| NA        | NA    |  |  |
| NA        | NA    |  |  |
| NA        | NA    |  |  |
| 0.9 - 1.3 | 0.9   |  |  |



|                                |        | TE                  | NSII F STR | ENGTH TES    | r.           |           |     |         |     |
|--------------------------------|--------|---------------------|------------|--------------|--------------|-----------|-----|---------|-----|
| Coupon Number:                 | W      | 3 T1                | NOILE STR  | LINGTHIES    |              | - 1       |     |         |     |
| Coupon Width:                  |        | '0 inch             |            |              |              |           |     |         |     |
| Coupon Thickness:              |        | 5 inch              |            |              |              |           |     |         |     |
| Coupon Area:                   | 0.16   | 6 inch <sup>2</sup> |            |              |              |           |     |         |     |
| Maximum Load:                  | 14,2   | 204 lb              |            |              |              |           |     |         |     |
| Tensile Strength:              | 85,5   | 65 psi              |            |              |              |           |     |         |     |
| Fracture Location:             | Base   | Metal               |            |              |              |           |     |         |     |
|                                |        |                     | BEND       | TEST         |              |           |     |         |     |
| Coupon Number:                 | W3 RB1 | W3 RB2              |            |              |              |           |     | Т       |     |
| Туре:                          | Root   | Root                |            |              |              |           |     |         |     |
| Results:                       | Pass   | Pass                |            |              |              |           |     |         |     |
|                                |        |                     | NICK-BRI   | AV TECT      |              |           |     |         |     |
| Coupon Number:                 | \\/3   | NB1                 | W3 N       |              |              | -         |     |         |     |
| Results:                       |        | iss                 | Pas        |              |              | -         |     |         | _   |
|                                |        |                     |            |              |              |           |     |         |     |
|                                |        | CH                  | ARPY TOU   | GHNESS TE    | ST           |           |     |         |     |
| Coupon Number:                 |        |                     |            |              | 7            |           | - 1 |         |     |
| Depth:                         |        |                     | 7,0        | 11           |              |           |     |         |     |
| Width:                         |        |                     |            |              |              |           |     |         |     |
| Notch Location:                |        |                     |            |              |              |           |     |         |     |
| Test Temperature:              |        |                     |            |              |              |           |     |         |     |
| Impact Energy:                 |        |                     |            |              |              |           |     |         |     |
| % Shear:<br>Lateral Expansion: |        |                     |            |              |              |           |     |         |     |
| Lateral Expansion.             |        |                     |            |              |              |           |     |         |     |
| Comments:                      |        |                     |            |              |              |           |     |         |     |
|                                |        |                     | OTHER      | TESTS        |              |           |     |         |     |
| Test Type:                     |        |                     |            |              |              |           |     |         |     |
| Results:                       |        |                     |            |              |              |           |     |         |     |
|                                |        |                     |            |              |              |           |     |         |     |
| We certify that the            |        |                     |            |              |              |           |     | velded, | and |
|                                |        |                     |            | monte of the | 21st Edition | of ADI 11 | 0/1 |         |     |



| API 1104 COUPON TEST REPOR | OUPON TEST REPO | ORT |
|----------------------------|-----------------|-----|
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| 12/4/2014 |
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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

Welding Direction: Uphill

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

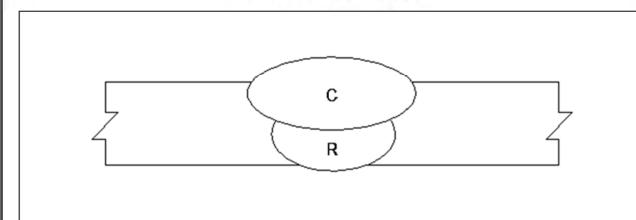
#### **WELDING PARAMETERS**

| 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   |
|                          |           |       |

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|  |  | H |
|  |  |   |

| Root  | Сар   |  |  |
|-------|-------|--|--|
| RG60  | RG60  |  |  |
| NR    | NR    |  |  |
| 3/32" | 3/32" |  |  |
| NA    | NA    |  |  |
| NA    | NA    |  |  |
| NA    | NA    |  |  |
| 0.0   |       |  |  |

Comments:



| -  |             |                     |          |        |             |         |         |     |
|--|-------------|---------------------|----------|--------|-------------|---------|---------|-----|
| Carrage Normalian  | 14/         | 4 T1                | NSILE ST | RENGTH | TEST        |         |         |     |
| Coupon Number:<br>Coupon Width:                          |             | 7 inch              |          |        | +           |         |         | _   |
| Coupon Thickness:  |             | 8 inch              |          |        | +           |         |         |     |
| Coupon Area:   |             | 9 inch <sup>2</sup> |          |        |             |         |         |     |
| Maximum Load:  |             | 55 psi              |          |        |             |         |         | _   |
| Tensile Strength:  |             | 251 lb              |          |        |             |         |         | _   |
| Fracture Location:                                       |             | ld (1)              |          |        |             |         |         |     |
|  |             |                     | DENI     | ) TECT |             |         |         |     |
| Coupon Number:   | W4 RB1      | W4 RB2              | BENI     | TEST   |             |         | $\top$  |     |
| Гуре:  | Root        | Root                |          |        |             |         | +       | _   |
| Results:   | Pass        | Pass                |          |        |             |         |         |     |
| Coupon Number:  Results:  Coupon Number:  Depth:  Width: |             | NB1                 | W4 I     | SS     | TEST        |         |         |     |
| Notch Location:<br>Fest Temperature:                     |             | -                   |          |        |             |         | <br>    | _   |
| mpact Energy:  |             |                     |          |        |             |         |         | _   |
| % Shear:   |             |                     |          |        |             |         |         |     |
| Lateral Expansion:                                       |             |                     |          |        |             |         |         |     |
| Comments: (1) T  | he fracture | surface passe       |          |        | of API 1104 | 5.6.3.3 |         |     |
| Test Type:   |             |                     | OTHE     | RTESTS |             |         |         |     |
| Results:   |             |                     |          |        |             |         |         |     |
| We certify that the                                      |             | s in this recor     |          |        |             |         | welded, | and |

| Test Number: 2-1  Location: Kiefner, Worthingto Welder: Jeff Ellis, Piedmont N |  | Date: 12/4/2014                                       |
|--|--|---|
|  |  |   |
| Welder: _ Jeff Ellis, Piedmont N   | and the second s |   |
|  | Natural Gas  |   |
| Malding Dungages Manual O.   |  | H   |
| Welding Process: Manual Ox   |  | PI 5L X42 to 2.375" diameter, 0.154" thick API 5L X42 |
| loint Design: Lap fillet joint v   |  | P15L X42 to 2.375 diameter, 0.154 thick API 5L X42    |
| Position: 5G, Fixed  | ин 1/10 дар  | Welding Direction: Uphill                             |
| Filler Metal: RG60   |  | Welding Direction. Opinii                             |
| Time Between Passes: 30 m  | inutes between ro  | pot and hot pass                                      |
| Preheat Temperature: Ambi  |  | Interpass Temperature: NR                             |
| Post-weld Heat Treatment:  |  |   |
| Line-up Clamps: None used  |  |   |
|  | cetylene weld tip  | was used  |
| The flow rate of   | f the acetylene was  | s 8 CFH and the flow rate of the oxygen was 20 CFH    |
| Pass:<br>AWS Classification:   | Root<br>RG60   |   |
| AWS Classification:  | NR NR  |   |
| Electrode Diameter:  | 3/32"  |   |
| Current/Polarity:  | NA   |   |
| Current Range:   | NA   |   |
| Voltage Range:   | NA   |   |
| Travel Speed Range, ipm:   | 0.8  |   |
| Comments:  |  |   |

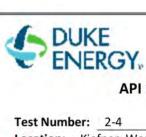
| Coupon Number: Coupon Width: Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type: Results: | BEND TEST                   | EST  |        |
|---|-----------------------------|--|--------|
| Coupon Width: Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type:                         | BEND TEST                   |  |        |
| Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type:                                       | BEND TEST                   |  |        |
| Coupon Area:  Maximum Load: Fensile Strength: Fracture Location:  Coupon Number: Type:  | BEND TEST                   |  |        |
| Maximum Load: Fensile Strength: Fracture Location:  Coupon Number: Fracture Location:   | BEND TEST                   |  |        |
| Coupon Number:  | BEND TEST                   |  |        |
| Coupon Number:  | BEND TEST                   |  |        |
| Туре:   | BEND TEST                   |  |        |
| Туре:   | BEND TEST                   |  |        |
| Гуре:   |                             |  |        |
|   |                             |  |        |
| Results:  |                             |  |        |
|   |                             |  |        |
|   | NICK-BREAK TEST             |  |        |
| Coupon Number: W5 NB1   | W5 NB2                      | W5 NB3   | W5 NB4 |
| Results: Pass   | Pass                        | Pass (1)   | Pass   |
| Coupon Number: Depth: Width: Notch Location:  |                             |  |        |
| Test Temperature:   |                             | <del>                                     </del> |        |
| mpact Energy:   |                             |  |        |
| % Shear:  |                             |  |        |
| Lateral Expansion:  |                             |  |        |
| Comments: (1) Indications were pr   | esent but were within the a | acceptable limits of API 11                      | 104    |
| Test Type:  | OTHER TESTS                 |  |        |
| Danilla   |                             |  |        |
| We certify that the statements in this  | record are correct and tha  |  |        |

| Test Number: 2-2 Date: 12/4/2014  Location: Kiefner, Worthington, Ohio  Welder: Jeff Ellis, Piedmont Natural Gas  Welding Process: Manual Oxy-Acetylene Welding Dipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" | API 1104                     | COUPON TEST F                           | REPORT          |                | Page:          | 1     | of | 2 |
|--|------------------------------|---|-----------------|----------------|----------------|-------|----|---|
| 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  oint Design: Lap fillet joint with 1/16" gap  Postition: 5G, Fixed Welding Direction: Uphill  filler Metal: RG60  Fime Between Passes: 32 minutes between root and hot pass  Preheat Temperature: Ambient (59°F) Interpass Temperature: NR  Post-weld Heat Treatment: None  inne-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 WELDING PARAMETERS  Pass: Root NR  AWS Classification: RG60  Manufacture: NR  Electrode Dlameter: 3/32"  Current/Polarity: NA  Current Range: NA  Voltage Range: NA  Voltage Range: NA  Voltage Range: NA  Voltage Range, ipm: 0.4-0.5  |                              |   | Date:           | 12/4/2014      |                |       |    |   |
| Melding Process: Manual Oxy-Acetylene Welding Dipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 12.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 12.375"  |                              |   |                 |                |                |       |    |   |
| Pipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375"  | Welder: Jeff Ellis, Piedmont | Natural Gas                             |                 |                |                |       |    |   |
| Pipe Material: 2.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 1.375" diameter, 0.218" thick API 5L X42 to 2.375" diameter, 0.218" thick API 5L X42 to 1.375"  | Molding Process Manual       | Ovy Asatulana Waldi                     | ing             |                |                |       |    |   |
| Position: 5G, Fixed Welding Direction: Uphill  Filler Metal: RG60  Fime 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 WELDING PARAMETERS  Pass: Root RG60  Manufacture: NR  Electrode Diameter: 3/32"  Current/Polarity: NA  Current Range: NA  Voltage Range: NA  Voltage Range, ipm: 0.4 – 0.5   |                              |   |                 | 75" diameter   | 0 219" thick A | DIELV | 12 | _ |
| Position: 5G, Fixed Welding Direction: Uphill  Filler Metal: RG60  Fime 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 Welding Direction: Uphill  WELDING PASS Temperature: NR  Pass: Root Welding Direction: Uphill  Na Welding Direction: Na Welding Directio |                              |   | 131 842 10 2.3  | 75 diameter,   | U.216 HIICK A  | PIJLA | 42 |   |
| Filler Metal: RG60  Fime 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   RG60   RG |                              | t with 1/10 gap                         | Weldi           | ng Direction:  | Unhill         |       |    |   |
| 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 RG60  Wanufacture: NR  Electrode Diameter: 3/32"  Current/Polarity: NA  Current Range: NA  Voltage Range: NA  Voltage Range, ipm: 0.4 – 0.5  |                              |   |                 | ing Direction. | Ориш           |       |    |   |
| 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 RG60  Manufacture: NR  Electrode Diameter: 3/32"  Current/Polarity: NA  Current Range: NA  Voltage Range: NA  Gravel Speed Range, ipm: 0.4 – 0.5   |                              | minutes between ro                      | ot and hot pass |                |                |       |    |   |
| 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 RG60 RG60  Wanufacture: NR RG60  Wanufacture: NR RG60  Current/Polarity: NA RG60  Current Range: NA RG60  Current R |                              |   |                 |                | ure: NR        |       |    |   |
| 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 RG60 Nanufacture: NR Electrode Diameter: 3/32" Current/Polarity: NA Current Range: NA Voltage Range: NA Voltage Range, ipm: 0.4-0.5   |                              |   |                 |                | ***            |       |    |   |
| The flow rate of the acetylene was 8 CFH and the flow rate of the oxygen was 20 CFH  WELDING PARAMETERS  Pass:  Root  RG60  Manufacture: NR  Selectrode Diameter: 3/32"  Current/Polarity: NA  Current Range: NA  Voltage Range: NA  Travel Speed Range, ipm:  Outpublic outpublic state of the oxygen was 20 CFH  WELDING PARAMETERS  Root  AND  AND  AND  AND  AND  AND  AND  AN   | ine-up Clamps: None use      | d                                       |                 |                |                |       |    |   |
| WELDING PARAMETERS     Pass:   Root           AWS Classification:   RG60       Manufacture:   NR         Electrode Diameter:   3/32"       Current/Polarity:   NA       Current Range:   NA       Manufacture:   Manufacture:   NA       M   | Comments: Number 3 oxy       | -acetylene weld tip v                   | was used        |                |                |       |    |   |
| WELDING PARAMETERS     Pass:   Root           AWS Classification:   RG60       Manufacture:   NR         Electrode Diameter:   3/32"       Current/Polarity:   NA       Current Range:   NA       Manufacture:   Manufacture:   NA       M   | The flow rate                | of the acetylene was                    | 8 CFH and the   | flow rate of t | ne oxygen was  | 20 CF | Н  |   |
| Manufacture:         NR           Electrode Diameter:         3/32"           Current/Polarity:         NA           Current Range:         NA           Voltage Range:         NA           Iravel Speed Range, ipm:         0.4 – 0.5  |                              | Root                                    | NOT AILANIE     | LING           |                |       |    |   |
| Selectrode Diameter:   3/32"   | AWS Classification:          | RG60                                    |                 |                |                |       | I  |   |
| Current/Polarity:         NA           Current Range:         NA           /oltage Range:         NA           Iravel Speed Range, ipm:         0.4 – 0.5  |                              |   |                 |                |                |       |    |   |
| Current Range:         NA           Voltage Range:         NA           Iravel Speed Range, ipm:         0.4 – 0.5   |                              |   |                 | -1112          |                |       |    |   |
| /oltage Range: NA O.4 – 0.5  |                              |   |                 |                |                |       |    |   |
| Travel Speed Range, ipm: 0.4 – 0.5   |                              | 1 |                 |                |                |       |    |   |
|  |                              |   |                 |                |                |       |    |   |
| comments:  |                              | 0.4 – 0.5                               |                 |                |                |       |    |   |
|  | .omments:                    |   |                 |                |                |       |    |   |
|  |                              | FIGURE                                  |                 | LENCE          |                |       |    |   |
| FIGURE 4. DEAD CEQUENCE  |                              | FIGURE                                  | I - BEAD SEQ    | DENCE          |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              |   |                 |                |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              |   |                 |                |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              |   | 7               |                |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              |   |                 |                |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              |   | <b>T</b>        |                |                |       |    |   |
| FIGURE 1 – BEAD SEQUENCE   |                              | /                                       | т               |                |                |       |    |   |

|                          |                     | TENSILE STRENGTH T                 | EST   |                     |  |
|--------------------------|---------------------|------------------------------------|---|---------------------|--|
| Coupon Number:           |                     |                                    |   |                     |  |
| Coupon Width:            |                     |                                    |   |                     |  |
| Coupon Thickness:        |                     |                                    |   |                     |  |
| Coupon Area:             |                     |                                    |   |                     |  |
| Maximum Load:            |                     |                                    |   |                     |  |
| Tensile Strength:        |                     |                                    |   |                     |  |
| Fracture Location:       |                     |                                    |   |                     |  |
|                          |                     | BEND TEST                          |   |                     |  |
| Coupon Number:           |                     |                                    |   |                     |  |
| Гуре:                    |                     |                                    |   |                     |  |
| Results:                 |                     |                                    |   |                     |  |
|                          |                     |                                    |   |                     |  |
| Coupon Number:           | W6 NB1              | NICK-BREAK TEST<br>W6 NB2          | W6 NB3  | W6 NB4              |  |
| Results:                 | Pass                | Pass                               | Pass  | Pass                |  |
|                          | , 455               | , 433                              | , 400   |                     |  |
|                          | C                   | HARPY TOUGHNESS                    | TEST  |                     |  |
| Coupon Number:           |                     |                                    |   | - 1                 |  |
| Depth:                   |                     |                                    |   |                     |  |
| Width:                   |                     |                                    |   |                     |  |
| Notch Location:          |                     |                                    |   |                     |  |
| Test Temperature:        |                     |                                    |   |                     |  |
| mpact Energy:            |                     |                                    |   |                     |  |
| % Shear:                 |                     |                                    |   |                     |  |
| Lateral Expansion:       |                     |                                    |   |                     |  |
| Comments:                |                     |                                    |   |                     |  |
|                          |                     | Text (200 200)                     |   |                     |  |
| Test Type:               |                     | OTHER TESTS                        |   |                     |  |
| Results:                 |                     |                                    |   |                     |  |
|                          |                     |                                    |   |                     |  |
| We certify that the star | tements in this red | ord are correct and tha            | t the test welds were pr                          | repared, welded, an |  |
|                          |                     |                                    | the 21st Edition of API 1                         |                     |  |
|                          |                     | A STATE OF THE PARTY OF THE PARTY. |   |                     |  |
|                          |                     |                                    |   |                     |  |
| We certify that the sta  |                     |                                    | t the test welds were puthe 21st Edition of API 1 |                     |  |

|  |                       |               | 42/4/2044         |                |           |   |   |
|--|-----------------------|---------------|-------------------|----------------|-----------|---|---|
| Test Number: 2-3   | tan Ohio              | Date:         | 12/4/2014         |                |           |   |   |
| Location: Kiefner, Worthing Welder: Jeff Ellis, Piedmont |                       |               |                   |                |           |   | _ |
| vveider. Jen Ellis, Fleditioni                           | . Ivaturar Gas        |               |                   |                |           |   |   |
| Welding Process: Manual (                                | Oxv-Acetylene Weldi   | ng            |                   |                |           |   |   |
| Pipe Material: 2.375" diam                               |                       |               | 75" diameter, 0.  | .154" thick AF | PI 5L X52 | 2 |   |
| A D S T D M S T T T T T T T T T T T T T T T T T T        | t with 1/16" gap      |               |                   |                |           | - |   |
| Position: 5G, Fixed                                      |                       | Weldi         | ing Direction:    | Uphill         |           |   |   |
| Filler Metal: RG60                                       |                       |               |                   |                |           |   |   |
| Time Between Passes: 32                                  | minutes between ro    |               |                   |                |           |   |   |
| Preheat Temperature: Am                                  | bient (64°F)          | Interp        | ass Temperatur    | e: NR          |           |   |   |
| Post-weld Heat Treatment:                                | None                  |               | True 802.7X       | C 375          |           |   |   |
| Line-up Clamps: None used                                |                       |               |                   |                |           |   |   |
| Comments: Number 3 oxy                                   | -acetylene weld tip v | vas used      |                   |                |           |   |   |
| The flow rate  | of the acetylene was  | 10 CFH and th | e flow rate of th | ne oxygen was  | s 22 CFF  | 1 |   |
|  |                       |               |                   |                |           |   |   |
|  | WELDI                 | NG PARAME     | TERS              |                |           |   |   |
| 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             |               | 101               |                |           |   |   |
| Comments:  |                       |               |                   |                |           |   |   |
|  |                       |               |                   |                |           |   |   |
| -  |                       |               |                   |                |           |   |   |
|  | FIGURE 1              | - BEAD SEQ    | UENCE             |                |           |   |   |
|  |                       |               |                   |                |           |   |   |
|  |                       |               |                   |                |           |   |   |
|  |                       |               |                   |                |           |   |   |
|  |                       | 1             |                   |                |           |   |   |
|  | $\vdash$              |               |                   |                |           |   |   |
|  | / _                   |               |                   |                |           |   |   |
| _  | ٦ (                   |               |                   |                |           |   |   |
|  |                       | R             |                   |                |           |   |   |
|  |                       | R \           | \                 |                |           |   |   |
|  |                       |               | )                 |                |           |   |   |
|  | フ                     |               |                   | 7              |           |   |   |
|  | _                     |               |                   | _              |           |   |   |
| _  |                       |               |                   |                |           |   |   |

| Test Number: 2-3          |                    |                         | Page                                    |                   |
|---------------------------|--------------------|-------------------------|---|-------------------|
|                           |                    | TENSILE STRENGTH        | TEST                                    |                   |
| Coupon Number:            |                    |                         |   |                   |
| Coupon Width:             |                    |                         |   |                   |
| Coupon Thickness:         |                    |                         |   |                   |
| Coupon Area:              |                    |                         |   |                   |
| Maximum Load:             |                    |                         |   |                   |
| Tensile Strength:         |                    |                         |   |                   |
| Fracture Location:        |                    |                         |   |                   |
|                           |                    | BEND TEST               |   |                   |
| Coupon Number:            |                    |                         |   |                   |
| Type:                     |                    |                         |   |                   |
| Results:                  |                    |                         |   |                   |
|                           |                    | NICK DDEAK TES          |   |                   |
| Coupon Number:            | W7 NB1             | W7 NB2                  | W7 NB3                                  | W7 NB4            |
| Results:                  | Pass               | Pass                    | Pass                                    | Pass              |
|                           |                    | 5.03 miles 5.55 m       |   |                   |
|                           |                    | CHARPY TOUGHNESS        | TEST                                    |                   |
| Coupon Number:            |                    |                         |   |                   |
| Depth:                    |                    |                         |   |                   |
| Width:                    |                    |                         | +                                       |                   |
| Notch Location:           |                    |                         | +                                       |                   |
| Test Temperature:         |                    |                         |   |                   |
| Impact Energy:  % Shear:  |                    |                         | + |                   |
| Lateral Expansion:        |                    |                         |   |                   |
| zaterai zapansioni        |                    |                         |   | <u> </u>          |
| Comments:                 |                    |                         |   |                   |
|                           |                    | OTHER TESTS             |   |                   |
| Test Type:                |                    | - APT 100               |   |                   |
| Results:                  |                    |                         |   |                   |
|                           | tomante in this ro | cord are correct and th | at the test welds were n                | ronared wolded an |
| We cortify that the st    |                    |                         | the 21st Edition of API 1               |                   |
| We certify that the state | d in accordance wi | th the requirements of  | THE 21ST EDITION OF WELL                |                   |
|                           | d in accordance wi | th the requirements of  | the 21st Edition of AFT 1               |                   |



Page: 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 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

34 minutes between root and hot pass Time Between Passes:

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

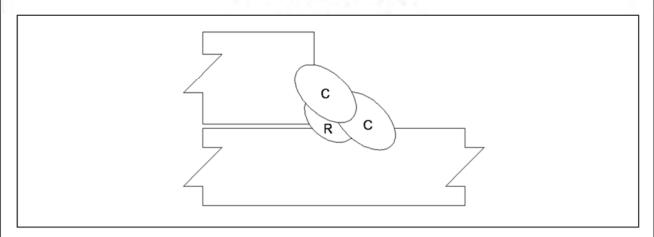
#### **WELDING PARAMETERS**

| Pass:                      |  |
|----------------------------|--|
| AWS Classification:        |  |
| Manufacture:               |  |
| <b>Electrode Diameter:</b> |  |
| Current/Polarity:          |  |
| <b>Current Range:</b>      |  |
| Voltage Range:             |  |
|                            |  |

| Travel Sp | peed Rar | ige, ipm: |
|-----------|----------|-----------|
|-----------|----------|-----------|

| voitage kange:        |      |
|-----------------------|------|
| Travel Speed Range, i | ipm: |
| Comments:             |      |

| Root      | Cap       |  |  |
|-----------|-----------|--|--|
| RG60      | RG60      |  |  |
| NR        | NR        |  |  |
| 3/32"     | 3/32"     |  |  |
| NA        | NA        |  |  |
| NA        | NA        |  |  |
| NA        | NA        |  |  |
| 0.4 - 0.5 | 0.6 - 0.8 |  |  |



|                    | TENSILE STRE           | NGTH TE   | ST   |  |   |   |
|--------------------|------------------------|---|--|--|---|---|
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    | BEND                   | TEST  |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    | NIGY DDE               |   |  |  |   |   |
| M/S NID1           |                        |   | W/S VIDS   |  | M/Q NIDA  |   |
|                    |                        |   | P. 4 - 5 - 1 - 5 - 5 - 5 - 5 - 5 - 5 - 5 - 5   |  | 17.00   |   |
|                    | A Charles              |   |  |  |   |   |
|                    | CHARPY TOUG            | HNESS T   | EST  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    | 7.7                    |   | Y A STATE OF THE S |  | V -   |   |
| cations were prese | ent but were wit       | hin the ac  | ceptable limits o  | API 110  | 14  |   |
|                    | OTHER                  | TESTS   |  |  |   |   |
|                    | 470 5 0 7 7 9          |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    | ner vill - ever        | A LANGER  | A CONTRACTOR AND TO  |  | La Selection and the  |   |
|                    |                        |   |  |  |   | , and   |
| d in accordance w  | ith the requiren       | nents of th   | ne 21st Edition of   | API 110  | 14.   |   |
|                    |                        |   |  |  |   |   |
|                    |                        |   |  |  |   |   |
|                    | cations were presented | TENSILE STRE  BEND  NICK-BRE  W8 NB1 W8 NB  Pass Pass (1)  CHARPY TOUG  Cations were present but were with the company of the | TENSILE STRENGTH TE  BEND TEST  NICK-BREAK TEST  W8 NB1  W8 NB2 Pass  Pass (1)  CHARPY TOUGHNESS T  CHARPY TOUGHNESS T  CATIONS were present but were within the acceptance of the company | TENSILE STRENGTH TEST  BEND TEST  NICK-BREAK TEST  W8 NB1  W8 NB2  W8 NB3 Pass  Pass (1)  Pass  CHARPY TOUGHNESS TEST  Cations were present but were within the acceptable limits of OTHER TESTS | TENSILE STRENGTH TEST  BEND TEST  NICK-BREAK TEST  W8 NB1  W8 NB2  W8 NB3 Pass  Pass (1)  Pass  CHARPY TOUGHNESS TEST  Cations were present but were within the acceptable limits of API 110  OTHER TESTS | TENSILE STRENGTH TEST  BEND TEST  NICK-BREAK TEST  W8 NB1 W8 NB2 W8 NB3 W8 NB4 Pass Pass (1) Pass Pass (1)  CHARPY TOUGHNESS TEST  CHARPY TOUGHNESS TEST  Cations were present but were within the acceptable limits of API 1104  OTHER TESTS |



Page:

1 of

2

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

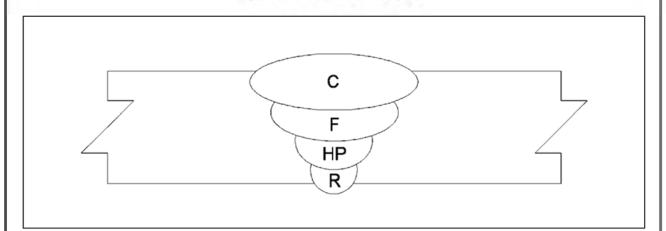
Pass:

AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:
Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill        | Cap       |  |
|-----------|-----------|-------------|-----------|--|
| E6010     | E6010     | E6010       | E6010     |  |
| Lincoln   | Lincoln   | Lincoln     | Lincoln   |  |
| 1/8"      | 1/8"      | 1/8"        | 1/8"      |  |
| DCEP      | DCEP      | DCEP        | DCEP      |  |
| 102 - 105 | 100 - 101 | 95 – 100    | 90        |  |
| 27 – 28   | 30 - 31   | 30 - 31     | 30 - 31   |  |
| 6.4 – 6.8 | 9.1 – 9.5 | 11.1 - 13.1 | 8.1 - 8.4 |  |



| NICK-BREAK TEST  Dupon Number:  Pass Pass Pass Pass Pass Pass Pass Pas   | -  |               |               |           |             |               | 7              |     |         |     |
|--|--|---------------|---------------|-----------|-------------|---------------|----------------|-----|---------|-----|
| Dupon Width: Dupon Thickness: Dupon Area: Daximum Load: Da |  |               | TE            | NSILE ST  | RENGTH      | TEST          | 1              |     |         |     |
| pupon Thickness: pupon Area: laximum Load: ensile Strength: acture Location:    BEND TEST  | 기계 시간이 어느 나는 얼마나 얼룩하다 하나 있다.   |               |               |           |             |               |                |     |         |     |
| Dupon Area:  Jaximum Load:  Jaximum  |  |               |               |           |             |               |                |     |         |     |
| Asximum Load:  Insile Strength: Insile S |  |               |               |           |             |               |                |     |         |     |
| BEND TEST  Dupon Number: W9 RB1 W9 RB2   Pass Pass   W9 NB1 W9 NB2   Dupon Number: W9 NB1 W9 NB2   Pass Pass   W9 NB2   Dupon Number: Pass Pass   Pass (1)  CHARPY TOUGHNESS TEST  Dupon Number: Pass Pass (1)  CHARPY TOUGHNESS TEST  |  |               |               |           |             |               |                |     |         |     |
| BEND TEST  |  |               | -             |           |             |               |                |     |         |     |
| BEND TEST  |  |               | -             |           |             |               |                |     |         |     |
| Dupon Number: W9 RB1 W9 RB2 Root Root Root Rout Roupon Number: W9 NB1 W9 NB2 RBS Pass RBS Pass RBS   | racture Location:  |               |               |           |             |               |                |     |         |     |
| Dupon Number: W9 RB1 W9 RB2 Root Root Root Rout Roupon Number: W9 NB1 W9 NB2 RBS Pass RBS Pass RBS   |  |               |               | BEN       | D TEST      |               |                |     |         |     |
| NICK-BREAK TEST  Dupon Number:  Pass Pass Pass Pass Pass Pass Pass Pas   | Coupon Number:   | W9 RB1        | W9 RB2        |           | 1           |               |                |     |         |     |
| NICK-BREAK TEST  Dupon Number: W9 NB1 W9 NB2  Pass Pass (1)  CHARPY TOUGHNESS TEST  Dupon Number: epth: idth: otch Location: est Temperature: npact Energy: Shear: atteral Expansion:  | Гуре:  | Root          | Root          |           |             |               |                |     |         |     |
| bupon Number: W9 NB1 W9 NB2 esults: Pass Pass (1)  CHARPY TOUGHNESS TEST  Dupon Number: epth: (idth: otch Location: est Temperature: mpact Energy: Shear: eteral Expansion:  | Results:   | Pass          | Pass          |           |             |               |                |     |         |     |
| bupon Number: W9 NB1 W9 NB2 pass Pass (1)  CHARPY TOUGHNESS TEST  Dupon Number: pepth: Pass Pass (2)  Cidth: Pass Pass (3)  CHARPY TOUGHNESS TEST  Dupon Number: Pass Pass (4)  CHARPY TOUGHNESS TEST  Dupon Number: Pass Pass (4) |  |               |               |           |             |               |                |     |         |     |
| CHARPY TOUGHNESS TEST  Dupon Number: epth: fidth: fidth: finteral Expansion:  Pass Pass (1)  CHARPY TOUGHNESS TEST  CHARPY TOUGHNESS TEST   CHARPY TOU |  |               |               |           |             | T             |                |     |         |     |
| CHARPY TOUGHNESS TEST  Dupon Number: epth: fidth: otch Location: est Temperature: npact Energy: Shear: eteral Expansion:   |  |               |               |           |             |               |                |     |         |     |
| pupon Number: epth: fidth: otch Location: est Temperature: npact Energy: Shear: eteral Expansion:  | Results:   | Pa            | ass           | Pas       | s (1)       |               |                |     |         |     |
| pupon Number: epth: fidth: otch Location: est Temperature: npact Energy: Shear: eteral Expansion:  |  |               | CH            | APPV TO   | IGHNESS     | TEST          |                |     |         |     |
| epth:  /idth: otch Location: est Temperature: inpact Energy: Shear: iteral Expansion:  | Coupon Number:   | 1             | Cit           | ARTIO     | OGTHVESS    | 1             |                |     |         |     |
| Vidth: Otch Location: Est Temperature: Inpact Energy: Shear: Interal Expansion:  | AND THE PERSON OF THE PERSON O |               |               |           |             |               |                |     |         |     |
| otch Location: est Temperature: npact Energy: Shear: eteral Expansion:   | Width:   |               |               |           |             |               |                |     |         |     |
| est Temperature: npact Energy: Shear: teral Expansion:   | Notch Location:  |               |               |           |             |               |                |     |         | _   |
| Shear: teral Expansion:  |  |               | - 15          |           |             |               |                |     |         |     |
| Shear: teral Expansion:  |  |               |               |           |             |               |                |     |         |     |
|  | % Shear:   |               |               |           |             |               |                |     |         |     |
| omments: (1) Indications were present but were within the acceptable limits of API 1104  | ateral Expansion:  |               |               |           |             |               |                |     |         |     |
| (1) Indications were present but were within the acceptable limits of API 1104   |  |               |               |           |             |               | T Declaration  |     |         |     |
|  | Comments: (1) I  | ndications    | were present  | but were  | within the  | acceptable li | mits of API 11 | 04  |         | _   |
| OTHER TESTS  |  |               |               | ОТНЕ      | R TESTS     |               |                |     |         |     |
| OTTIEN TESTS   | Test Type:   |               |               |           |             |               |                |     |         |     |
|  | Sanulka.   |               |               |           |             |               |                |     |         |     |
| OTHER TESTS  | % Shear: Lateral Expansion: Comments:(1)   Comments:(1)  |               |               | ОТНЕ      | R TESTS     |               | mits of API 11 | 04  |         |     |
| The state of the s | Test Type:   |               |               |           |             |               |                |     |         |     |
|  | Sanulka.   |               |               |           |             |               |                |     |         |     |
| est Type:  |  |               |               |           |             |               |                |     | welded, | and |
| est Type:  esults:  Ve certify that the statements in this record are correct and that the test welds were prepared, welded, and   |  | stea iii acci | or dance with | the requi | Cilicitis O | tile 213t Lu  | tion of Al 111 | 04. |         |     |
| est Type:esults:   | Date: 10/16/201  |               |               |           |             |               |                |     |         |     |

2



#### **API 1104 COUPON TEST REPORT**

Page: 1 of

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

Root

Preheat Temperature: Ambient (65°F) Interpass Temperature: NR

Post-weld Heat Treatment: None

Line-up Clamps: None used

Comments:

#### WELDING PARAMETERS

Hot Pass

Pass:

AWS Classification: Manufacture:

Electrode Diameter: Current/Polarity:

Current Range: Voltage Range:

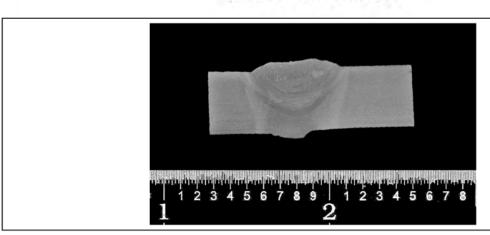
Comments:

Travel Speed Range, ipm:

|   | E6010   | E7010-P1  | E7010-P1  | E7010-P1  |  |
|---|---------|-----------|-----------|-----------|--|
|   | Lincoln | Lincoln   | Lincoln   | Lincoln   |  |
|   | 1/8"    | 5/32"     | 5/32"     | 5/32"     |  |
|   | DCEP    | DCEP      | DCEP      | DCEP      |  |
|   | 75 – 77 | 100 - 110 | 105 - 112 | 100 – 105 |  |
| 1 | 24 – 27 | 25 – 28   | 25 – 29   | 25 – 29   |  |
|   | 35-57   | 41-55     | 31-44     | 29-48     |  |

Fill

Cap



| Test Number:  | 3-2                       |                     |                         |                |            | Pag         | ge: 2 | of          |
|---|---------------------------|---------------------|-------------------------|----------------|------------|-------------|-------|-------------|
|   |                           |                     | TENSILE STR             | RENGTH TES     | ST.        |             |       |             |
| Coupon Number:  | W                         | 10 T1               | W10                     | ) T2           |            |             |       |             |
| Coupon Width:   | 0.97                      | '0 inch             | 1.039                   | inch           |            |             |       |             |
| Coupon Thickness:   |                           |                     | 0.374                   | inch           |            |             |       |             |
| Coupon Area:  | 0.37                      | 1 inch <sup>2</sup> | 0.389 inch <sup>2</sup> |                |            |             |       |             |
| Maximum Load:   |                           | 872 lb              |                         | 69 lb          |            |             |       |             |
| Tensile Strength:   |                           | 13 psi              | 81,155 psi              |                |            |             |       |             |
| racture Location:   | Base                      | Metal               | Base                    | Metal          |            |             |       |             |
|   |                           |                     | BENE                    | TEST           |            |             |       |             |
| Coupon Number:  | W10 FB1                   | W10 FB2             | W10 RB1                 | W10 RB2        |            |             |       | 194         |
| Туре:   | Face                      | Face                | Root                    | Root           |            |             |       |             |
| Results:  | Pass                      | Pass                | Pass (1)                | Pass           |            |             |       |             |
|   |                           |                     | NICK BD                 | EAK TEST       |            |             |       |             |
| Coupon Number:  | W10                       | NB1                 | W10                     |                |            |             | T     |             |
| Results:  |                           | s (1)               | Pass (1)                |                |            |             |       |             |
| Depth: Width: Notch Location:                               |                           |                     |                         |                |            |             |       |             |
| Test Temperature: mpact Energy:                             |                           |                     |                         |                |            |             |       |             |
| % Shear:  |                           |                     |                         |                |            |             |       |             |
|   | 1                         |                     |                         |                |            |             |       |             |
| Lateral Expansion:  |                           | were preser         | nt but were w           | vithin the acc | ceptable l | imits of AP | 1104  |             |
|   | ndications                | were preser         |                         |                |            |             |       |             |
| Comments: _(1)  |                           |                     |                         | RTESTS         |            |             |       |             |
| Comments: (1)   |                           |                     |                         | 4.000.40       |            |             |       |             |
| Comments: _(1)    Fest Type:  Results:  We certify that the | statement                 | s in this rec       |                         | ect and that   | the test v | velds were  |       | , welded, a |
| Comments: _(1)    Test Type:  Results:  We certify that the | statement<br>sted in acco | s in this rec       | ord are corre           | ect and that   | the test v | velds were  |       | , welded, a |
| Test Type: Results: We certify that the                     | statement<br>sted in acco | s in this rec       | ord are corre           | ect and that   | the test v | velds were  |       | , welded, a |



Page: 1 of 2

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

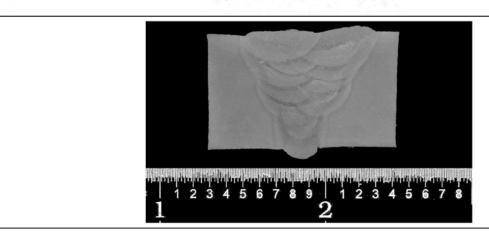
Pass:

AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass   | Fill       | Cap       |  |
|-----------|------------|------------|-----------|--|
| E6010     | E7010-P1   | E7010-P1   | E7010-P1  |  |
| Lincoln   | Lincoln    | Lincoln    | Lincoln   |  |
| 1/8"      | 5/32"      | 5/32"      | 5/32"     |  |
| DCEP      | DCEP       | DCEP       | DCEP      |  |
| 107 - 113 | 134 - 141  | 120 - 143  | 108 - 115 |  |
| 24 – 26   | 26 - 31    | 26 - 30    | 27 - 29   |  |
| 5.1 - 8.8 | 7.2 – 14.3 | 4.5 – 10.7 | 4.0 - 8.3 |  |



|                                   |                                      |                 |                                       |                              |          |              | ge:    |   |        |    |
|-----------------------------------|--------------------------------------|-----------------|---------------------------------------|------------------------------|----------|--------------|--------|---|--------|----|
|                                   |                                      |                 | ENSILE STE                            |                              | ST       |              | -      |   |        |    |
| Coupon Number:                    |                                      | 11 T1<br>7 inch | W1:                                   |                              |          |              | -      |   |        | _  |
| Coupon Width:                     |                                      | 0 inch          | 1.133                                 |                              |          |              | -      |   |        |    |
| Coupon Thickness:<br>Coupon Area: |                                      |                 | 0.826 inch<br>0.936 inch <sup>2</sup> |                              |          |              | +      |   |        | _  |
| Maximum Load:                     | 1.015 inch <sup>2</sup><br>71,300 lb |                 |                                       | 00 lb                        |          |              |        |   |        |    |
| Tensile Strength:                 |                                      | 00 psi          |                                       | 00 psi                       |          |              |        |   |        | _  |
| Fracture Location:                |                                      | Metal           |                                       | Metal                        |          |              |        |   |        |    |
|                                   |                                      |                 | DENI                                  | ) TECT                       |          |              |        |   |        |    |
| Coupon Number:                    | W11 SB1                              | W11 SB2         | W11 SB3                               | W11 SB4                      |          |              |        |   |        |    |
| Гуре:                             | Face                                 | Face            | Root                                  | Root                         |          |              |        | - |        |    |
| Results:                          | Pass                                 | Pass (1)        | Pass (1)                              | Pass (1)                     | 1        |              |        |   |        |    |
| Coupon Number: [                  |                                      | NB1<br>s (1)    | NICK-BR<br>W11<br>Pass                |                              |          |              |        |   |        |    |
|                                   | _                                    | CI              | HARPY TOU                             | JGHNESS T                    | EST      |              |        |   |        |    |
| Coupon Number:                    |                                      |                 |                                       |                              |          |              |        |   |        |    |
| Depth:                            |                                      |                 |                                       |                              |          | 11111        |        |   |        |    |
| Width:                            |                                      | _               | -                                     |                              |          |              |        |   |        |    |
| Notch Location:                   |                                      |                 |                                       |                              |          |              |        |   |        |    |
| Test Temperature:                 | -                                    |                 |                                       |                              |          |              |        |   |        |    |
| Impact Energy:<br>% Shear:        |                                      | _               |                                       |                              | -        | _+           |        | - |        | _  |
| Lateral Expansion:                |                                      |                 |                                       |                              |          |              |        |   |        |    |
|                                   | ndications                           | were presen     | t but were w                          | vithin the ac                | ceptable | limits of Al | PI 110 | 4 |        |    |
|                                   |                                      |                 | OTHE                                  | R TESTS                      |          |              |        |   |        |    |
| Test Type:                        |                                      |                 |                                       |                              |          |              |        |   |        |    |
| Results:                          |                                      |                 |                                       |                              |          |              |        |   |        |    |
|                                   | statement                            |                 | ord are corre                         | ect and that<br>ements of th |          |              |        |   | elded, | an |
|                                   | statement                            |                 |                                       |                              |          |              |        |   | elded, | ar |



|               | PQR No. 1-X42          | 2-179              |                    |                  | Orig. Issue Date  |                          | Revision Date        |             |
|---------------|------------------------|--------------------|--------------------|------------------|-------------------|--------------------------|----------------------|-------------|
| TYPE OF       | WPS No. BW-1-          | A-I                |                    |                  | Orig. Issue Date  |                          | Revision Date        |             |
| RECORD        | API 1104 🗸             | Other              |                    |                  | A                 |                          |                      |             |
|               | Process Name: Sh       | ielded Metal       | Arc Welding (      | SMAW)            | Type of Process:  | Manual                   |                      |             |
| PROCESS       | For:                   | Butt Welding       | / Fillet           | Welding          |                   |                          |                      |             |
| PIPE          | Material Specification | on: 1.315" O       | .D X-42 -0.:       | 179" WT. A       | PI 5L             |                          |                      |             |
| DIAMETER      | API 1104 6.2           | .2 Guidelines      | ✓ Under            | 2-3/8" OD        | 2-3/8"            | to 12-3/4" OD            | > 12-3               | /4" OD      |
| MATERIAL      | API 1104 5.4.          | 2.2 Guidelines     | √ ≤ 42,00          | 00 PSI Yield     | > 42,00           | 00 to < 65,000 PSI Yield | ≥ 65,000             | PSI Yield   |
| THICKNESS     | API 1104 6.2           | .2 Guidelines      | ✓ Under 3          | 3/16" thick      | 3/16" t           | thru 3/4" thick          | Over 3/              | 4" thick    |
|               | AWS Electrode Nos:     | E6010              | AWS Electrode Size | : 1/8"           | AWS Specification | : A5.1                   | Filler Metal Group:  | 1           |
| FILLER METALS | AWS Electrode Nos:     |                    | AWS Electrode Size | ж.               | AWS Specification |                          | Filler Metal Group:  |             |
| GAS           | SHIELDING GAS: N/      | Ά                  |                    | FLOW RATE: N/A   |                   | FLUX: N/A                | 1                    |             |
| PREHEAT       | Minimum Preheat T      | emperature (F): 50 | 0                  | Interpass Temper | ature (F):        | Other:                   |                      |             |
|               |                        |                    | D AXIS             |                  | TE                | CHNIQUE                  | DIREC                | TION        |
|               | Flat (1G, 1F, 1FR)     |                    | Plate              |                  | Backhand          | П                        | Vertical - Up        |             |
|               | Horizontal (2G, 2F, 2  | 2FR)               | Pipe               |                  | Forehand          | 7                        | Vertical - Down      | 7           |
| POSITION      | Vertical (3G, 3F)      |                    | Rotated            |                  |                   |                          |                      | 100         |
|               | Overhead (4G, 4F)      |                    | Fixed              | V                |                   |                          |                      | - 71        |
|               | Multiple (5G, 5F)      | 7                  | Inclined (6G, 6F)  |                  |                   |                          |                      |             |
|               | Combination            |                    |                    |                  |                   |                          |                      |             |
|               |                        | DISPOSITION STYL   | E                  | М                | ETHOD             |                          | ARC TYPE             |             |
| TECHNIQUE     | Stringer Beads         | <b>√</b>           |                    | Multiple Pass    | J                 | Single Arc 🗸             |                      | ou []       |
|               | Weave Beads            | A                  |                    | Single Pass      |                   | Multiple Arc             |                      | Other:      |
| CLEANING      | Base Material:         | Power 🗸            | Hand               |                  | Weld: Power       | √ Har                    | nd 🔲                 |             |
|               |                        | вит                | WELD 4             |                  |                   | FILLE                    | T WELD               |             |
|               | 371/2" ± 21/2"         | FOR FITTINGS       |                    |                  |                   | 1/16° ± 1/3              | 2 11                 |             |
|               | 30" + 5",-             | O FOR PIPE         |                    |                  |                   | 1/16" ± 1/32"            |                      |             |
| JOINT DESIGN  |                        | سليليا →           | <b>≠</b> =½6"      |                  |                   | 716 - 732                |                      |             |
|               |                        | 1                  | 7                  |                  |                   | 1                        | -                    | 1           |
|               | 1/32" TO 1/1           | e.1 \              |                    |                  |                   | 1                        | /                    | /           |
|               | 1/8" ± 1/1             | . JL               |                    |                  |                   | ./                       | -                    |             |
|               | 78 - 71                | י דר               | -                  |                  | 17"               | TO 45°                   |                      |             |
|               |                        |                    | Groove D           | esigns of        | : Test Cou        | ipons                    |                      |             |
|               | Current Type:          | AC                 | DC 🗸               | Polarity:        | Straight/Negative |                          | Reverse/Positive     | <b>√</b>    |
| ELECTRICAL    | 12 10 10 10            |                    | ELECTRODE NO. &    |                  |                   | RANGE                    | MAXIMUM TIME         | SPEED RANGE |
| CHARACTERIS-  | BEAD NO.               | Passes             | TYPE               | Size             | VOLTS             | AMPS                     | LAPSE ALLOWED (Min.) | (IPM)       |
| TICS &        | Root                   | 1                  | E6010              | 1/8"             | 20-24             | 75-130                   | 5.                   | 3-20        |
| SEQUENCE OF   | Hot Pass               | 1                  | E6010              | 1/8"             | 20-24             | 75-130                   | 5                    | 3-20        |
| BEADS         | Fill                   |                    |                    |                  |                   |                          |                      |             |
|               | Сар                    | 1                  | E6010              | 1/8"             | 20-24             | 75-130                   | 5                    | 3-20        |

|                                | Specimen No.  | Width  | Thickness              | Area (in.^2)        |           | ite Total<br>d(Lbs.)        |  | e Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|--------------------------------|---|--|------------------------|---------------------|-----------|-----------------------------|--|------------------------|---------------------------------------|--|
|                                | 1   |  |                        |                     |           |                             |  |                        |                                       |  |
| TENSILE TEST                   | 2   |  |                        |                     |           |                             |  |                        |                                       |  |
|                                | 3   |  |                        |                     | T         |                             |  |                        |                                       |  |
|                                | 4   |  |                        |                     |           |                             |  |                        |                                       | J. Land                                      |
|                                | Specimen No.  | Root Bend                                      | Face Bend              | Side Bend           |           | Bend /                      | Acceptable                                   |                        | Com                                   | ments  |
|                                | 5   | 180 Degrees                                    | NA                     | NA                  | Yes       |                             | No   |                        |                                       |  |
|                                | 6   | 180 Degrees                                    | NA                     | NA                  | Yes       | 100                         | No   |                        |                                       |  |
|                                | 7   | 180 Degrees                                    | NA                     | NA                  | Yes       |                             | No   |                        |                                       |  |
| GUIDED BEND                    | 8   | 180 Degrees                                    | NA                     | NA                  | Yes       |                             | No   |                        |                                       | - 7  |
| TEST                           | 9   | NA   | 180 Degrees            | NA .                | Yés       |                             | No   |                        |                                       |  |
|                                | 10  | NA   | 180 Degrees            | NA                  | Yes       |                             | No   |                        |                                       |  |
|                                | 11  | NA   | 180 Degrees            | NA                  | Yes       |                             | No   |                        |                                       |  |
|                                | 12  | NA   | 180 Degrees            | NA .                | Yés       |                             | No   |                        |                                       | - 7  |
|                                | Specimen No.  | Accepta  | ble Yes/No             |                     |           |                             | Co   | mments                 |                                       |  |
|                                | 13  | Yes  | No                     |                     |           |                             |  |                        |                                       |  |
| NICK BREAK                     | 14  | Yes  | No                     |                     |           |                             |  |                        |                                       |  |
| TEST                           | 15  | Yes  | No                     |                     |           |                             |  |                        |                                       |  |
|                                | 16  | Yes  | No                     |                     |           |                             |  |                        |                                       |  |
|                                |   |  |                        |                     |           |                             |  |                        |                                       |  |
| FILLET WELD                    | Satisfactory:   | Yes  | No                     |                     | Penetrati | ion into Par                | rent Meta                                    | :                      | Yes                                   | No   |
| FILLET WELD<br>TEST            | Satisfactory:<br>Fillet Weld - Fractu   |  | No                     |                     |           | ion into Par<br>f Percent o |  | ŧ                      | Yes                                   | No   |
| TEST                           |   |  | No L                   | License Number 8    | Length of |                             |  |                        |                                       |  |
|                                | Fillet Weld - Fractu  |  | No                     | License Number 8    | Length of |                             |  |                        | in.:                                  |  |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor:   | re Test  | No                     |                     | Length of | f Percent o                 | f Defect                                     |                        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor: We certify that the   | re Test statements in this re                  |                        |                     | Length of | f Percent o                 | f Defect                                     |                        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104.   | re Test. statements in this re                 |                        |                     | Length of | f Percent o                 | f Defect                                     |                        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Condi  | statements in this re<br>ucted By:<br>Results: |                        | that the test coupo | Length of | f Percent o                 | f Defect                                     |                        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Condi  | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | f Defect                                     |                        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test 6  | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | f Defect                                     | ested in accord        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F  | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | ded, and t                                   | ested in accord        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F Mechanical Test Co                       | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | ded, and t                                   | ested in accord        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F Mechanical Test Co                       | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | ded, and t                                   | ested in accord        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F Mechanical Test Co Approved By: APPROVED | statements in this re<br>ucted By:<br>Results: | cord are correct and t | that the test coupo | Length of | f Percent o                 | ded, and t<br>Laborato<br>Organizal<br>Date: | ested in accord        | in.:<br>Stencil Mark                  | <b>%</b> :                                   |



| TVDE OF       | PQR No. 2-X42          | -154                       |                         |                   | Orig. Issue Date   |                              | Revision Date        |                      |
|---------------|------------------------|----------------------------|-------------------------|-------------------|--------------------|------------------------------|----------------------|----------------------|
| TYPE OF       | WPS No. BW-2-          | A-I                        |                         |                   | Orig. Issue Date   |                              | Revision Date        |                      |
| RECORD        | API 1104 🗸             | Other                      |                         |                   |                    |                              |                      |                      |
|               | Process Name: Sh       | ielded Metal               | Arc Welding (S          | SMAW)             | Type of Process:   | Manual                       |                      | - 11                 |
| PROCESS       | For:                   | Butt Welding               | / Fillet                | Welding           |                    |                              |                      |                      |
| PIPE          | Material Specification | on: 2.375" C               | D X-42 -0.1             | L54" WT. A        | PI 5L              |                              |                      |                      |
| DIAMETER      | API 1104 6.2           | 2.2 Guidelines             | Under 2                 | 2-3/8" OD         | √ 2-3/8"           | to 12-3/4" OD                | > 12-3               | /4" OD               |
| MATERIAL      | API 1104 5.4.          | .2.2 Guidelines            | ✓ ≤ 42,00               | 0 PSI Yield       | > 42,00            | 0 to < 65,000 PSI Yield      | ≥ 65,000             | PSI Yield            |
| THICKNESS     | API 1104 6.2           | 2.2 Guidelines             | ✓ Under 3               | /16" thick        | 3/16" t            | thru 3/4" thick              | Over 3/              | 4" thick             |
|               | AWS Electrode Nos:     | : E6010                    | AWS Electrode Size      | : 1/8"            | AWS Specification: | A5.1                         | Filler Metal Group:  | 1                    |
| FILLER METALS | AWS Electrode Nos:     |                            | AWS Electrode Size      | -                 | AWS Specification: |                              | Filler Metal Group:  |                      |
| GAS           | SHIELDING GAS: N/      | 'A                         |                         | FLOW RATE: N/A    |                    | FLUX: N/A                    | •                    |                      |
| PREHEAT       | Minimum Preheat        | Temperature (F): 50        | ) 0                     | Interpass Tempera | ature (F):         | Other:                       |                      |                      |
|               |                        | WEI                        | LD AXIS                 |                   | TE                 | CHNIQUE                      | DIREC                | TION                 |
|               | Flat (1G, 1F, 1FR)     |                            | Plate                   |                   | Backhand           |                              | Vertical - Up        |                      |
|               | Horizontal (2G, 2F, 2  | 2FR)                       | Pipe                    | 1                 | Forehand           | 4                            | Vertical - Down      | 4                    |
| POSITION      | Vertical (3G, 3F)      |                            | Rotated                 |                   |                    |                              |                      |                      |
|               | Overhead (4G, 4F)      |                            | Fixed                   | 4                 |                    |                              |                      |                      |
|               | Multiple (5G, 5F)      | 4                          | Inclined (6G, 6F)       |                   |                    |                              |                      |                      |
|               | Combination            |                            |                         |                   | 7.                 |                              |                      |                      |
|               |                        | DISPOSITION STYL           | E                       | М                 | ETHOD              |                              | ARC TYPE             |                      |
| TECHNIQUE     | Stringer Beads         | J                          |                         | Multiple Pass     | J                  | Single Arc                   |                      | Other:               |
|               | Weave Beads            | 14                         |                         | Single Pass       |                    | Multiple Arc                 |                      |                      |
| CLEANING      | Base Material:         | Power 🗸                    | Hand                    |                   | Weld: Power        | √ Hai                        | nd 🔲                 |                      |
|               |                        | BUT                        | T WELD                  |                   |                    | FILLE                        | TWELD                |                      |
|               |                        | FOR FITTINGS<br>O FOR PIPE |                         |                   |                    | 1/16° ± 1/3<br>1/16° ± 1/32° | 12"                  |                      |
| JOINT DESIGN  | 1/32" TO 1/1           | 15                         | /16"                    |                   |                    | 716" ± 732"                  |                      |                      |
|               | 1/8" ± 1/              | (ie' <b> </b>              | ►<br>Groove D           | esigns of         | 17"<br>Test Cou    | TO 45°                       |                      | A-                   |
|               | Current Type:          | AC 🗍                       | DC 7                    | Polarity:         | Straight/Negative  |                              | Reverse/Positive     | 17                   |
| ELECTRICAL    | ситенстуре:            |                            |                         | , clarity:        | 1                  | RANGE                        | MAXIMUM TIME         | COSED DANCE          |
| CHARACTERIS-  | BEAD NO.               | Passes                     | ELECTRODE NO. &<br>TYPE | Size              | VOLTS              | AMPS                         | LAPSE ALLOWED (Min.) | SPEED RANGE<br>(IPM) |
| TICS &        | Root                   | 1                          | E6010                   | 1/8"              | 19-24              | 75-130                       | 5                    | 3-20                 |
| SEQUENCE OF   | Hot Pass               | 1                          | E6010                   | 1/8"              | 19-24              | 75-130                       | 5                    | 3-20                 |
| BEADS         | Fill                   |                            |                         |                   |                    |                              |                      |                      |
|               | Сар                    | 1                          | E6010                   | 1/8"              | 19-24              | 75-130                       | 5                    | 3-20                 |

|                                | Specimen No.  | Width  | Thickness                | Area (in.^2)        |          | ate Total<br>d(Lbs.) |  | e Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|--------------------------------|---|--|--------------------------|---------------------|----------|----------------------|--|------------------------|---------------------------------------|--|
| TENOUE TEST                    | 1   |  | F 1                      |                     |          |                      |  |                        |                                       |  |
| TENSILE TEST                   | 2   |  | 1 == 1                   |                     |          |                      |  |                        |                                       |  |
|                                | 3   |  |                          |                     |          |                      |  |                        |                                       |  |
|                                | 4   |  |                          |                     |          |                      |  | - 1                    |                                       | بالمسلم                                      |
|                                | Specimen No.  | Root Bend  | Face Bend                | Side Bend           |          | Bend                 | Acceptable                                   | 2                      | Com                                   | ments  |
| 1                              | 5   | 180 Degrees  | NA                       | NA                  | Yes      |                      | No   | 15                     |                                       |  |
|                                | 6   | 180 Degrees  | NA                       | NA.                 | Yes      |                      | No   |                        |                                       |  |
|                                | 7   | 180 Degrees  | NA NA                    | NA                  | Yes      | 1 14 11              | No   |                        |                                       |  |
| GUIDED BEND                    | 8   | 180 Degrees  | NA                       | NA                  | Yes      |                      | No   |                        |                                       | 7  |
| TEST                           | 9   | NA.  | 180 Degrees              | NA                  | Yes      | THE STATE OF         | No   |                        |                                       |  |
|                                | 10  | NA .   | 180 Degrees              | NA                  | Yes      |                      | No   |                        |                                       |  |
|                                | 11  | NA   | 180 Degrees              | NA                  | Yes      |                      | No   | me                     |                                       |  |
|                                | 12  | NA.  | 180 Degrees              | NA                  | Yes      |                      | No   | Total L                |                                       |  |
|                                | Specimen No.  | Accepta  | ble Yes/No               |                     |          |                      | Co   | mments                 |                                       |  |
|                                | 13  | Yes  | No 🗍                     |                     |          |                      |  |                        |                                       |  |
| NICK BREAK                     | 14  | Yes  | No 🗍                     |                     |          |                      |  |                        |                                       |  |
| TEST                           | 15  | Yes  | No 🗍                     |                     |          |                      |  |                        |                                       |  |
|                                | 16  | Yes  | No 🗍                     |                     |          |                      |  |                        |                                       |  |
| FILLET WELD                    | Satisfactory:   | Yes  | No 🗆                     |                     | Penetrat | tion into Pa         | rent Meta                                    | ÷                      | Yes                                   | No 🗍   |
|                                | 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1   |  |                          |                     |          |                      |  |                        | 1,500                                 |  |
| TEST                           | Fillet Weld - Fractu  | re Test  |                          |                     | Length o | f Percent o          | f Defect                                     |                        | in.:                                  | %:   |
| TEST                           |   | re Test  |                          | License Number 8    |          | f Percent o          | f Defect                                     |                        | in.:<br>Stencil Mark                  | %:   |
|                                | Fillet Weld - Fractu  | re Test  |                          | License Number 8    |          | of Percent o         | f Defect                                     |                        |                                       | %:   |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor:   |  | ecord are correct and    |                     | & State  |                      |  | ested in accor         | Stencil Mark                          |  |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor: We certify that the   | statements in this re  | cord are correct and t   |                     | & State  |                      |  | ested in accor         | Stencil Mark                          |  |
| WELDER INFO                    | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104.   | statements in this re<br>ucted By:                                       | ecord are correct and t  |                     | & State  |                      |  | ested in accor         | Stencil Mark                          |  |
| TEST                           | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination  | statements in this re<br>ucted By:<br>Results:                           | ecord are correct and to | that the test coupo | k State  |                      |  | ested in accor         | Stencil Mark                          |  |
| WELDER INFO                    | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination  | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati |                          | that the test coupo | k State  |                      | ded, and t                                   | ested in accor         | Stencil Mark                          |  |
| WELDER INFO                    | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test (  | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati |                          | that the test coupo | k State  |                      | ded, and t                                   | ry Test No:            | Stencil Mark                          |  |
| WELDER INFO                    | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test for  | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati |                          | that the test coupo | k State  |                      | ded, and t                                   | ry Test No:            | Stencil Mark                          |  |
| WELDER INFO                    | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test if Mechanical Test Co                      | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati | ve Qualification of Gro  | that the test coupo | k State  |                      | ded, and t<br>Laborato<br>Organiza           | ry Test No:            | Stencil Mark                          |  |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test if Mechanical Test Co                      | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati | ve Qualification of Gro  | that the test coupo | k State  |                      | ded, and t<br>Laborato<br>Organiza           | ry Test No:            | Stencil Mark                          |  |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: Contractor: We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co Approved By: APPROVED | statements in this re<br>ucted By:<br>Results:<br>Results (For Alternati | ve Qualification of Gro  | that the test coupo | k State  |                      | ded, and t<br>Laborato<br>Organizal<br>Date: | ry Test No:            | Stencil Mark                          |  |



| TV05 05        | PQR No. 12-X42          | -219              |                    |                   | Orig. Issue Date   |                                | Revision Date       |             |
|----------------|-------------------------|-------------------|--------------------|-------------------|--------------------|--------------------------------|---------------------|-------------|
| TYPE OF        | WPS No. BW-2-A          | <i>∖-II</i>       |                    |                   | Orig. Issue Date   |                                | Revision Date       |             |
| RECORD         | API 1104 🗸              | Other             |                    |                   | <b>*</b>           |                                | *                   |             |
|                | Process Name: Shie      | lded Metal        | Arc Welding (S     | SMAW)             | Type of Process:   | Vanual                         |                     |             |
| PROCESS        | For: B                  | utt Welding       | / Fillet           | Welding           |                    |                                |                     |             |
| PIPE           | Material Specification  | 12.375" O         | .D X-42- 0.21      | 19" WT. API 5     | Ĺ                  |                                |                     |             |
| DIAMETER       | API 1104 6.2.2          | Guidelines        | Under              | 2-3/8" OD         | 2-3/8"             | to 12-3/4" OD                  | > 12-3              | /4" OD      |
| MATERIAL       | API 1104 5.4.2.         | 2 Guidelines      | ✓ ≤ 42,00          | 00 PSI Yield      | > 42,00            | 0 to < 65,000 PSI Yield        | ≥ 65,000            | PSI Yield   |
| THICKNESS      | API 1104 6.2.2          | Guidelines        | Under 3            | 3/16" thick       | √ 3/16" t          | hru 3/4" thick                 | Over 3/             | 4" thick    |
| FILLED MACTALS | AWS Electrode Nos: E    | 6010              | AWS Electrode Size | : 1/8"            | AWS Specification: | A5.1                           | Filler Metal Group: | 1           |
| FILLER METALS  | AWS Electrode Nos:      |                   | AWS Electrode Size | :                 | AWS Specification: |                                | Filler Metal Group: |             |
| GAS            | SHIELDING GAS: N/A      |                   |                    | FLOW RATE: N/A    |                    | FLUX: N/A                      |                     |             |
| PREHEAT        | Minimum Preheat Ter     | mperature (F): 50 | 0                  | Interpass Tempera | iture (F):         | Other:                         |                     | 1 - 1       |
|                |                         | WEL               | D AXIS             |                   | TE                 | CHNIQUE                        | DIRE                | CTION       |
|                | Flat (1G, 1F, 1FR)      |                   | Plate              |                   | Backhand           |                                | Vertical - Up       |             |
|                | Horizontal (2G, 2F, 2F) | (8)               | Pipe               | V                 | Forehand           | V                              | Vertical - Down     | 7           |
| POSITION       | Vertical (3G, 3F)       |                   | Rotated            |                   |                    |                                |                     |             |
|                | Overhead (4G, 4F)       |                   | Fixed              | V                 |                    |                                |                     |             |
|                | Multiple (5G, 5F)       | 1                 | Inclined (6G, 6F)  |                   |                    |                                |                     |             |
|                | Combination             |                   |                    |                   |                    |                                |                     |             |
|                | D                       | ISPOSITION STYL   |                    | M                 | ETHOD              |                                | ARC TYPE            |             |
| TECHNIQUE      | Stringer Beads          |                   |                    | Multiple Pass     | <b>V</b>           | Single Arc                     |                     | Other:      |
|                | Weave Beads             |                   |                    | Single Pass       |                    | Multiple Arc                   |                     | Others      |
| CLEANING       | Base Material: P        | ower 🗸            | Hand               |                   | Weld: Power        | ✓ Han                          | d 📗                 |             |
|                |                         | вутт              | WELD -/            |                   |                    | FILLET                         | WELD                |             |
|                | 371/2" ± 21/2" FO       | OR FITTINGS       |                    |                   |                    | 1/ + 14-                       | 1                   |             |
|                | 30" + 5" 0              | FOR PIPE          |                    |                   |                    | 1/16" ± 1/32"<br>1/16" ± 1/32" |                     |             |
| JOINT DESIGN   |                         | 1 1 :-            | <b>   </b>   − ½6" |                   |                    | 716 ± 732 1<br>L               |                     |             |
|                | 4                       | 1                 |                    |                   |                    |                                | -1-35               | )           |
|                | 1/32" TO 1/16"          | 1/1/              | 4-                 |                   |                    | # 1                            | - TRY 4             | 7           |
|                |                         | <b>→</b>          |                    |                   |                    | 1 /                            | 81                  | -/          |
|                | 1/8" ± 1/16             | ·  -              | -                  |                   | 17"                | TO 45°                         |                     |             |
|                | 100                     |                   |                    |                   |                    |                                |                     |             |
|                |                         |                   | Groove D           | esigns of         | Test Cou           | pons                           |                     |             |
|                | Current Type: A         | с                 | DC /               | Polarity:         | Straight/Negative  | A B                            | Reverse/Positive    | V           |
| ELECTRICAL     | 222.5                   |                   | ELECTRODE NO. &    | 100               |                    | RANGE                          | MAXIMUM TIME        | SPEED RANGE |
| CHARACTERIS-   | BEAD NO.                | Passes            | TYPE               | Size              | VOLTS              | AMPS                           | (Min.)              | (IPM)       |
| TICS &         | Root                    | 1                 | E6010              | 1/8"              | 19-24              | 75-130                         | 5                   | 3-20        |
| SEQUENCE OF    | Hot Pass                | 1                 | E6010              | 1/8"              | 20-24              | 75-130                         | 5                   | 3-20        |
| BEADS          | Fill                    | 1                 | E6010              | 1/8"              | 20-24              | 75-130                         | 5                   | 3-20        |
|                | Сар                     | 1                 | E6010              | 1/8"              | 20-24              | 75-130                         | 5                   | 3-20        |

(Over)

|                            | Specimen No.   | Widt  |            | This         | kness        | Area (in.^2)        | Ultim      | ate Total    | Ultimat                       | e Unit Stress | Type of Failure       | Location of Failure<br>Base Metal or |
|----------------------------|--|---|------------|--------------|--------------|---------------------|------------|--------------|-------------------------------|---------------|-----------------------|--------------------------------------|
|                            | specimen wo.   | Wide  | ,          | Thic         | Kiless.      | Alea (III. 2)       | Loa        | d(Lbs.)      |                               | (psi)         | Ductile or Brittle    | Weld                                 |
| TENSILE TEST               | 1  | 1.11  | 1          | 0.           | 237          | 0,263               |            | 17,220       |                               | 65,39         | DUCTILE               | BASE                                 |
| TENSILE TEST               | 2  | 0.94  | 4          | 0.           | 230          | 0.217               |            | 19,440       |                               | 89,53         | 5 DUCTILE             | WELD                                 |
|                            | 3  |   |            |              | 3.5          |                     |            |              |                               |               |                       | (T                                   |
|                            | 4  |   |            | -            |              |                     |            |              |                               |               |                       |                                      |
|                            | Specimen No.   | Root Be   | end        | Face         | Bend         | Side Bend           |            | Bend         | Acceptable                    | 2             | Com                   | ments                                |
|                            | 5  | 180 Deg   | grees      | 1            | NA           | NA                  | Yes        | 4            | No                            |               |                       |                                      |
| -                          | 6  | 180 Deg   | grees      |              | AV           | NA                  | Yes        | 4            | No                            |               |                       |                                      |
| GUIDED BEND                | 7  | 180 Deg   | grees      | N            | AV           | NA                  | Yes        |              | No                            |               |                       |                                      |
| TEST                       | 8  | 180 Deg   | grees      | 1            | NA           | NA.                 | Yes        |              | No                            |               |                       |                                      |
| 1631                       | 9  | NA.   |            | 180 D        | egrees       | NA                  | Yes        | 1            | No                            |               |                       |                                      |
|                            | 10   | NA  | <b>1</b>   | 180 D        | egrees       | NA                  | Yes        | 4            | No                            |               |                       |                                      |
|                            | 11   | NA  |            | 180 D        | egrees       | NA                  | Yes        |              | No                            |               |                       |                                      |
|                            | 12   | NA  | 2 = 1      | 180 D        | egrees       | NA                  | Yes        |              | No                            |               | 1                     |                                      |
|                            | Specimen No.   | ٨   | Acceptat   | ble Yes/No   |              |                     |            |              | Co                            | mments        |                       |                                      |
| NICK BREAK                 | 13   | Yes   | 1          | No           | Fici         |                     |            |              |                               |               |                       |                                      |
| TEST                       | 14   | Yes   | 4          | No           |              |                     |            |              |                               |               |                       |                                      |
|                            | 15   | Yes   |            | No           |              |                     |            |              |                               |               |                       |                                      |
|                            | 16   | Yes   |            | No           |              |                     |            |              |                               |               |                       |                                      |
| FILLET WELD                | Satisfactory:  | Yes   |            | No           |              |                     | Penetra    | tion into Pa | rent Meta                     | l.            | Yes                   | No 🗍                                 |
| TEST                       | Fillet Weld - Fractu   | re Test   |            |              |              |                     | Length o   | of Percent o | f Defect                      |               | in.:                  | %:                                   |
| Y                          | Welder Name: An  | drew Gre  | een &      |              |              | License Number 8    | State      |              |                               |               | Stencil Mark          |                                      |
|                            | read their a   |   |            |              |              |                     |            |              |                               |               |                       |                                      |
| 14/51 DED 14/50            | Austin Hipsh   | er  |            |              |              |                     |            |              |                               |               |                       |                                      |
| WELDER INFO                |  |   |            |              |              |                     |            |              |                               |               |                       |                                      |
| WELDER INFO                | Austin Hipsh   |   | n this rec | cord are co  | orrect and t | that the test coupo | ns were pr | epared, we   | ded, and t                    | ested in acc  | ordance with the requ | irements of API                      |
| WELDER INFO                | Austin Hipsh Contractor: AMS   | statements in   | n this rec | cord are co  | orrect and t | that the test coupo | ns were pr | epared, wel  | ded, and t                    | ested in acc  | ordance with the requ | irements of API                      |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104.   | statements ir ucted By:                                   | n this rec | cord are co  | orrect and t | that the test coupo | ns were pr | epared, wel  | ded, and t                    | ested in acc  | ordance with the requ | irements of API                      |
| WELDER INFO  CERTIFICATION | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond   | statements in<br>ucted By:<br>Results:                    |            |              |              |                     |            | epared, wel  | ded, and t                    | ested in acc  | ordance with the requ | irements of API                      |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination  | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            |              |              |                     |            | epared, wel  |                               | ested in acc  | ordance with the requ | irements of API                      |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test f  | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            |              |              |                     |            | epared, wel  |                               | ry Test No:   | ordance with the requ | irements of API                      |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test to   | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            |              | ation of Gro |                     |            | epared, we   | Laborato                      | ry Test No:   | ordance with the requ | irements of API                      |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            | ve Qualifica | ation of Gro |                     |            | epared, we   | Laborato<br>Organiza          | ry Test No:   | ordance with the requ | irements of API                      |
| CERTIFICATION              | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            | ve Qualifica | ation of Gro |                     |            | epared, wel  | Laborato<br>Organiza          | ry Test No:   | ordance with the requ | irements of API                      |
| CERTIFICATION              | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co Approved By: APPROVED | statements ir<br>ucted By:<br>Results:<br>Results (For Al |            | ve Qualifica | ation of Gro |                     |            | epared, wel  | Laborato<br>Organiza<br>Date: | ry Test No:   | ordance with the requ | irements of API                      |



|               |                                    |                        |                         | 1.110                                   | CLD OTTL Q        | O'TEN TOTTIN             | SIV ILCOID           | (1 411)              |
|---------------|------------------------------------|------------------------|-------------------------|---|-------------------|--------------------------|----------------------|----------------------|
| TVDF OF       | PQR No. 20-GRB                     | -250                   |                         |   | Orig. Issue Date  |                          | Revision Date        |                      |
| TYPE OF       | WPS No. BW-3-A-                    | II                     | 2.5                     |   | Orig. Issue Date  |                          | Revision Date        |                      |
| RECORD        | API 1104 🗸 🔾                       | ther                   |                         |   | ^                 |                          |                      |                      |
|               | Process Name: Shield               | ded Metal              | Arc Welding (S          | MAW)                                    | Type of Process:  | Manual                   |                      |                      |
| PROCESS       | For: But                           | t Welding              | √ Fillet                | Welding                                 |                   |                          |                      |                      |
| PIPE          | Material Specification:            | 20.0" O.E              | GRADE-B-                | 0.250" WT.                              | API 5L            |                          |                      |                      |
| DIAMETER      | API 1104 6.2.2                     | Guidelines             | Under 2                 | 2-3/8" OD                               | 2-3/8"            | to 12-3/4" OD            | > 12-3               | 4/4" OD              |
| MATERIAL      | API 1104 5.4.2.2                   | Guidelines             | ✓ ≤ 42,00               | 00 PSI Yield                            | > 42,00           | 00 to < 65,000 PSI Yield | ≥ 65,000             | PSI Yield            |
| THICKNESS     | API 1104 6.2.2                     | Guidelines             | Under 3                 | /16" thick                              | √ 3/16"           | thru 3/4" thick          | Over 3/              | /4" thick            |
|               | AWS Electrode Nos: E6              | 010                    | AWS Electrode Size      | : 1/8"                                  | AWS Specification | : A5.1                   | Filler Metal Group:  | 1                    |
| FILLER METALS | AWS Electrode Nos:                 |                        | AWS Electrode Size      |   | AWS Specification | 1                        | Filler Metal Group:  |                      |
| GAS           | SHIELDING GAS: N/A                 |                        |                         | FLOW RATE: N/A                          | 7                 | FLUX: N/A                |                      |                      |
| PREHEAT       | Minimum Preheat Temp               | perature (F): 5        | 0 0                     | Interpass Temper                        | ature (F):        | Other:                   |                      | 1000                 |
|               |                                    |                        | LD AXIS                 |   | TE                | CHNIQUE                  | DIREC                | CTION                |
|               | Flat (1G, 1F, 1FR)                 |                        | Plate                   |   | Backhand          |                          | Vertical - Up        |                      |
|               | Horizontal (2G, 2F, 2FR)           |                        | Pipe                    | V                                       | Forehand          | V                        | Vertical - Down      | 7                    |
| POSITION      | Vertical (3G, 3F)                  |                        | Rotated                 |   |                   |                          |                      |                      |
|               | Overhead (4G, 4F)                  |                        | Fixed                   | V                                       | 1                 |                          |                      |                      |
|               | Multiple (5G, 5F)                  | 4                      | Inclined (6G, 6F)       |   |                   |                          |                      |                      |
|               | Combination                        |                        |                         |   |                   |                          |                      |                      |
| 6             | DIS                                | POSITION STY           | E                       | M                                       | ETHOD             |                          | ARC TYPE             |                      |
| TECHNIQUE     | Stringer Beads                     | (                      |                         | Multiple Pass                           | 1                 | Single Arc 🗸             | 1                    | 50 F3                |
|               | Weave Beads                        |                        |                         | Single Pass                             | 5                 | Multiple Arc             |                      | Other:               |
| CLEANING      | Base Material: Po                  | wer 🗸                  | Hand                    |   | Weld: Power       | √ Ha                     | nd                   |                      |
|               |                                    | BUT                    | T WELD                  |   |                   | FILL                     | ET WELD              |                      |
| JOINT DESIGN  | 371/2" ± 21/2" FOI<br>30" + 5" - 0 | R FITTINGS<br>FOR PIPE | / <sub>16</sub> "       |   | 17'               | /16° ± 1/32<br>1 TO 45°  |                      |                      |
|               | Current Type: AC                   |                        | Groove [                | esigns of                               | f Test Cou        |                          | Reverse/Positive     |                      |
| ELECTRICAL    | 1                                  |                        | T                       | 2 11111111                              |                   | RANGE                    | MAXIMUM TIME         |                      |
| CHARACTERIS-  | BEAD NO.                           | Passes                 | ELECTRODE NO. &<br>TYPE | Size                                    | VOLTS             | AMPS                     | LAPSE ALLOWED (Min.) | SPEED RANGE<br>(IPM) |
| TICS &        | Root                               | 1                      | E6010                   | 1/8"                                    | 20-24             | 75-130                   | (Will.)              | 3-20                 |
| SEQUENCE OF   | Hot Pass                           | 1                      | E6010                   | 1/8"                                    | 20-24             | 75-130                   | 5                    | 3-20                 |
| BEADS         | Fill                               | 1                      | E6010                   | 1/8"                                    | 20-24             | 75-130                   | 5                    | 3-20                 |
| 22,129        | Сар                                | 1                      | E6010                   | 1/8"                                    | 20-24             | 75-130                   | 5                    | 3-20                 |
|               |                                    | 1                      |                         | ■ 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 |                   |                          |                      |                      |

(Over)

| Specimen No.   | Width  | Thickness   | Area (in.^2)   | and the second of   |   | Ultimate Unit Stress<br>(psi)  | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld  |
|--|--|---|--|---|---|--|---------------------------------------|---|
| 1  | 1.027  | 0.264   | 0.271  | 24030   | )   | 88630  | DUCTILE                               | WELD  |
| 2  | 0.966  | 0.252   | 0,243  | 21640   | )   | 88895  | DUCTILE                               | BASE  |
| 3  | 1.034  | 0.274   | 0.283  | 25260   | )   | 89158  | DUCTILE                               | BASE  |
| 4  | 1.143  | 0.282   | 0.322  | 25410   | )   | 78833  | DUCTILE                               | BASE  |
| Specimen No.   | Root Bend  | Face Bend   | Side Bend  |   | Bend /  | Acceptable   | Com                                   | ments   |
| 5  | 180 Degrees  | NA  | NA   | Yes   | 1   | No   |                                       |   |
| 6  | 180 Degrees  | NA  | NA   | Yes   | 1   | No   |                                       |   |
| 7  | 180 Degrees  | NA  | NA   | Yes   | 1   | No 🔲   |                                       |   |
| 8  | 180 Degrees  | NA  | NA   | Yes   | 1   | No 💮   |                                       |   |
| 9  | NA   | 180 Degrees   | NA   | Yes   | 4   | No   |                                       |   |
| 10   | NA   | 180 Degrees   | NA   | Yes   | 1   | No   |                                       |   |
| 11   | NA   | 180 Degrees   | NA   | Yes   | 4   | No   |                                       |   |
| 12   | NA   | 180 Degrees   | NA   | Yes   | 7   | No   |                                       |   |
| Specimen No.   | Acceptal   | ble Yes/No  |  |   |   | Comments   |                                       |   |
| 13   | Yes 🗸  | No 🗍  |  |   |   |  |                                       |   |
| 14   | Yes 🗸  | No 🗍  |  |   |   |  |                                       |   |
| 15   | Yes 🗸  | No 🗍  |  |   |   |  |                                       |   |
| 16   | Yes 🗸  | No 🗆  |  |   |   |  |                                       |   |
| 1.44   |  | 7.0   |  |   |   |  |                                       |   |
| Satisfactory:  | Yes  | No 🗍  |  | Penetration   | into Par  | rent Metal:  | Yes                                   | No 🗍  |
|  | Yes  |   |  | Penetration<br>Length of Pe   |   |  | Yes in.:                              | No  |
| Satisfactory:<br>Fillet Weld - Fractu  | Yes  | No  | License Number 8   | Length of Pe  |   |  |                                       | 1111  |
| Satisfactory:<br>Fillet Weld - Fractu  | Yes re Test adrew Green &  | No  | License Number 8   | Length of Pe  |   |  | in.:                                  | 1111  |
| Satisfactory:<br>Fillet Weld - Fractu<br>Welder Name: An   | Yes re Test adrew Green & er   | No  | License Number 8   | Length of Pe  |   |  | in.:                                  | 1111  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS  | Yes re Test re Test re Test re Test re Test re Green & re Test | No I  |  | Length of Pe  | rcent o   |  | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS  | Yes re Test adrew Green & er statements in this re   | No I  |  | Length of Pe  | rcent o   | f Defect   | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the  | Yes re Test adrew Green & er statements in this reucted By:  | No I  |  | Length of Pe  | rcent o   | f Defect   | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond  | Yes re Test re | No I  | that the test coupo  | Length of Pe<br>& State   | rcent o   | f Defect   | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond  | Yes re Test re | No  | that the test coupo  | Length of Pe<br>& State   | rcent o   | f Defect   | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Condition Visual Examination Radiographic Test for              | Yes re Test re | No  | that the test coupo  | Length of Pe<br>& State   | rcent o   | f Defect  ded, and tested in accor   | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Condi Visual Examination Radiographic Test for                  | Yes re Test re | No  | that the test coupo  | Length of Pe<br>& State   | rcent o   | ded, and tested in accord  | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test E Mechanical Test Co  | Yes re Test re | cord are correct and to   | that the test coupo  | Length of Pe<br>& State   | rcent o   | ded, and tested in accordance laboratory Test No: Organization:  | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test E Mechanical Test Co  | Yes re Test re | cord are correct and to   | that the test coupo  | Length of Pe<br>& State   | rcent o   | ded, and tested in accordance laboratory Test No: Organization:  | in.:<br>Stencil Mark                  | %:  |
| Satisfactory: Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Condi Visual Examination Radiographic Test f Mechanical Test Co | Yes re Test re | cord are correct and to   | that the test coupo  | Length of Pe<br>& State   | rcent o   | ded, and tested in accordance Laboratory Test No: Organization: Date:  | in.:<br>Stencil Mark                  | %:  |
|  | 1 2 3 4 Specimen No. 5 6 7 8 9 10 11 12 Specimen No. 13 14   | 1 1.027 2 0.966 3 1.034 4 1.143 Specimen No. Root Bend 5 180 Degrees 6 180 Degrees 7 180 Degrees 8 180 Degrees 9 NA 10 NA 11 NA 12 NA Specimen No. Accepta 13 Yes  14 Yes  15 Yes | 1 1.027 0.264 2 0.966 0.252 3 1.034 0.274 4 1.143 0.282  Specimen No. Root Bend Face Bend 5 180 Degrees NA 6 180 Degrees NA 7 180 Degrees NA 8 180 Degrees NA 9 NA 180 Degrees 10 NA 180 Degrees 11 NA 180 Degrees 12 NA 180 Degrees Specimen No. Acceptable Yes/No 13 Yes  No  15 Yes  No  15 | 1 1.027 0.264 0.271 2 0.966 0.252 0.243 3 1.034 0.274 0.283 4 1.143 0.282 0.322  Specimen No. Root Bend Face Bend Side Bend 5 180 Degrees NA NA 6 180 Degrees NA NA 7 180 Degrees NA NA 8 180 Degrees NA NA 9 NA 180 Degrees NA NA 10 NA 180 Degrees NA 11 NA 180 Degrees NA 12 NA 180 Degrees NA Specimen No. Acceptable Yes/No 13 Yes NO  15 Yes NO | Specimen No.   Width   Thickness   Area (in,^2)   Load(Lb     1 | 1 1.027 0.264 0.271 24030 2 0.966 0.252 0.243 21640 3 1.034 0.274 0.283 25260 4 1.143 0.282 0.322 25410  Specimen No. Root Bend Face Bend Side Bend Bend 5 180 Degrees NA NA Yes  7 180 Degrees NA NA Yes  7 180 Degrees NA NA Yes  9 NA 180 Degrees NA NA Yes  9 NA 180 Degrees NA Yes  10 NA 180 Degrees NA Yes  11 NA 180 Degrees NA Yes  12 NA 180 Degrees NA Yes  15 Specimen No. Acceptable Yes/No  13 Yes  NO  15 Yes  NO  15 Yes  NO  15 Yes  NO | 1                                     | Specimen No.   Width   Thickness   Area (in.^2)   Load(Lbs.)   (psi)   Ductile or Brittle |

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| Page:   | 1 | of | 2 |
|---------|---|----|---|
| ~ D ~ . | _ | •  | _ |

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

| . 4551                     |  |
|----------------------------|--|
| <b>AWS Classification:</b> |  |
| Manufacture:               |  |

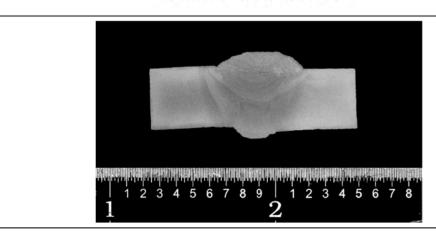
Pass.

**Electrode Diameter:** Current/Polarity: **Current Range:** 

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root                                   | Hot Pass | Fill      | Cap      |  |
|--|----------|-----------|----------|--|
| E6010                                  | E7010-P1 | E7010-P1  | E7010-P1 |  |
| Lincoln                                | Lincoln  | Lincoln   | Lincoln  |  |
| 1/8"                                   | 5/32"    | 5/32"     | 5/32"    |  |
| DCEP                                   | DCEP     | DCEP      | DCEP     |  |
| 75 – 76                                | 96 – 100 | 95 – 98   | 93 – 95  |  |
| 24 – 26                                | 24 – 27  | 25 – 28   | 27 – 29  |  |
| 3.5 - 5.2 3.4 - 5.4 4.4 - 5.3 3.4 - 5. |          | 3.4 - 5.5 |          |  |



| Test Number:  | 4-1                     |               |                            |                |            | Page         | e: 2      | of        |
|---|-------------------------|---------------|----------------------------|----------------|------------|--------------|-----------|-----------|
|   |                         |               | TENSILE STR                | RENGTH TES     | т          |              |           |           |
| Coupon Number:  | W:                      | 12 T1         | W12 T2                     |                |            |              |           |           |
| Coupon Width:   | 1.067 inch              |               | 1.023 inch                 |                |            |              |           |           |
| Coupon Thickness:   | 0.367 inch              |               | 0.368 inch                 |                |            |              |           |           |
| Coupon Area:  | 0.392 inch <sup>2</sup> |               | 0.376 inch <sup>2</sup>    |                |            |              |           |           |
| Maximum Load:   | 35,340 lb               |               | 31984 lb                   |                |            |              |           |           |
| Tensile Strength:   | 90,154 psi              |               | 85,065 psi                 |                |            |              |           |           |
| Fracture Location:  | Base                    | Metal         | Base I                     | Metal          |            |              |           |           |
|   |                         |               | BENE                       | TEST           |            |              |           |           |
| Coupon Number:  | W12 FB1                 | W12 FB2       | W12 RB2                    | W12 RB2        |            |              |           | 198       |
| Туре:   | Face                    | Face          | Root                       | Root           |            |              |           | 4 114     |
| Results:  | Pass                    | Pass          | Pass                       | Pass           |            |              |           |           |
|   |                         |               | NICK BD                    | EAV TEST       |            |              |           |           |
| Coupon Number:  | W12 NB1                 |               | NICK-BREAK TEST<br>W12 NB2 |                |            |              | T         |           |
| Results:  |                         |               | Pass (1)                   |                |            |              |           |           |
| Coupon Number:<br>Depth:<br>Width:<br>Notch Location:                         |                         |               |                            |                |            |              |           |           |
| Foot Townsustance   |                         |               |                            |                |            |              |           |           |
|   |                         |               |                            |                |            |              |           |           |
| mpact Energy:   |                         |               | - 4                        |                |            |              |           |           |
| mpact Energy:<br>% Shear:   |                         |               |                            |                |            |              |           |           |
| Impact Energy:<br>% Shear:<br>Lateral Expansion:                              |                         |               | A COLOR                    |                |            |              |           |           |
| Impact Energy:<br>% Shear:<br>Lateral Expansion:                              | ndications              | were preser   | nt but were w              | vithin the acc | eptable l  | imits of API | 1104      |           |
| Impact Energy: % Shear: Lateral Expansion: Comments: (1)                      |                         |               | ОТНЕ                       | RTESTS         |            | imits of API | 1104      |           |
| Impact Energy: % Shear: Lateral Expansion: Comments: (1)                      |                         |               | OTHE                       | RTESTS         |            |              | 1104      |           |
| Impact Energy: % Shear: Lateral Expansion: Comments: (1)                      |                         |               | OTHE                       | RTESTS         |            |              | 1104      |           |
| mpact Energy: % Shear: Lateral Expansion: Comments: (1)   Fest Type: Results: | statement               | s in this rec | OTHER                      | RTESTS         | the test v | velds were p | orepared, | welded, a |
| We certify that the   | statement               | s in this rec | OTHER                      | R TESTS        | the test v | velds were p | orepared, | welded,   |



Page: 1 of 2

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

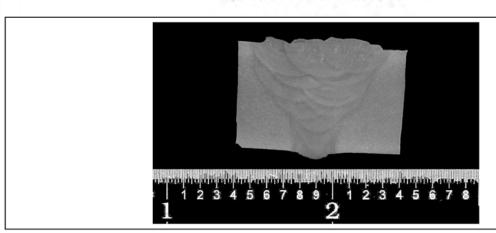
Pass:

AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:

Voltage Range:

Travel Speed Range, ipm: Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E6010     | E7010-P1  | E7010-P1  | E7010-P1  |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 1/8"      | 5/32"     | 5/32"     | 5/32"     |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 78 – 79   | 107 - 118 | 107 - 119 | 105 - 116 |  |
| 24 – 26   | 26 – 30   | 20 - 31   | 27 - 31   |  |
| 3.9 – 4.8 | 5.2 - 7.2 | 2.4 - 6.7 | 2.7 - 5.1 |  |



|  |              |                     | FENCUE ST                             | SENSTII TE        |             |              |          |            |        |     |
|--|--------------|---------------------|---------------------------------------|-------------------|-------------|--------------|----------|------------|--------|-----|
| Coupon Number:   | 14/          | 13 T1               | W13                                   |                   | 51          |              | 1        |            |        | _   |
| Coupon Width:  |              | 4 inch              |                                       | 3 inch            |             |              | +        |            |        | _   |
| Coupon Thickness:  |              | )5 inch             |                                       | 0.912 inch        |             |              | +-       |            |        | _   |
| Coupon Area:   |              | 5 inch <sup>2</sup> | 0.912 inch<br>1.029 inch <sup>2</sup> |                   |             |              |          |            |        | _   |
| Maximum Load:  |              | 060 lb              | -                                     | 30 lb             |             |              | +        |            |        | _   |
| Tensile Strength:  |              | 000 psi             |                                       | 00 psi            |             |              | -        |            |        |     |
| Fracture Location:   |              | Metal               |                                       | Metal             |             |              |          |            |        |     |
|  |              |                     | DENI                                  | TEST              |             |              |          |            |        |     |
| Coupon Number:   | W13 SB1      | W13 SB2             | W13 SB3                               | W13 SB4           |             |              | 111      |            |        | _   |
| Туре:  | Side         | Side                | Side                                  | Side              |             |              |          | _          |        |     |
| Results:   | Pass (1)     | Pass (1)            | Pass                                  | Pass (1)          |             |              |          |            |        |     |
|  |              |                     | ALLES E                               | Store was a       |             |              |          |            |        |     |
|  |              |                     |                                       | EAK TEST          |             |              |          |            |        |     |
| Coupon Number:   |              | NB1                 | W13                                   |                   |             |              |          |            |        |     |
| Results:   | Pas          | s (1)               | Pass                                  | (1)               |             |              | 1        |            |        | _   |
|  |              | CI                  | HARPY TOU                             | JGHNESS T         | EST         |              |          |            |        |     |
| Coupon Number:   |              |                     |                                       |                   |             |              |          | 1          |        |     |
| Depth:   |              |                     |                                       | T1                | 11          |              |          |            |        |     |
| Width:   |              |                     |                                       |                   |             |              |          |            |        |     |
| Notch Location:  |              |                     |                                       |                   |             |              |          |            |        |     |
| Test Temperature:  | 1            |                     | - 1                                   |                   |             |              |          |            |        |     |
| Impact Energy:   |              |                     |                                       |                   |             |              |          |            |        |     |
| % Shear:   |              |                     |                                       |                   |             |              |          | -          |        |     |
| Lateral Expansion:   |              |                     |                                       |                   |             |              |          |            |        | _   |
| Comments: (1)  | ndications   | were presen         | t but were w                          | vithin the ac     | ceptable    | limits of AP | 1104     |            |        |     |
|  |              |                     | ОТНЕ                                  | R TESTS           |             |              |          |            |        |     |
| Test Type:   |              |                     | OTHE                                  |                   |             |              |          |            |        |     |
| Results:   |              |                     |                                       |                   |             |              |          |            |        | _   |
| A series and a ser | 55945-25.55  | Tautal e bern       | VI.377                                | W. C. S. C. CORN. | San San San | Tenga Trace  | Legiona. | No. et a f | March. |     |
|  |              |                     |                                       |                   |             |              |          | ed, we     | lded,  | and |
|  | stad in acco |                     | in the require                        | ements of th      | ie 21st L   | uition of Ar | 1104.    |            |        |     |
|  | sted in acco | Ji dance with       |                                       |                   |             |              |          |            |        |     |
|  |              | ordance with        |                                       |                   |             |              |          |            |        |     |
|  | 4            | nigman, Kiefr       | ner                                   | 1 - 6 - 6         |             |              |          |            |        | _   |



Page: 1 of 2

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:

AWS Classification: Manufacture:

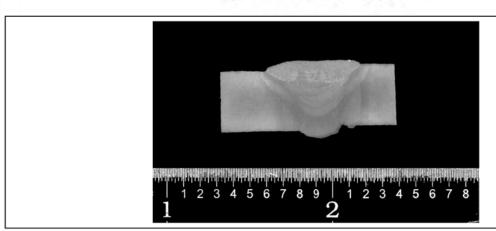
Electrode Diameter: Current/Polarity: Current Range:

Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Сар      |  |
|-----------|-----------|-----------|----------|--|
| E6010     | E8010-P1  | E8010-P1  | E8010-P1 |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln  |  |
| 1/8"      | 5/32"     | 5/32"     | 5/32"    |  |
| DCEP      | DCEP      | DCEP      | DCEP     |  |
| 68 – 76   | 98 – 100  | 99 - 109  | 92 – 107 |  |
| 22 – 26   | 24 – 27   | 24 – 26   | 24 – 28  |  |
| 2.9 - 5.2 | 3.8 - 5.5 | 4.7 - 7.3 | 3.1-5.4  |  |



| Test Number:  | 4-3       |                     |                         |              |            | Pa          | ge:        | 2 of 2        |
|---|-----------|---------------------|-------------------------|--------------|------------|-------------|------------|---------------|
|   |           |                     | TENSILE STE             | RENGTH TE    | ST         |             |            |               |
| Coupon Number:  | W:        | 14 T1               | W14                     | 4 T2         |            |             |            |               |
| Coupon Width:   | 1.21      | .5 inch             | 1.102                   | 2 inch       |            |             |            |               |
| oupon Thickness:  | 0.37      | 4 inch              | 0.370 inch              |              |            |             |            |               |
| Coupon Area:  | 0.45      | 4 inch <sup>2</sup> | 0.408 inch <sup>2</sup> |              |            |             |            |               |
| /laximum Load:  |           | 575 lb              | 37,1                    | 68 lb        |            |             |            |               |
| Tensile Strength:   |           | 73 psi              | _                       | 97 psi       |            |             |            |               |
| racture Location:   | Base      | Metal               | Base                    | Metal        |            |             |            |               |
|   |           |                     | BENI                    | TEST         |            |             |            |               |
| Coupon Number:  | W14 FB1   | W14 FB2             | W14 RB2                 | W14 RB2      |            |             | 11 71 =    | _H(H          |
| Гуре:   | Face      | Face                | Root                    | Root         |            |             | <i>i</i> 1 |               |
| Results:  | Pass (1)  | Pass (1)            | Pass (1)                | Pass (1)     |            |             |            |               |
|   |           |                     | NICK-BR                 | EAK TEST     |            |             |            |               |
| Coupon Number:  | W14       | NB1                 |                         | W14 NB2      |            |             | The        |               |
| Results:  |           | s (1)               | Pass                    |              |            |             |            |               |
| Coupon Number: Depth: Width: Notch Location: Test Temperature: mpact Energy: % Shear: |           |                     |                         |              |            |             |            |               |
| ateral Expansion:   |           |                     |                         |              |            |             |            |               |
| Test Type:  |           |                     |                         | R TESTS      | ceptable I | imits of AP | 1104       |               |
| We certify that the   | statement | s in this rec       | ord are corre           | ect and that | the test v | velds were  |            | d, welded, ar |



Page: 1 of 2

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:

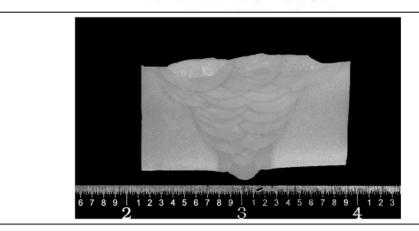
AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:

Current Range: Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root       | Hot Pass   | Fill      | Cap        |  |
|------------|------------|-----------|------------|--|
| E6010      | E8010-P1   | E8010-P1  | E8010-P1   |  |
| Lincoln    | Lincoln    | Lincoln   | Lincoln    |  |
| 1/8"       | 5/32"      | 5/32"     | 5/32"      |  |
| DCEP       | DCEP       | DCEP      | DCEP       |  |
| 99 – 108   | 132 - 136  | 121 - 152 | 105 - 116  |  |
| 24 – 25    | 25 – 27    | 25 – 29   | 27 – 31    |  |
| 7.6 – 11.5 | 8.2 - 12.6 | 2.4 - 6.7 | 4.6 – 14.5 |  |



| Test Number:        | 4-4           |                |                 |               |             | Page         | : 2   | of          |
|---------------------|---------------|----------------|-----------------|---------------|-------------|--------------|-------|-------------|
|                     |               |                | ENSILE STR      | ENGTH TES     | ST          |              |       |             |
| Coupon Number:      |               | 15 T1          | W15             |               |             |              |       |             |
| Coupon Width:       |               | 1 inch         | 1.087           |               |             |              |       |             |
| Coupon Thickness:   |               | 7 inch         | 0.879           |               |             |              |       |             |
| Coupon Area:        |               | 6 inch2        | 0.955           |               |             |              |       |             |
| Maximum Load:       |               | 800 lb         | 83,80           |               |             |              |       |             |
| Tensile Strength:   |               | 00 psi         | 87,70           |               |             |              |       |             |
| Fracture Location:  | Base          | Metal          | Base f          | vietai        |             |              |       |             |
|                     |               |                | BEND            | TEST          |             |              |       |             |
| Coupon Number:      | W15 SB1       | W15 SB2        | W15 SB3         | W15 SB4       |             |              |       |             |
| Туре:               | Side          | Side           | Side            | Side          |             |              |       |             |
| Results:            | Pass (1)      | Pass (1)       | Pass (1)        | Pass          |             |              |       |             |
|                     |               |                | 4.12.5.22       | on make       |             |              |       |             |
|                     | 14/45         | ND4            |                 | EAK TEST      |             |              |       |             |
| Coupon Number:      |               | NB1            | W15             |               |             |              |       |             |
| Results:            | Pa            | iss            | Pass            | (1)           |             |              |       |             |
|                     |               | C              | HARPY TOU       | GHNESS TE     | ST          |              |       |             |
| Coupon Number:      |               |                |                 |               |             |              |       |             |
| Depth:              |               |                |                 |               |             |              |       |             |
| Width:              |               |                |                 |               |             |              |       |             |
| Notch Location:     |               |                |                 |               |             |              |       |             |
| Test Temperature:   |               |                |                 |               |             |              |       |             |
| Impact Energy:      |               |                |                 |               |             |              |       |             |
| % Shear:            |               |                |                 |               |             |              |       |             |
| Lateral Expansion:  |               |                |                 |               |             |              |       |             |
| Comments: (1) I     | ndications    | were presen    | t but were w    | ithin the acc | ceptable li | mits of API  | 104   |             |
| 2                   |               |                |                 |               |             |              |       |             |
|                     |               |                | OTHER           | RTESTS        |             |              |       |             |
| Test Type:          |               |                |                 |               |             |              |       |             |
| Results:            |               |                |                 |               |             |              |       |             |
| We certify that the | statamant     | s in this year |                 | at and that   | the test w  | rolds word m |       | م اممامامین |
|                     |               |                | h the require   |               |             |              |       | weided, a   |
|                     | stea iii acci | Ji dance with  | ii tiic require | inches of th  | C ZISC LU   | tion of Arr. | .104. |             |
|                     |               |                |                 |               |             |              |       |             |
| Date: 10/16/2014    | 4             |                |                 |               |             |              |       |             |



| TYPE OF                    | PQR No. 12-X         | 50-375                       |                    |                  | Orig. Issue Date   |                         | Revision Date                     |                      |
|----------------------------|----------------------|------------------------------|--------------------|------------------|--------------------|-------------------------|-----------------------------------|----------------------|
|                            | WPS No. BW-2         | -В- <i>II</i>                | 25                 |                  | Orig. Issue Date   |                         | Revision Date                     |                      |
| RECORD                     | API 1104 🗸           | Other                        |                    |                  | N.                 |                         |                                   |                      |
| PROCESS                    | Process Name: Sh     | ielded Metal                 | Arc Welding (S     | SMAW)            | Type of Process: N | <b>Manual</b>           |                                   |                      |
| PROCESS                    | For:                 | Butt Welding                 | √ Fillet           | Welding          |                    |                         |                                   |                      |
| PIPE                       | Material Specificati | on: 12.0" O.D                | ) X-60- 0.37       | '5" WT. API      | 5L                 |                         |                                   |                      |
| DIAMETER                   | API 1104 6.2         | 2.2 Guidelines               | Under:             | 2-3/8" OD        | ✓ 2-3/8"           | to 12-3/4" OD           | > 12-3                            | /4" OD               |
| MATERIAL                   | API 1104 5.4         | .2.2 Guidelines              | ≤ 42,00            | 00 PSI Yield     | > 42,00            | 0 to < 65,000 PSI Yield | ≥ 65,000                          | PSI Yield            |
| THICKNESS                  | API 1104 6.2         | 2.2 Guidelines               | Under 3            | /16" thick       | √ 3/16" t          | hru 3/4" thick          | Over 3/                           | 4" thick             |
| FULED MASTALS              | AWS Electrode Nos    | : E6010                      | AWS Electrode Size | : 1/8"           | AWS Specification: | A5.1                    | Filler Metal Group:               | 1                    |
| FILLER METALS              | AWS Electrode Nos    | : E7010                      | AWS Electrode Size | : 1/8"           | AWS Specification: | A5.5                    | Filler Metal Group:               | 1                    |
| GAS                        | SHIELDING GAS: N     | /A                           |                    | FLOW RATE: N/A   |                    | FLUX: N/A               |                                   |                      |
| PREHEAT                    | Minimum Preheat      | Temperature (F): 50          | D <sup>0</sup>     | Interpass Temper | ature (F):         | Other:                  |                                   | 100                  |
|                            |                      | WE                           | LD AXIS            |                  | TE                 | CHNIQUE                 | DIREC                             | TION                 |
|                            | Flat (1G, 1F, 1FR)   |                              | Plate              |                  | Backhand           |                         | Vertical - Up                     |                      |
|                            | Horizontal (2G, 2F,  | 2FR)                         | Pipe               | V                | Forehand           | V                       | Vertical - Down                   | 7                    |
| POSITION                   | Vertical (3G, 3F)    |                              | Rotated            |                  |                    |                         |                                   |                      |
|                            | Overhead (4G, 4F)    |                              | Fixed              | V                |                    |                         |                                   |                      |
|                            | Multiple (5G, 5F)    | <b>V</b>                     | Inclined (6G, 6F)  |                  |                    |                         |                                   |                      |
|                            | Combination          | - G                          |                    |                  |                    |                         |                                   |                      |
|                            |                      | DISPOSITION STYL             | E                  | M                | ETHOD              |                         | ARC TYPE                          |                      |
| TECHNIQUE                  | Stringer Beads       | 4                            |                    | Multiple Pass    | 4                  | Single Arc              | I,                                | Other:               |
|                            | Weave Beads          |                              |                    | Single Pass      |                    | Multiple Arc            |                                   | other.               |
| CLEANING                   | Base Material:       | Power 🗸                      | Hand               |                  | Weld: Power        | ✓ Hai                   | nd                                |                      |
|                            |                      | BUT                          | T WELD 4           |                  |                    | FILLE                   | T WELD                            |                      |
| JOINT DESIGN               |                      | FOR FITTINGS<br>- 0 FOR PIPE | J<br><b>→</b>      | Jesigns o        | l7"<br>f Test Cou  | /16" ± /32  10 45°      | -e b-                             |                      |
|                            | Current Type:        | AC                           | DC 🗸               | Polarity:        | Straight/Negative  | . I                     | Reverse/Positive                  | J                    |
| ELECTRICAL<br>CHARACTERIS- | BEAD NO.             | Passes                       | ELECTRODE NO. &    | Size             | VOLTS              | RANGE AMPS              | MAXIMUM TIME LAPSE ALLOWED (Min.) | SPEED RANGE<br>(IPM) |
| TICS &                     | Root                 | 1                            | E6010              | 1/8"             | 20-24              | 75-130                  | 5                                 | 3-20                 |
| SEQUENCE OF                | Hot Pass             | 1                            | E7010              | 1/8"             | 18-23              | 65-140                  | 5                                 | 3-20                 |
| BEADS                      | Fill                 | 2                            | E7010              | 1/8"             | 18-24              | 65-140                  | 5                                 | 3-20                 |
|                            | Сар                  | 1                            | E7010              | 1/8"             | 18-24              | 65-140                  | 5                                 | 3-20                 |

|                            | Specimen No.  | Width   | Thickness               | Area (in.^2)        | 100        | ate Total<br>d(Lbs.) | Ultimate Unit Stress<br>(psi)   | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|----------------------------|---|---|-------------------------|---------------------|------------|----------------------|---|---------------------------------------|--|
|                            | 1   | 0.946   | 0.378                   | 0.358               | 17         | 28,497               | 79,692  | DUCTILE                               | WELD   |
| TENSILE TEST               | 2   | 1.031   | 0.403                   | 0.415               |            | 35,710               | 85,946  | DUCTILE                               | BASE   |
|                            | 3   |   |                         |                     |            |                      |   |                                       |  |
|                            | 4   |   |                         |                     |            |                      |   |                                       |  |
|                            | Specimen No.  | Root Bend   | Face Bend               | Side Bend           |            | Bend A               | Acceptable  | Com                                   | ments  |
|                            | 5   | 180 Degrees   | NA                      | NA                  | Yes        | 1                    | No 📗  |                                       |  |
|                            | 6   | 180 Degrees   | NA                      | NA                  | Yes        | 4                    | No.   |                                       |  |
|                            | 7   | 180 Degrees   | NA                      | NA                  | Yes        | 1 3/11               | No 🗍  |                                       |  |
| GUIDED BEND                | 8   | 180 Degrees   | NA                      | NA                  | Yes        |                      | No 🗔  |                                       |  |
| TEST                       | 9   | NA.   | 180 Degrees             | NA                  | Yes        | 1                    | No  |                                       |  |
|                            | 10  | NA.   | 180 Degrees             | NA                  | Yes        | <b>V</b>             | No  |                                       |  |
|                            | 11  | NA  | 180 Degrees             | NA                  | Yes        |                      | No 🗍  |                                       |  |
|                            | 12  | NA  | 180 Degrees             | NA                  | Yes        |                      | No 🗌  |                                       |  |
|                            | Specimen No.  | Accepta   | ble Yes/No              |                     |            |                      | Comments  |                                       |  |
| NICK BBEAK                 | 13  | Yes 🗸   | No                      |                     |            |                      |   |                                       |  |
| NICK BREAK                 | 14  | Yes 🗸   | No                      |                     |            |                      |   |                                       |  |
| TEST                       | 15  | Yes   | No                      |                     |            |                      |   |                                       |  |
|                            | 16  | Yes   | No                      |                     |            |                      |   |                                       |  |
| FILLET WELD                | Satisfactory:   | Yes   | No                      |                     | Penetra    | tion into Par        | ent Metal:  | Yes                                   | No   |
| TEST                       |   | 11/2011   |                         |                     | Laurable a | of Percent of        | Defeat  |                                       |  |
|                            | Fillet Weld - Fractu  | re Test   |                         |                     | Length C   | of Percent of        | Defect  | in.:                                  | %:   |
|                            | March 2012  | drew Green 8  |                         | License Number 8    |            | or Percent of        | Defect  | in.:<br>Stencil Mark                  | %:   |
| WELDER INFO                | Welder Name: An   | drew Green &<br>er  | k .                     | License Number 8    |            | i reicent of         | Defect  |                                       | %:   |
|                            | Welder Name: An<br>Austin Hipsh<br>Contractor: AMS  | drew Green &<br>er  |                         |                     | k State    |                      | ded, and tested in accor  | Stencil Mark                          |  |
|                            | Welder Name: An Austin Hipsh Contractor: AMS  | er  |                         |                     | k State    |                      |   | Stencil Mark                          |  |
| WELDER INFO                | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104.  | er statements in this re  |                         |                     | k State    |                      |   | Stencil Mark                          |  |
|                            | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond  | er statements in this re ucted By: Results:                           |                         | that the test coupo | k State    |                      |   | Stencil Mark                          |  |
| WELDER INFO                | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond  | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and   | that the test coupo | k State    |                      |   | Stencil Mark                          |  |
| WELDER INFO                | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test (   | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and   | that the test coupo | k State    |                      | ded, and tested in accor  | Stencil Mark                          |  |
| WELDER INFO                | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test of Mechanical Test Cond                       | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and   | that the test coupo | k State    |                      | ded, and tested in accor  | Stencil Mark                          |  |
| WELDER INFO                | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Cond                        | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and i | that the test coupo | k State    |                      | ded, and tested in accor<br>Laboratory Test No:<br>Organization:          | Stencil Mark                          |  |
| WELDER INFO  CERTIFICATION | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Cond                        | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and i | that the test coupo | k State    |                      | ded, and tested in accor<br>Laboratory Test No:<br>Organization:          | Stencil Mark                          |  |
| WELDER INFO  CERTIFICATION | Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test of Mechanical Test Cond Approved By: APPROVED | er  statements in this re  ucted By:  Results:  Results (For Alternat | ecord are correct and i | that the test coupo | k State    |                      | ded, and tested in accor<br>Laboratory Test No:<br>Organization:<br>Date: | Stencil Mark                          |  |



| TVDF OF       | PQR No. 12-X52               | 2-375                      |                    |                  | Orig. Issue Date   |                              | Revision Date                 |             |
|---------------|------------------------------|----------------------------|--------------------|------------------|--------------------|------------------------------|-------------------------------|-------------|
| TYPE OF       | WPS No. BW-2-E               | 3-II R                     |                    |                  | Orig. Issue Date   |                              | Revision Date                 |             |
| RECORD        | API 1104 🗸                   | Other                      |                    |                  | 1                  |                              |                               |             |
| 22222         | Process Name: Shie           | elded Metal                | Arc Welding (S     | MAW)             | Type of Process: N | /lanual                      |                               |             |
| PROCESS       | For: B                       | lutt Welding               | / Fillet           | Welding          |                    |                              |                               |             |
| PIPE          | Material Specification       | : 12.375" C                | .D X-52 - 0.3      | 75" WT. AP       | 15L                |                              |                               |             |
| DIAMETER      | API 1104 6.2.2               | 2 Guidelines               | Under 2            | 2-3/8" OD        | ✓ 2-3/8" t         | to 12-3/4" OD                | > 12-3                        | /4" OD      |
| MATERIAL      | RESTRI                       | CTED                       | ≤ 42,00            | 0 PSI Yield      | > 42,000           | to ≤ <b>52,000</b> PSI Yield | ≥ 65,000                      | PSI Yield   |
| THICKNESS     | API 1104 6.2.2               | 2 Guidelines               | Under 3            | /16" thick       | √ 3/16" ti         | nru 3/4" thick               | Over 3/                       | 4" thick    |
| FULFD MASTALS | AWS Electrode Nos:           | E6010                      | AWS Electrode Size | : 1/8"           | AWS Specification: | A5.1                         | Filler Metal Group:           | 1           |
| FILLER METALS | AWS Electrode Nos:           |                            | AWS Electrode Size | ( )              | AWS Specification: |                              | Filler Metal Group:           |             |
| GAS           | SHIELDING GAS: N/A           |                            |                    | FLOW RATE: N/A   |                    | FLUX: N/A                    |                               |             |
| PREHEAT       | Minimum Preheat Te           | mperature (F): 50          | 0                  | Interpass Temper | ature (F):         | Other:                       |                               | 1           |
|               |                              | WEL                        | D AXIS             |                  | TEC                | CHNIQUE                      | DIRE                          | CTION       |
|               | Flat (1G, 1F, 1FR)           |                            | Plate              |                  | Backhand           |                              | Vertical - Up                 |             |
|               | Horizontal (2G, 2F, 2F       | R)                         | Pipe               | V                | Forehand           | V                            | Vertical - Down               | 7           |
| POSITION      | Vertical (3G, 3F)            |                            | Rotated            |                  |                    |                              |                               |             |
|               | Overhead (4G, 4F)            |                            | Fixed              | V                |                    |                              |                               |             |
|               | Multiple (5G, 5F)            | 4                          | Inclined (6G, 6F)  |                  |                    |                              |                               |             |
|               | Combination                  |                            |                    |                  |                    |                              |                               |             |
|               |                              | DISPOSITION STYL           |                    | M                | ETHOD              |                              | ARC TYPE                      |             |
| TECHNIQUE     | Stringer Beads               | <b>/</b>                   |                    | Multiple Pass    | 1                  | Single Arc                   |                               | Other:      |
|               | Weave Beads                  |                            |                    | Single Pass      |                    | Multiple Arc                 |                               | outen [     |
| CLEANING      | Base Material: F             | Power 🗸                    | Hand               |                  | Weld: Power        | ✓ Han                        | d 📗                           |             |
|               |                              | вит                        | WELD 4             |                  | 0.0                | FILLET                       | WELD                          |             |
|               | 371/2° ± 21/2° 1<br>30° + 5° | FOR FITTINGS<br>O FOR PIPE |                    |                  |                    | V16' ± 1/3                   | 2"L                           |             |
| JOINT DESIGN  |                              | 1 1 :-                     | <b>⊢</b> 1/16"     |                  |                    | 1/16" ± 1/32"<br>I           |                               |             |
|               |                              | 1                          | -\_                |                  |                    | -                            |                               | 1           |
|               | 1/32" TO 1/16                | 1                          | /                  |                  |                    | 4 (                          | 7170                          | 7           |
|               | 200.200                      | $\neg$                     |                    |                  |                    | 1)                           |                               | -/          |
|               | /8" ± /1                     | 6' 🗝 🕴                     | -                  |                  | 17"                | TO 45°                       |                               |             |
|               |                              |                            |                    |                  |                    |                              |                               |             |
|               |                              |                            | Groove [           | designs o        | f Test Cou         | ipons                        |                               |             |
|               | Current Type: A              | AC                         | DC /               | Polarity:        | Straight/Negative  | A B                          | Reverse/Positive              | 7           |
| ELECTRICAL    | BEAD NO.                     | Passes                     | ELECTRODE NO. &    | Size             |                    | RANGE                        | MAXIMUM TIME<br>LAPSE ALLOWED | SPEED RANGE |
| CHARACTERIS-  | DEAD NO.                     | r asses                    | TYPE               | 3126             | VOLTS              | AMPS                         | (Min.)                        | (IPM)       |
| TICS &        | Root                         | 1                          | E6010              | 1/8"             | 20-25              | 75-130                       | 5                             | 3-20        |
| SEQUENCE OF   | Hot Pass                     | 1                          | E6010              | 1/8"             | 20-25              | 75-130                       | 5                             | 3-20        |
| BEADS         | Fill                         | 2                          | E6010              | 1/8"             | 20-25              | 75-130                       | 5                             | 3-20        |
|               | Cap                          | 1                          | E6010              | 1/8"             | 20-25              | 75-130                       | 5                             | 3-20        |

|                                | Specimen No.  | Width   | Thickness              | Area (in.^2)       |          | ate Total<br>d(Lbs.) | Ultima                           | te Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|--------------------------------|---|---|------------------------|--------------------|----------|----------------------|----------------------------------|-------------------------|---------------------------------------|--|
|                                | 1   | 0.950   | 0.450                  | 0.428              | 33       | 3480                 |                                  | 78316                   | DUCTILE                               | BASE   |
| TENSILE TEST                   | 2   | 0.890   | 0.490                  | 0.436              | 33       | 3650                 |                                  | 77161                   | DUCTILE                               | BASE   |
|                                | 3   |   |                        |                    |          |                      |                                  |                         |                                       |  |
| I                              | 4   |   |                        |                    |          |                      |                                  |                         |                                       | , T  |
|                                | Specimen No.  | Root Bend   | Face Bend              | Side Bend          |          | Bend /               | Acceptabl                        | e                       | Com                                   | ments  |
| 1                              | 5   | 180 Degrees   | NA                     | NA                 | Yes      | 4                    | No                               | TEI I                   |                                       |  |
|                                | 6   | 180 Degrees   | NA                     | NA                 | Yes      | 7                    | No                               |                         |                                       |  |
|                                | 7   | 180 Degrees   | NA                     | NA                 | Yes      | 1 14 1               | No                               |                         |                                       |  |
| GUIDED BEND                    | 8   | 180 Degrees   | NA                     | NA                 | Yes      |                      | No                               |                         |                                       |  |
| TEST                           | 9   | NA  | 180 Degrees            | NA                 | Yes      | 1                    | No                               | THE STATE OF            |                                       |  |
|                                | 10  | NA  | 180 Degrees            | NA                 | Yes      | 4                    | No                               |                         |                                       |  |
|                                | 11  | NA  | 180 Degrees            | NA                 | Yes      |                      | No                               |                         |                                       |  |
|                                | 12  | NA  | 180 Degrees            | NA                 | Yes      |                      | No                               |                         |                                       |  |
|                                | Specimen No.  | Acceptal  | ble Yes/No             |                    |          |                      | Co                               | mments                  |                                       |  |
| AUGU DDEAU                     | 13  | Yes   | No 🔲                   |                    |          |                      |                                  |                         |                                       |  |
| NICK BREAK                     | 14  | Yes 🗸   | No 🔲                   |                    |          |                      |                                  |                         |                                       |  |
| TEST                           | 15  | Yes   | No 🔲                   |                    |          |                      |                                  |                         |                                       |  |
|                                | 16  | Yes   | No 🔲                   |                    |          |                      |                                  |                         |                                       |  |
| FULLET MARKE                   | Carrier Com   |   |                        |                    | Lance of | e la la la           | e de la composición              |                         |                                       |  |
| FILLET WELD                    | Satisfactory:   | Yes   | No                     |                    | Penetrat | tion into Par        | rent Meta                        | H:                      | Yes                                   | No   |
| TEST                           | Satisfactory:<br>Fillet Weld - Fractu   |   | No                     |                    |          | of Percent o         | 1300                             | lit.                    | in.:                                  | %:   |
| TEST                           | Fillet Weld - Fractu  | re Test<br>Idrew Green &  |                        | License Number 8   | Length o |                      | 1300                             | it:                     |                                       |  |
|                                | Fillet Weld - Fractu<br>Welder Name: An   | re Test<br>Idrew Green &<br>er  |                        | License Number 8   | Length o |                      | 1300                             | i:                      | in.:                                  |  |
| TEST                           | Fillet Weld - Fractu<br>Welder Name: An<br>Austin Hipsh<br>Contractor: AMS  | re Test<br>ndrew Green &<br>er  |                        |                    | Length o | of Percent o         | f Defect                         |                         | in.:<br>Stencil Mark                  | %:   |
| TEST                           | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS   | re Test  Idrew Green & er  statements in this re  |                        |                    | Length o | of Percent o         | f Defect                         |                         | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the   | re Test  Idrew Green & er  statements in this re ucted By:                                      |                        |                    | Length o | of Percent o         | f Defect                         |                         | in.:<br>Stencil Mark                  | %:   |
| TEST                           | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination  | re Test  Idrew Green & er  statements in this re ucted By: Results:                             |                        | hat the test coupo | Length o | of Percent o         | f Defect                         |                         | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination  | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | f Defect                         |                         | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test 6  | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | f Defect                         | tested in accord        | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Cond                                       | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | ded, and                         | tested in accord        | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test if Mechanical Test Co                      | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | ded, and                         | tested in accord        | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test if Mechanical Test Co                      | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | ded, and                         | tested in accord        | in.:<br>Stencil Mark                  | %:   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: An Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co Approved By: APPROVED | re Test  Idrew Green & er  statements in this re  ucted By:  Results:  Results (For Alternation | cord are correct and t | hat the test coupo | Length o | of Percent o         | ded, and Laborato Organiza Date: | tested in accord        | in.:<br>Stencil Mark                  | %:   |



| TV05 05       | PQR No. 16-X60          | -312              |                    |                   | Orig. Issue Date   |                         | Revision Date                 |             |
|---------------|-------------------------|-------------------|--------------------|-------------------|--------------------|-------------------------|-------------------------------|-------------|
| TYPE OF       | WPS No. BW-3-B          | - <i>II</i>       |                    |                   | Orig. Issue Date   |                         | Revision Date                 |             |
| RECORD        | API 1104 🗸              | Other             |                    |                   | *                  |                         | *                             |             |
|               | Process Name: Shie      | lded Metal        | Arc Welding (S     | MAW)              | Type of Process:   | Manual                  |                               |             |
| PROCESS       | For: Bu                 | utt Welding       | / Fillet           | Welding           |                    |                         |                               |             |
| PIPE          | Material Specification: | 16.0" O.D         | X-60 - 0.3         | 12" WT. AP        | 1 5L               |                         |                               |             |
| DIAMETER      | API 1104 6.2.2          | Guidelines        | Under              | 2-3/8" OD         | 2-3/8"             | to 12-3/4" OD           | √ > 12-3                      | 3/4" OD     |
| MATERIAL      | API 1104 5.4.2.         | 2 Guidelines      | ≤ 42,00            | 0 PSI Yield       | > 42,00            | 0 to < 65,000 PSI Yield | ≥ 65,000                      | PSI Yield   |
| THICKNESS     | API 1104 6.2.2          | Guidelines        | Under 3            | /16" thick        | √ 3/16" t          | thru 3/4" thick         | Over 3/                       | /4" thick   |
| FILLED METALS | AWS Electrode Nos: E    | 6010              | AWS Electrode Size | : 1/8"            | AWS Specification: | : A5.1                  | Filler Metal Group:           | 1           |
| FILLER METALS | AWS Electrode Nos: E    | 7010              | AWS Electrode Size | : 1/8"            | AWS Specification: | A5.5                    | Filler Metal Group:           | 1           |
| GAS           | SHIELDING GAS: N/A      |                   |                    | FLOW RATE: N/A    |                    | FLUX: N/A               |                               |             |
| PREHEAT       | Minimum Preheat Ten     | nperature (F): 50 | 0                  | Interpass Tempera | iture (F):         | Other:                  |                               | 1000        |
|               |                         | WEL               | D AXIS             |                   | TE                 | CHNIQUE                 | DIRE                          | CTION       |
|               | Flat (1G, 1F, 1FR)      |                   | Plate              |                   | Backhand           |                         | Vertical - Up                 |             |
|               | Horizontal (2G, 2F, 2FR | )                 | Pipe               | V                 | Forehand           | V                       | Vertical - Down               | 7           |
| POSITION      | Vertical (3G, 3F)       |                   | Rotated            |                   |                    |                         |                               |             |
|               | Overhead (4G, 4F)       |                   | Fixed              | V                 |                    |                         |                               |             |
|               | Multiple (5G, 5F)       | 1                 | Inclined (6G, 6F)  |                   |                    |                         |                               |             |
|               | Combination             |                   |                    |                   |                    |                         |                               |             |
|               | DI                      | SPOSITION STYL    |                    | ME                | THOD               |                         | ARC TYPE                      |             |
| TECHNIQUE     | Stringer Beads          | ]                 |                    | Multiple Pass     | /                  | Single Arc 🗸            | 9                             | Other:      |
|               | Weave Beads             |                   |                    | Single Pass       |                    | Multiple Arc            |                               | Other L     |
| CLEANING      | Base Material: P        | ower 🗸            | Hand               |                   | Weld: Power        | ✓ Han                   | d                             |             |
|               |                         | ВЦТ               | WELD 4             |                   |                    | FILLE                   | TWELD                         |             |
|               | 371/2" ± 21/2" FO       |                   |                    |                   |                    | 1/1. 4 1/2              |                               |             |
|               | 30° + 5° 0              | FOR PIPE          |                    |                   |                    | 1/16° ± 1/30            |                               |             |
| JOINT DESIGN  |                         | 1 1 1-0           | <b>   -</b> 1/16"  |                   |                    | 1/16" ± 1/32"           |                               |             |
|               |                         |                   | <u></u>            |                   |                    | 1                       | -1-05                         | 7           |
|               | 1/32" TO 1/16"          | 1 \ 1/            |                    |                   |                    | 4                       | - C. M.                       | 7           |
|               |                         | 74                |                    |                   |                    | 1 /                     | -                             | -/          |
|               | 1/8" ± 1/16."           | -                 | _                  |                   | 17"                | TO 45°                  |                               |             |
|               | /                       |                   |                    |                   |                    |                         |                               |             |
|               |                         |                   | Groove D           | esigns of         | Test Cou           | pons                    |                               |             |
|               | Current Type: AC        |                   | DC 🗸               | Polarity:         | Straight/Negative  |                         | Reverse/Positive              | J           |
| ELECTRICAL    | READ NO                 | Passac            | ELECTRODE NO. &    | Cine              |                    | RANGE                   | MAXIMUM TIME<br>LAPSE ALLOWED | SPEED RANGE |
| CHARACTERIS-  | BEAD NO.                | Passes            | TYPE               | Size              | VOLTS              | AMPS                    | (Min.)                        | (IPM)       |
| TICS &        | Root                    | 1                 | E6010              | 1/8"              | 20-24              | 75-130                  | 5                             | 3-20        |
| SEQUENCE OF   | Hot Pass                | 1                 | E7010              | 1/8"              | 18-23              | 65-140                  | 5                             | 3-20        |
| BEADS         | Fill                    | 2                 | E7010              | 1/8"              | 18-23              | 65-140                  | 5                             | 3-20        |
|               | Сар                     | 1                 | E7010              | 1/8"              | 18-23              | 65-140                  | 5                             | 3-20        |

|                            | Specimen No.   | Width  | Thickness               | Area (in.^2)         | Ultimate<br>Load(L |           |                                    | Unit Stress<br>osi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|----------------------------|--|--|-------------------------|----------------------|--------------------|-----------|------------------------------------|---------------------|---------------------------------------|--|
|                            | 1  | 0.984  | 0.327                   | 0.322                | 11-                | 26,720    |                                    | 83,041              | DUCTILE                               | WELD   |
| TENSILE TEST               | 2  | 1.021  | 0,336                   | 0.343                |                    | 26,930    |                                    | 78,500              | DUCTILE                               | BASE   |
|                            | 3  | 1.114  | 0.336                   | 0.374                | -                  | 28,640    |                                    | 76,515              | DUCTILE                               | BASE   |
| J.                         | 4  | 1.02   | 0.321                   | 0.327                |                    | 26,020    |                                    | 79,470              | DUCTILE                               | BASE   |
|                            | Specimen No.   | Root Bend  | Face Bend               | Side Bend            |                    | Bend A    | Acceptable                         |                     | Com                                   | ments  |
| 1                          | 5  | 180 Degrees  | NA                      | NA                   | Yes                | 1         | No                                 |                     |                                       |  |
|                            | 6  | 180 Degrees  | NA                      | NA                   | Yes                | 4         | No                                 |                     |                                       |  |
| CUIDED DEND                | 7  | 180 Degrees  | NA                      | NA                   | Yes                | 1         | No                                 |                     |                                       |  |
| GUIDED BEND                | 8  | 180 Degrees  | NA                      | NA                   | Yes                | 1         | No                                 | 70                  |                                       |  |
| TEST                       | 9  | NA   | 180 Degrees             | NA                   | Yes                | 1         | No                                 |                     |                                       |  |
|                            | 10   | NA   | 180 Degrees             | NA                   | Yes                | 4         | No                                 |                     |                                       |  |
|                            | 11   | NA   | 180 Degrees             | NA                   | Yes                | 4         | No                                 | TI E                |                                       |  |
|                            | 12   | NA   | 180 Degrees             | NA                   | Yes                | 4         | No                                 | U a L               |                                       |  |
|                            | Specimen No.   | Acceptal   | ole Yes/No              |                      |                    |           | Com                                | ments               |                                       |  |
| AUGU BBEAU                 | 13   | Yes 🗸  | No 🗍                    |                      |                    |           |                                    |                     |                                       |  |
| NICK BREAK                 | 14   | Yes 🗸  | No 🗍                    |                      |                    |           |                                    |                     |                                       |  |
| TEST                       | 15   | Yes  | No 🗌                    |                      |                    |           |                                    |                     |                                       |  |
|                            | 16   | Yes 🗸  | No 🗍                    |                      |                    |           |                                    |                     |                                       |  |
| FILLET WELD                | Satisfactory:  | Yes  | No                      |                      | Penetration        | into Par  | ent Metal:                         | · · · · ·           | Yes                                   | No   |
| TEST                       | Fillet Weld - Fractu   | re Test  |                         |                      | Length of P        | ercent of | Defect                             |                     | in.:                                  | %:   |
|                            | Welder Name: An  | drew Green &   |                         | License Number &     | State              |           |                                    |                     | Stencil Mark                          |  |
| WEI DED INFO               | Austin Hipsh   | er   |                         |                      |                    |           |                                    |                     |                                       |  |
| WELDER INFO                | Austin Hipsh   |  |                         |                      |                    |           |                                    |                     |                                       |  |
| WELDER INFO                | Contractor: AMS  |  | cord are correct and t  | that the test coupor | ns were prepa      | red, weld | ded, and tes                       | eted in accord      | dance with the requi                  | rements of API                               |
| WELDER INFO                | Contractor: AMS  | statements in this re-   | cord are correct and t  | that the test coupor | ns were prepa      | red, weld | ded, and tes                       | eted in accord      | dance with the requi                  | rements of API                               |
|                            | Contractor: AMS We certify that the 1104.  | statements in this re-<br>ucted By:  | cord are correct and t  | hat the test coupor  | ns were prepa      | red, weld | ded, and tes                       | eted in accord      | dance with the requi                  | rements of API                               |
| WELDER INFO  CERTIFICATION | Contractor: AMS We certify that the 1104. Welding Test Condi   | statements in this re-<br>ucted By:<br>Results:                            | cord are correct and t  |                      |                    | red, weld | ded, and tes                       | ited in accord      | dance with the requi                  | rements of API                               |
|                            | Contractor: AMS We certify that the 1104. Welding Test Condi   | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ |                         |                      |                    |           | ded, and tes                       |                     | dance with the requi                  | rements of API                               |
|                            | Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F   | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ |                         |                      |                    |           |                                    | Test No:            | dance with the requi                  | rements of API                               |
|                            | Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F   | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ |                         |                      |                    |           | Laboratory                         | Test No:            | dance with the requi                  | rements of API                               |
|                            | Contractor: AMS We certify that the 1104. Welding Test Condition Visual Examination Radiographic Test for Mechanical Test Condition Approved By: | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ | re Qualification of Gro |                      |                    |           | Laboratory                         | Test No:            | dance with the requi                  | rements of API                               |
| CERTIFICATION              | Contractor: AMS We certify that the 1104. Welding Test Condition Visual Examination Radiographic Test for Mechanical Test Condition Approved By: | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ | re Qualification of Gro |                      |                    |           | Laboratory                         | Test No:            | dance with the requi                  | rements of API                               |
| CERTIFICATION              | Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test F Mechanical Test Co Approved By: APPROVED      | statements in this re-<br>ucted By:<br>Results:<br>Results (For Alternativ | re Qualification of Gro |                      |                    |           | Laboratory<br>Organizatio<br>Date: | Test No:            | dance with the requi                  | rements of API                               |

Please refer to the Duke Energy NGBU Intranet site for the latest authorized version.



Page: 1 of 2

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:

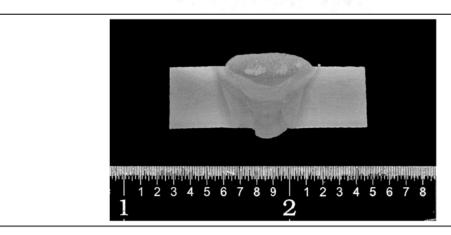
AWS Classification: Manufacture: Electrode Diameter:

Current Range:
Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root       | Hot Pass   | Fills     | Cap       |  |
|------------|------------|-----------|-----------|--|
| E6010      | E8010-P1   | E8010-P1  | E8010-P1  |  |
| Lincoln    | Lincoln    | Lincoln   | Lincoln   |  |
| 1/8"       | 5/32"      | 5/32"     | 5/32"     |  |
| DCEP       | DCEP       | DCEP      | DCEP      |  |
| 106 - 113  | 141 – 145  | 131 – 137 | 114 – 119 |  |
| 24 – 26    | 25 – 27    | 26 – 28   | 25 – 28   |  |
| 7.0 - 11.2 | 8.0 - 11.4 | 5.7 - 8.5 | 4.3 - 6.0 |  |



| Test Number:   | 5-1       |                     |               |                   |          | Pag     | e: 2 | of 2       |
|--|-----------|---------------------|---------------|-------------------|----------|---------|------|------------|
|  |           | -                   | TENSILE STE   | RENGTH TE         | ST       |         |      |            |
| Coupon Number:   | W         | 16 T1               | W16           | 5 T2              |          |         |      |            |
| Coupon Width:  | 1.02      | 9 inch              | 1.073         | inch              |          |         |      |            |
| Coupon Thickness:  | 0.37      | '0 inch             | 0.377         | inch              |          |         |      |            |
| Coupon Area:   | 0.38      | 1 inch <sup>2</sup> | 0.405         | inch <sup>2</sup> |          |         | 10   |            |
| /laximum Load:   | 32,8      | 841 lb              | 33,0          | 19 lb             |          |         |      |            |
| ensile Strength:   | 86,1      | .96 psi             | 81,53         | 0 psi             |          |         |      |            |
| racture Location:  | Base      | Metal               | Base          | Metal             |          |         |      |            |
|  |           |                     | BENE          | TEST              |          |         |      |            |
| Coupon Number:   | W16 FB1   | W16 FB2             | W16 RB1       | W16 RB2           |          |         | 1    | 115        |
| Гуре:  | Face      | Face                | Root          | Root              |          |         |      | 111        |
| Results:   | Pass      | Pass                | Pass (1)      | Pass              |          |         | 110  | 1111       |
|  |           |                     | NICK-BD       | EAK TEST          |          |         |      |            |
| Coupon Number:   | W/16      | NB1                 | W16           |                   |          |         | T-   |            |
| Results:   |           | s (1)               | Pass          |                   |          |         |      |            |
| Depth:<br>Vidth:<br>Votch Location:<br>Test Temperature: |           |                     |               |                   |          |         |      |            |
| mpact Energy:<br>6 Shear:                                |           |                     |               |                   |          |         |      |            |
| ateral Expansion:  |           |                     |               |                   |          |         |      |            |
| Comments: _(1)   |           |                     | OTHE          | RTESTS            |          |         | 1104 |            |
| A  | statement | s in this rec       | ord are corre | ect and that      | the test | 100.000 |      | welded, an |



| TV05 05                | PQR No. 16-X65-                   | 375              |                         |                   | Orig. Issue Date  |                                | Revision Date                  |                      |
|------------------------|-----------------------------------|------------------|-------------------------|-------------------|-------------------|--------------------------------|--------------------------------|----------------------|
| TYPE OF                | WPS No. BW-3-C-                   | П                |                         |                   | Orig. Issue Date  |                                | Revision Date                  |                      |
| RECORD                 | API 1104 🗸 (                      | Other            |                         |                   | <b>*</b>          |                                |                                |                      |
|                        | Process Name: Shiel               | ded Metal        | Arc Welding (S          | SMAW)             | Type of Process:  | Manual                         |                                |                      |
| PROCESS                | For: But                          | tt Welding       | / Fillet                | Welding           |                   |                                |                                |                      |
| PIPE                   | Material Specification:           | 16.0" O.D        | X-65- 0.37              | 5" WT. API        | 5L                |                                |                                |                      |
| DIAMETER               | API 1104 6.2.2                    | Guidelines       | Under:                  | 2-3/8" OD         | 2-3/8"            | to 12-3/4" OD                  | > 12-3                         | /4" OD               |
| MATERIAL               | API 1104 5.4.2.2                  | Guidelines       | ≤ 42,00                 | 00 PSI Yield      | > 42,00           | 00 to < 65,000 PSI Yield       | 65,000                         | PSI Yield            |
| THICKNESS              | API 1104 6.2.2                    | Guidelines       | Under 3                 | /16" thick        | √ 3/16"           | thru 3/4" thick                | Over 3/                        | 4" thick             |
| FILLED MATTALE         | AWS Electrode Nos: E              | 5010             | AWS Electrode Size      | : 1/8"            | AWS Specification | : A5.1                         | Filler Metal Group:            | 1                    |
| FILLER METALS          | AWS Electrode Nos: E8             | 3010             | AWS Electrode Size      | : 1/8"            | AWS Specification | : A5.5                         | Filler Metal Group:            | 2                    |
| GAS                    | SHIELDING GAS: N/A                |                  |                         | FLOW RATE: N/A    | 7                 | FLUX: N/A                      |                                |                      |
| PREHEAT                | Minimum Preheat Tem               | perature (F): 50 | ) <sup>0</sup>          | Interpass Tempera | ature (F):        | Other:                         |                                |                      |
|                        |                                   | WEI              | .D AXIS                 |                   | Ť                 | CHNIQUE                        | DIREC                          | CTION                |
|                        | Flat (1G, 1F, 1FR)                |                  | Plate                   |                   | Backhand          |                                | Vertical - Up                  |                      |
|                        | Horizontal (2G, 2F, 2FR)          |                  | Pipe                    | 7                 | Forehand          | 7                              | Vertical - Down                | 7                    |
| POSITION               | Vertical (3G, 3F)                 |                  | Rotated                 |                   |                   |                                |                                |                      |
|                        | Overhead (4G, 4F)                 |                  | Fixed                   | V                 |                   |                                |                                |                      |
|                        | Multiple (5G, 5F)                 | <b>V</b>         | Inclined (6G, 6F)       |                   |                   |                                |                                |                      |
|                        | Combination                       |                  |                         |                   |                   |                                |                                |                      |
|                        | DIS                               | SPOSITION STYL   | E                       | М                 | ETHOD -           |                                | ARC TYPE                       |                      |
| TECHNIQUE              | Stringer Beads                    | ]                |                         | Multiple Pass     | 4                 | Single Arc J                   |                                | Other:               |
|                        | Weave Beads                       |                  |                         | Single Pass       |                   | Multiple Arc                   |                                | ш.                   |
| CLEANING               | Base Material: Po                 | ower 🗸           | Hand                    |                   | Weld: Power       | √ Hai                          | nd                             |                      |
|                        |                                   | BUT              | T WELD 4                |                   | 3.4               | FILLE                          | TWELD                          |                      |
| JOINT DESIGN           | 371/2°± 21/2° FOF<br>30° + 5° 0 1 | FOR PIPE         | <b>   =</b> -1/16"      |                   |                   | 1/16" ± 1/32"<br>1/16" ± 1/32" | 52"                            |                      |
|                        | 1/32" TO 1/16"<br>1/8" ± 1/16"    | 1                | <del>/</del>            |                   | 17"               | TO 45°                         |                                |                      |
|                        |                                   |                  |                         |                   | Test Cou          |                                | n and In take                  |                      |
| FIFETDICAL             | Current Type: AC                  |                  | DC J                    | Polarity:         | Straight/Negative |                                | Reverse/Positive  MAXIMUM TIME | 7                    |
| ELECTRICAL             | BEAD NO.                          | Passes           | ELECTRODE NO. &<br>TYPE | Size              |                   | RANGE                          | LAPSE ALLOWED                  | SPEED RANGE<br>(IPM) |
| CHARACTERIS-<br>TICS & | Root                              | à.               |                         | 1/8"              | VOLTS<br>20-24    | AMPS 75-130                    | (Min.)<br>5                    | 3-20                 |
| SEQUENCE OF            | Hot Pass                          | 1                | E6010                   | 1/8"              | 22-26             | 75-130<br>75-135               | 5                              | 3-20                 |
| BEADS                  | Fill                              | 1                | E8010                   | 1/8"              | 22-26             | 75-135                         | 5                              | 3-20                 |
| DEADS                  | Cap                               | 1                | E8010                   | 1/8"              | 22-26             | 75-135                         | 5                              | 3-20                 |
|                        | 1.23%                             | -                |                         |                   |                   |                                |                                |                      |

|                            | Specimen No.   | Width  | Thickness  | Area (in.^2)        |             | ate Total<br>d(Lbs.) |                                   | Unit Stress<br>psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|----------------------------|--|--|--|---------------------|-------------|----------------------|-----------------------------------|---------------------|---------------------------------------|--|
|                            | 1  | 1.046  | 0.395  | 0.413               | 3           | 5140                 | 8                                 | 5050                | DUCTILE                               | WELD   |
| TENSILE TEST               | 2  | 0.969  | 0.367  | 0.356               | 3           | 1220                 | 8                                 | 7790                | DUCTILE                               | BASE   |
|                            | 3  | 1.069  | 0.381  | 0.407               | 3           | 6370                 | 8                                 | 9298                | DUCTILE                               | WELD   |
| I - U                      | 4  | 0.951  | 0.38   | 0.361               | 3           | 2590                 | 9                                 | 0182                | DUCTILE                               | BASE   |
|                            | Specimen No.   | Root Bend  | Face Bend  | Side Bend*          |             | Bend                 | Acceptable                        |                     | Com                                   | ments  |
|                            | 5  | 180 Degrees  | NA   | NA                  | Yes         | J                    | No                                |                     |                                       |  |
|                            | 6  | 180 Degrees  | NA   | NA                  | Yes         | 1                    | No                                |                     |                                       |  |
| COURTE STATE               | 7  | 180 Degrees  | NA   | NA                  | Yes         | 4                    | No                                |                     |                                       |  |
| GUIDED BEND                | 8  | 180 Degrees  | NA   | NA                  | Yes         | 7                    | No                                | Tul I               |                                       |  |
| TEST                       | 9  | NA   | 180 Degrees  | NA                  | Yes         | 1                    | No                                | 111                 |                                       |  |
|                            | 10   | NA   | 180 Degrees  | NA                  | Yes         | 4                    | No                                |                     |                                       |  |
|                            | 11   | NA   | 180 Degrees  | NA                  | Yes         | 4                    | No                                |                     |                                       |  |
|                            | 12   | NA   | 180 Degrees  | NA                  | Yes         | 4                    | No                                |                     |                                       |  |
|                            | Specimen No.   | Acceptal   | ole Yes/No   |                     |             |                      | Con                               | ments               |                                       |  |
| NICK DDEAK                 | 13   | Yes  | No 🔲   |                     |             |                      |                                   |                     |                                       |  |
| NICK BREAK                 | 14   | Yes  | No 🔲   |                     |             |                      |                                   |                     |                                       |  |
| TEST                       | 15   | Yes 🗸  | No   |                     |             |                      |                                   |                     |                                       |  |
|                            | 16   | Yes 🗸  | No 🔲   |                     |             |                      |                                   |                     |                                       |  |
| FILLET WELD                | Satisfactory:  | Yes  | No   |                     | Penetrat    | tion into Pa         | rent Metal:                       | 1                   | Yes                                   | No 🗍   |
| TEST                       | Fillet Weld - Fractu   | re Test  |  |                     | Length o    | of Percent o         | f Defect                          |                     | in,:                                  | %:   |
| 4                          |  | draw Croon 0   |  | License Number 8    | State       |                      |                                   |                     | Stencil Mark                          |  |
| WEI DER INFO               | Welder Name: An<br>Austin Hipsh  |  |  |                     |             |                      |                                   |                     |                                       |  |
| WELDER INFO                |  | er   |  |                     |             |                      |                                   |                     |                                       |  |
| WELDER INFO                | Austin Hipsh   | er   | cord are correct and   | that the test coupo | ns were pr  | epared, wel          | lded, and te                      | sted in accord      | dance with the requi                  | rements of API                               |
| WELDER INFO                | Austin Hipsh Contractor: AMS   | er<br>statements in this re  |  | that the test coupo | ns were pri | epared, wei          | lded, and te                      | sted in accord      | dance with the requi                  | rements of API                               |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104.   | er<br>statements in this re<br>ucted By:                             |  | that the test coupo | ns were pri | epared, wei          | lded, and te                      | sted in accord      | dance with the requi                  | rements of API                               |
| WELDER INFO  CERTIFICATION | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination  | er<br>statements in this re<br>ucted By:<br>Results:                 |  |                     |             | epared, wel          | lded, and te                      | sted in accord      | dance with the requi                  | rements of API                               |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination  | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and   |                     |             | epared, wel          | lded, and te                      |                     | dance with the requi                  | rements of API                               |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test (  | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and   |                     |             | epared, wel          |                                   | y Test No:          | dance with the requi                  | rements of API                               |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I  | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and   |                     |             | epared, wel          | Laborator                         | y Test No:          | dance with the requi                  | rements of API                               |
|                            | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and to the correct and the co |                     |             | epared, wel          | Laborator<br>Organizati           | y Test No:          | dance with the requi                  | rements of API                               |
| CERTIFICATION              | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and to the correct and the co |                     |             | epared, wel          | Laborator<br>Organizati           | y Test No:          | dance with the requi                  | rements of API                               |
| CERTIFICATION              | Austin Hipsh Contractor: AMS We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test ( Mechanical Test Co Approved By: APPROVED | er statements in this re ucted By: Results: Results (For Alternation | cord are correct and to the correct and the co |                     |             | epared, wei          | Laboratori<br>Organizati<br>Date: | y Test No:          | dance with the requi                  | rements of API                               |



# API 1104 COUPON TEST REPORT

Page: 1 of

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:

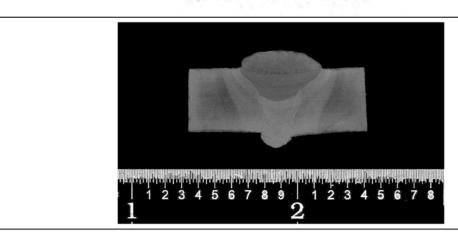
AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:

Current Range: Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root       | Hot Pass  | Fills     | Сар       |       |
|------------|-----------|-----------|-----------|-------|
| E6010      | E8010-P1  | E8010-P1  | E8010-P1  |       |
| Lincoln    | Lincoln   | Lincoln   | Lincoln   |       |
| 1/8"       | 5/32"     | 5/32"     | 5/32"     |       |
| DCEP       | DCEP      | DCEP      | DCEP      | - III |
| 102 - 114  | 139 - 141 | 126 - 142 | 111 - 132 |       |
| 22 – 25    | 26 – 27   | 25 – 28   | 20 – 29   |       |
| 6.1 – 11.3 | 5.9 - 8.7 | 4.8 - 9.3 | 4.4 – 7.5 |       |



| Test Number:                 | 6-1        |                     |              |                   |               | Page              | : 2    | of 2              |
|------------------------------|------------|---------------------|--------------|-------------------|---------------|-------------------|--------|-------------------|
|                              |            |                     | TENSILE STI  | RENGTH T          | EST           |                   |        |                   |
| Coupon Number:               | W:         | 17 T1               |              | 7 T2              |               | 7 T3              | W1     | 7 T4              |
| Coupon Width:                | 1.01       | .5 inch             | 0.953        | 3 inch            | 1.04:         | l inch            | 1.084  | 4 inch            |
| Coupon Thickness:            | 0.38       | 2 inch              | 0.383        | 3 inch            | 0.386         | inch inch         | 0.382  | 2 inch            |
| Coupon Area:                 | 0.38       | 8 inch <sup>2</sup> | 0.365        | inch <sup>2</sup> | 0.402         | inch <sup>2</sup> | 0.414  | inch <sup>2</sup> |
| Maximum Load:                | 34,2       | 230 lb              | 32,7         | 31 lb             | 35,5          | 91 lb             | 35,8   | 71 lb             |
| Tensile Strength:            | 88,2       | 22 psi              | 89,67        | 75 psi            | 88,53         | 35 psi            | 86,64  | 46 psi            |
| Fracture Location:           | Base       | Metal               | Base         | Metal             | Base          | Metal             | Base   | Metal             |
|                              |            |                     | 227          |                   |               |                   |        |                   |
| 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              |
| Coupon Number: [<br>Results: |            | NB1<br>s (1)        | W17<br>Pa    | SS                | Pas           | NB3<br>s (1)      |        | NB4               |
|                              |            | С                   | HARPY TOL    | JGHNESS 1         | rest          |                   |        |                   |
| Coupon Number:<br>Depth:     |            | -                   |              |                   |               |                   |        |                   |
| Width:                       |            | _                   |              |                   |               |                   |        |                   |
| Notch Location:              | _          | -+                  |              |                   |               |                   |        |                   |
| Test Temperature:            |            |                     |              |                   |               |                   |        |                   |
| Impact Energy:               |            | _                   |              |                   |               |                   |        |                   |
| % Shear:                     |            |                     |              |                   |               |                   |        |                   |
| Lateral Expansion:           |            |                     |              |                   |               |                   |        |                   |
|                              |            |                     |              |                   |               |                   |        |                   |
| Comments: (1)                | ndications | were presen         | t but were v | vithin the a      | cceptable lir | nits of API 1     | 104    |                   |
|                              |            |                     | P .131.1     |                   |               |                   |        |                   |
|                              |            |                     | OTHE         | R TESTS           |               |                   |        |                   |
| Test Type:                   |            |                     |              |                   |               |                   |        |                   |
| Results:                     |            |                     |              |                   |               |                   |        |                   |

Test Conducted By: Jim Winigman, Kiefner
Certified By: Matt Boring, P.E., CWI, CEng, Kiefner

Approved By:



Page: 1 of 2

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

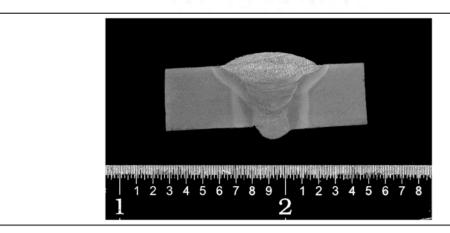
Pass:

AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E7016     | E7018     | E7018     | E7018     |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 3/32"     | 1/8"      | 1/8"      | 1/8"      |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 76 – 84   | 97 - 108  | 111 – 115 | 99 – 111  |  |
| 20 – 25   | 20 - 22   | 21 – 23   | 20 - 22   |  |
| 2.5 - 5.2 | 3.4 - 5.9 | 3.0 - 4.3 | 2.3 - 4.4 |  |



| Test Number:   | 7-1     |                     |             |                   |               | Page:      | 2         | of 2      |
|--|---------|---------------------|-------------|-------------------|---------------|------------|-----------|-----------|
|  |         |                     | TENSILE STR | RENGTH TES        | ST            |            |           |           |
| Coupon Number:   | W       | 18 T1               | W18         | 8 T2              |               |            |           |           |
| Coupon Width:  | 1.02    | 8 inch              | 1.016       | inch              |               |            |           |           |
| oupon Thickness:   |         | 4 inch              | 0.381       | Linch             |               |            |           |           |
| Coupon Area:   | 0.38    | 4 inch <sup>2</sup> | 0.387       | inch <sup>2</sup> |               |            |           |           |
| /laximum Load:   | 29,4    | 486 lb              | 29,73       | 33 lb             |               | 1)         |           |           |
| ensile Strength:   | 76,7    | '87 psi             | 76,82       | 29 psi            |               |            |           |           |
| racture Location:  | Base    | Metal               | Base I      | Metal             |               |            |           |           |
|  |         |                     | BEND        | TEST              |               |            |           |           |
| Coupon Number:   | W18 FB1 | W18 FB2             | W18 RB1     | W18 RB2           |               |            |           | 10        |
| ype:   | Face    | Face                | Root        | Root              |               |            |           |           |
| Results:   | Pass    | Pass                | Pass        | Pass              |               | - 4        |           |           |
|  |         |                     | NICK DD     | EAV TEST          |               |            |           |           |
| oupon Number:  | W/18    | NB1                 | W18         | NB2               |               |            |           |           |
| Results:   |         | s (1)               | Pass        |                   |               |            |           |           |
| Depth: Vidth: Vidth: Votch Location: Test Temperature: Test Energy: Shear: A Shear: A steral Expansion:  |         |                     |             |                   |               |            |           |           |
| Comments: (1)  |         |                     | ОТНЕ        | R TESTS           |               | s of API 1 | 104       |           |
| No. of the contract of the con |         | S. 10 . 7           |             |                   | the test weld |            | renared w | velded an |



Page: 1 of 2

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

FIGURE 1 - BEAD SEQUENCE

Pass:

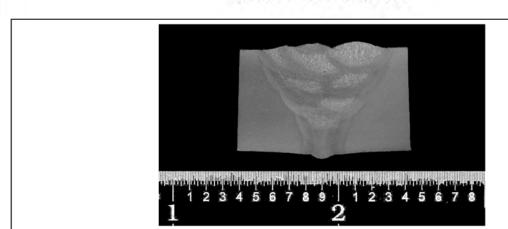
AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:

Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E7016     | E7018     | E7018     | E7018     |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 3/32"     | 1/8"      | 1/8"      | 1/8"      |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 79 – 82   | 104 - 110 | 110 - 119 | 109 - 119 |  |
| 21 – 24   | 22 – 23   | 21 – 24   | 21 - 23   |  |
| 2.6 - 4.3 | 2.9 - 4.8 | 2.1 - 4.8 | 2.3 - 4.9 |  |



| Type: Fa   | 0.99<br>0.86<br>0.85<br>66,2<br>77,5                                | 19 T1 11 inch 13 inch 15 inch 240 lb 100 psi 1 Metal  W19 SB2  Face  Pass (1)                           | 0.980<br>0.866<br>0.849<br>67,41<br>79,50<br>Base I                           | inch<br>inch<br>inch <sup>2</sup><br>70 lb   | Τ          | Pag        |            |           |
|--|---|---|---|--|------------|------------|------------|-----------|
| Coupon Width: Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type: Results:  Coupon Number:   | 0.99<br>0.86<br>0.85<br>66,2<br>77,5<br>Base<br>9 SB1<br>ace<br>ass | 19 T1<br>11 inch<br>13 inch<br>15 inch <sup>2</sup><br>240 lb<br>100 psi<br>14 Metal<br>W19 SB2<br>Face | 0.980<br>0.866<br>0.849<br>67,4<br>79,50<br>Base I                            | 9 T2<br>0 inch<br>5 inch<br>inch <sup>2</sup><br>70 lb<br>00 psi<br>Metal<br>D TEST<br>W19 SB4<br>Root |            |            |            |           |
| Coupon Width: Coupon Thickness: Coupon Area: Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type: Results:  Coupon Number:   | 0.99<br>0.86<br>0.85<br>66,2<br>77,5<br>Base<br>9 SB1<br>ace<br>ass | 11 inch<br>63 inch<br>55 inch <sup>2</sup><br>240 lb<br>600 psi<br>Metal<br>W19 SB2<br>Face             | 0.980<br>0.866<br>0.849<br>67,4<br>79,50<br>Base I<br>BENE<br>W19 SB3<br>Root | o inch inch inch <sup>2</sup> 70 lb 00 psi Metal  O TEST W19 SB4 Root                                  |            |            |            |           |
| Coupon Thickness:  Coupon Area:  Maximum Load: Tensile Strength: Fracture Location:  Coupon Number: Type: Results:  Coupon Number:   | 0.86<br>0.85<br>66,2<br>77,5<br>Base<br>9 SB1<br>ace                | 3 inch<br>5 inch <sup>2</sup><br>240 lb<br>00 psi<br>Metal<br>W19 SB2<br>Face                           | 0.866<br>0.849<br>67,47<br>79,50<br>Base I<br>BENE<br>W19 SB3<br>Root         | inch inch² 70 lb 00 psi Metal  O TEST  W19 SB4 Root  |            |            |            |           |
| Coupon Area:  Maximum Load: Fensile Strength: Fracture Location:  Coupon Number:  Type: Results:  Coupon Number:   | 0.85<br>66,2<br>77,5<br>Base<br>9 SB1<br>ace<br>ass                 | 5 inch <sup>2</sup><br>240 lb<br>500 psi<br>Metal<br>W19 SB2<br>Face                                    | 0.849<br>67,4<br>79,50<br>Base I<br>BENE<br>W19 SB3<br>Root                   | inch <sup>2</sup> 70 lb 90 psi Metal  O TEST W19 SB4 Root  |            |            |            |           |
| Maximum Load: Fensile Strength: Fracture Location:  Coupon Number: Factorial W19  Coupon Number: Pactorial | 77,5<br>Base<br>9 SB1<br>ace<br>ass                                 | Metal W19 SB2 Face  | 79,50<br>Base I<br>BENE<br>W19 SB3<br>Root                                    | Metal  O TEST  W19 SB4  Root   |            |            |            |           |
| Coupon Number: W19 Type: Fa Results: P3 Coupon Number:   | Base<br>9 SB1<br>ace<br>ass   | Metal W19 SB2 Face  | BENE<br>W19 SB3<br>Root   | Metal  O TEST  W19 SB4  Root   |            |            |            |           |
| Coupon Number: W19 Type: Fa Results: Pi Coupon Number:   | 9 SB1<br>ace<br>ass   | W19 SB2<br>Face   | BENE<br>W19 SB3<br>Root   | W19 SB4 Root   |            |            |            |           |
| Type: Fa Results: Pa Coupon Number:  | ace<br>ass  | Face  | W19 SB3<br>Root   | W19 SB4<br>Root  |            |            |            |           |
| Type: Fa Results: Pa Coupon Number:  | ace<br>ass  | Face  | W19 SB3<br>Root   | W19 SB4<br>Root  |            |            |            |           |
| Type: Fa Results: Pa Coupon Number:  | ace<br>ass  | Face  | Root  | Root   |            |            |            | 1         |
| Results: Pa  |   | Pass (1)  | Pass  | Pass   |            |            |            |           |
|  | W19   |   |   |  |            |            |            |           |
|  | W19   |   |   | Low Service  |            |            |            |           |
|  | W19   | ND1   | NICK-BR<br>W19  | EAK TEST   |            |            | The second |           |
| Nesuits.   | Pa  | ass   | Pass  |  |            |            | +          |           |
| Coupon Number: Depth: Width:   |   |   |   |  |            |            |            |           |
| Notch Location:  |   |   | 10  |  |            |            |            |           |
| Test Temperature:  |   |   |   |  |            |            |            |           |
| mpact Energy:  |   |   |   |  |            |            |            |           |
| % Shear:   |   |   | 1   |  |            |            |            |           |
| Lateral Expansion:   |   |   |   |  |            |            |            |           |
| Comments: (1) Indica   | ations v  | were presen   | it but were w   | vithin the acc   | eptable li | mits of AP | 1104       |           |
|  |   |   | OTHER   | RTESTS   |            |            |            |           |
| Test Type:   |   |   |   |  |            |            |            |           |
| Desultar   |   |   |   |  |            |            |            |           |
| We certify that the state tested   |   |   |   | ect and that t<br>ements of the  |            |            |            | elded, an |
| Date: 10/16/2014   |   |   |   |  |            |            |            |           |
|  | m Win   | igman, Kiefi  | ner   |  |            |            |            |           |



# **API 1104 COUPON TEST REPORT**

Page: 1 of

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

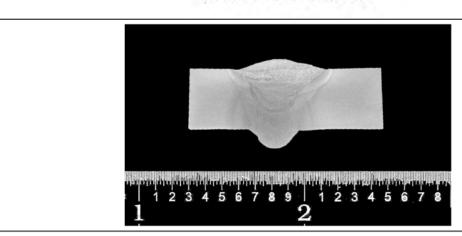
Pass:

AWS Classification: Manufacture: Electrode Diameter: Current/Polarity: Current Range:

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E7016     | E7018     | E7018     | E7018     |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 3/32"     | 1/8"      | 1/8"      | 1/8"      |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 78 – 89   | 96 – 102  | 106 - 109 | 100 - 118 |  |
| 20 – 28   | 20 – 22   | 20 - 23   | 20 - 24   |  |
| 2.5 - 6.0 | 3.7 – 5.3 | 3.2 – 4.5 | 2.6 - 6.5 |  |



| Test Number:   | 8-1                       |                     |                |                   |             | Page         | : 2        | of 2        |
|--|---------------------------|---------------------|----------------|-------------------|-------------|--------------|------------|-------------|
|  |                           |                     | TENICU E CTI   | RENGTH TES        |             |              |            |             |
| Coupon Number:   | \A/r                      | 20 T1               | 1              | O T2              | I. j.       |              | r -        |             |
| Coupon Width:  |                           | 7 inch              | -              | inch              |             |              |            |             |
| Coupon Thickness:  |                           | 9 inch              |                | inch              |             |              |            | _           |
| Coupon Area:   |                           | 4 inch <sup>2</sup> |                | inch <sup>2</sup> |             |              |            |             |
| Maximum Load:  | 34,:                      | 143 lb              | 33,6           | 09 lb             |             |              |            |             |
| Tensile Strength:  | 86,6                      | 56 psi              | 86,84          | 15 psi            |             |              |            |             |
| Fracture Location:   | Base                      | Metal               | Base           | Metal             |             |              |            |             |
|  |                           |                     | RENI           | TEST              |             |              |            |             |
| Coupon Number:   | W20 FB1                   | W20 FB2             | W20 RB1        | W20 RB2           |             |              | 11 === 1   | r H         |
| Туре:  | Face                      | Face                | Root           | Root              |             |              |            |             |
| Results:   | Pass                      | Pass (1)            | Pass           | Pass (1)          |             |              |            |             |
|  |                           |                     | 12.12.002      | La te district    |             |              |            |             |
| Coupon Number:   | 14/20                     | NB1                 | NICK-BR<br>W20 | EAK TEST          |             | -            |            |             |
| Results:   |                           | s (1)               | Pass           |                   |             |              |            |             |
| Coupon Number:   |                           | -                   |                |                   |             |              |            |             |
|  |                           |                     |                |                   |             |              |            |             |
| Width:<br>Notch Location:  |                           |                     |                |                   |             |              |            |             |
| Width:<br>Notch Location:<br>Test Temperature:   |                           |                     |                |                   |             |              |            |             |
| Width:<br>Notch Location:<br>Test Temperature:<br>Impact Energy:   |                           |                     |                |                   |             |              |            |             |
| Width:<br>Notch Location:<br>Test Temperature:<br>Impact Energy:<br>% Shear:   |                           |                     |                |                   |             |              |            |             |
| Width: Notch Location: Test Temperature: Impact Energy: % Shear: Lateral Expansion:                                    | ndications                | were preser         | nt but were v  | vithin the acce   | eptable lim | its of API 1 | 1104       |             |
| Depth: Width: Notch Location: Test Temperature: Impact Energy: % Shear: Lateral Expansion:  Comments: (1)              | ndications                | were preser         | P. 013         | vithin the acce   | eptable lim | its of API 1 | 1104       |             |
| Width: Notch Location: Test Temperature: Impact Energy: % Shear: Lateral Expansion: Comments:(1)                       |                           |                     | OTHE           | R TESTS           | eptable lim | its of API 1 | 1104       |             |
| Width: Notch Location: Test Temperature: Impact Energy: % Shear: Lateral Expansion: Comments:(1)                       |                           |                     | OTHE           | R TESTS           |             | its of API 1 | 1104       |             |
| Width: Notch Location: Fest Temperature: Impact Energy: Shear: Lateral Expansion: Comments: (1)   Fest Type: Results:  | statement                 | s in this rec       | OTHE           | R TESTS           | he test we  | lds were p   | repared, v | velded, an  |
| Width: Notch Location: Test Temperature: Impact Energy: % Shear: Lateral Expansion: Comments:(1)   Test Type: Results: | statement<br>sted in acco | s in this rec       | OTHE           | R TESTS           | he test we  | lds were p   | repared, v | velded, and |



Page: 1 of 2

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:

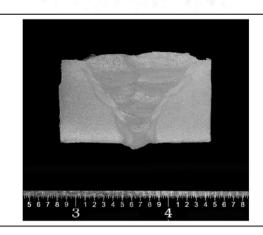
#### WELDING PARAMETERS

Pass:

AWS Classification: Manufacture: **Electrode Diameter:** Current/Polarity: **Current Range:** Voltage Range:

Travel Speed Range, ipm: Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E7016     | E7018     | E7018     | E7018     |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 3/32"     | 1/8"      | 1/8"      | 1/8"      |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 68 – 75   | 101 – 108 | 120 - 137 | 120 - 130 |  |
| 20 – 23   | 20 – 22   | 20 - 23   | 20 - 22   |  |
| 2.7 - 4.3 | 2.6 - 4.4 | 2.0 - 5.0 | 2.0 - 4.1 |  |



| -2       |  |   |                         |            | Page         | e: 2   | of 2      |
|----------|--|---|-------------------------|------------|--------------|--------|-----------|
|          |  | TENSILE STR   | RENGTH TE               | ST         |              |        |           |
| W        |  | 1   |                         |            |              |        |           |
| 1.12     | 0 inch   | 1.041   | inch                    |            |              |        |           |
| 0.88     | 6 inch   | 0.887   | 'inch                   |            |              |        |           |
| 0.99     | 2 inch <sup>2</sup>  | 0.923   | inch <sup>2</sup>       |            |              |        |           |
| 87,4     | 487 lb   | 77,8  | 11 lb                   |            |              |        |           |
| 88,1     | .92 psi  | 84,30   | 2 psi                   |            |              |        |           |
| Base     | Metal  | Base  | Metal                   |            |              |        |           |
|          |  | BEND  | TEST                    |            |              |        |           |
| W21 SB1  | W21 SB2  | W21 SB3   | W21 SB4                 |            |              |        |           |
| Side     | Side   | Side  | Side                    |            |              |        |           |
| Pass (1) | Pass   | Pass (1)  | Pass                    |            |              |        |           |
|          |  | AUGU DD   |                         |            |              |        |           |
| \\/21    | NR1  |   |                         |            |              |        |           |
|          |  |   |                         |            |              |        |           |
|          | С  | HARPY TOU   | IGHNESS T               | EST        |              |        |           |
|          |  |   |                         |            |              |        |           |
|          |  |   |                         |            |              |        |           |
|          |  |   |                         |            |              |        |           |
|          |  | -   |                         |            |              |        |           |
|          |  |   |                         |            |              |        |           |
|          |  | ОТНЕ  | R TESTS                 | ceptable I | imits of API | 1104   |           |
| J. E     | 3.07   |   | ect and that            | the test v | Telescond S  |        | elded, an |
|          | W2<br>1.12<br>0.88<br>0.99<br>87,<br>88,1<br>Base<br>W21 SB1<br>Side<br>Pass (1) | W21 T1 1.120 inch 0.886 inch 0.992 inch² 87,487 lb 88,192 psi Base Metal  W21 SB1 | ## TENSILE STR   W21 T1 | W21 T1     | W21 T1       | W21 T1 | W21 T1    |



# **API 1104 COUPON TEST REPORT**

Page:

| <b>Test Number:</b> | 9-1 | Date: | 10/16/201 |
|---------------------|-----|-------|-----------|
| lest Number:        | 9-1 | Date: | 10/16/20  |

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:

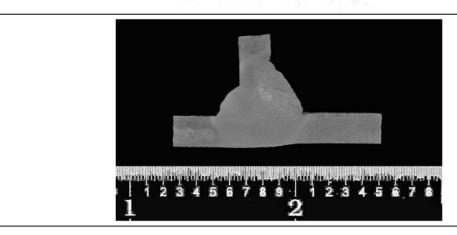
AWS Classification: Manufacture: **Electrode Diameter:** Current/Polarity:

**Current Range:** Voltage Range:

Comments:

Travel Speed Range, ipm:

| Root      | Hot Pass   | Cap       |  |
|-----------|------------|-----------|--|
| E6010     | E6010      | E6010     |  |
| Lincoln   | Lincoln    | Lincoln   |  |
| 1/8"      | 1/8"       | 1/8"      |  |
| DCEP      | DCEP       | DCEP      |  |
| 65 – 71   | 85 – 89    | 84 – 90   |  |
| 24 – 26   | 25 – 28    | 25 – 28   |  |
| 2.2 - 3.4 | 5.4 – 10.7 | 4.0 - 5.6 |  |



| Test Number: 9-1                  |               |                |                    | Page                       | e: 2 of 2 |
|-----------------------------------|---------------|----------------|--------------------|----------------------------|-----------|
|                                   |               | TENSII         | LE STRENGTH TE     | ST                         |           |
| Coupon Number:                    |               |                |                    |                            |           |
| Coupon Width:                     |               |                |                    |                            |           |
| Coupon Thickness:                 |               |                |                    |                            |           |
| Maximum Load:                     | _             |                |                    |                            |           |
| ensile Strength:                  |               |                |                    |                            |           |
| racture Location:                 |               |                |                    |                            |           |
|                                   |               |                | DEND TECT          |                            |           |
| Coupon Number:                    |               |                | BEND TEST          |                            |           |
| ype:                              |               |                |                    |                            |           |
| Results:                          |               |                |                    |                            |           |
|                                   |               |                |                    |                            |           |
| Coupon Number:                    | W22 NB1       | NIC            | W22 NB2            | W22 NB3                    | W22 NB4   |
| Results:                          | Pass          |                | Pass               | Pass                       | Pass (1)  |
| Coupon Number:                    |               | CHARP          | Y TOUGHNESS T      | E31                        |           |
| Vidth:                            |               |                |                    |                            |           |
| Notch Location:                   |               |                |                    |                            |           |
| est Temperature:<br>mpact Energy: |               |                | -                  |                            |           |
| 6 Shear:                          |               |                | 1                  |                            |           |
| ateral Expansion:                 |               |                |                    |                            |           |
| Comments: (1) Indi                | cations were  | present hut y  | were within the a  | cceptable limits of API    | 1104      |
| .onments. (1) man                 | cations were  | present but v  | vere within the ac | ceeptable littles of Al 1. | 1104      |
|                                   |               |                | OTHER TESTS        |                            |           |
| est Type:                         |               |                |                    |                            |           |
| Results:  We certify that the sta | atements in t | his record are | e correct and that |                            |           |
| teste                             |               |                |                    |                            |           |



| ag | e | 1 | of |
|----|---|---|----|
|    |   |   |    |

| Test Number:   | 9-2 | Date: | 10/16/2014 |
|----------------|-----|-------|------------|
| rest iduliber. | J-Z | Date. | 10/10/2014 |

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

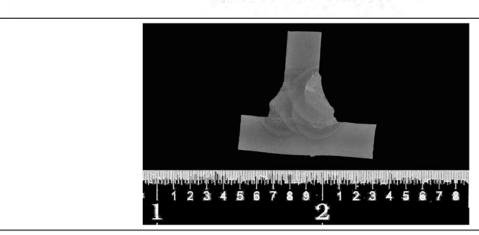
Pass:

AWS Classification: Manufacture: **Electrode Diameter:** Current/Polarity: **Current Range:** 

Voltage Range:

Travel Speed Range, ipm: Comments:

| Root      | Hot Pass  | Сар       |     |  |
|-----------|-----------|-----------|-----|--|
| E6010     | E7010-P1  | E7010-P1  |     |  |
| Lincoln   | Lincoln   | Lincoln   |     |  |
| 1/8"      | 5/32"     | 5/32"     |     |  |
| DCEP      | DCEP      | DCEP      |     |  |
| 85 – 95   | 110 - 111 | 110 - 113 |     |  |
| 24 – 28   | 26 – 28   | 26 - 28   | 11  |  |
| 2.9 - 4.5 | 4.0 - 6.4 | 3.5 - 6.4 | 7,1 |  |



| Test Number: 9-2  |                |                |                   | Pa                    | ge: 2 of 2              |
|---|----------------|----------------|-------------------|-----------------------|-------------------------|
|   |                | TENSI          | LE STRENGTH TE    | EST                   |                         |
| Coupon Number:  |                |                |                   |                       |                         |
| Coupon Width:   |                |                |                   |                       |                         |
| oupon Thickness:  |                | _              |                   |                       |                         |
| Coupon Area: Maximum Load:  |                | -+-            |                   |                       |                         |
| ensile Strength:  |                |                |                   |                       |                         |
| racture Location:   |                |                |                   |                       |                         |
|   |                |                | and the           |                       | •                       |
| Sauman Number   | 1              |                | BEND TEST         | 1                     |                         |
| oupon Number:   |                |                |                   |                       |                         |
| Results:  |                |                |                   | 1                     |                         |
|   |                |                |                   | 1                     |                         |
| ar best be  |                | NIC            | CK-BREAK TEST     |                       | 4                       |
| Coupon Number:  | W23 NB1        |                | W23 NB2           | W23 NB3               | W23 NB4                 |
| Results:  | Pass           |                | Pass              | Pass                  | Pass                    |
|   |                | CHARP          | Y TOUGHNESS T     | TEST                  |                         |
| Coupon Number:  |                |                |                   |                       |                         |
| Depth:  |                |                | 1001              |                       |                         |
| Width:  |                |                | 10/1=             |                       |                         |
| Notch Location:   |                |                | 101=              |                       |                         |
| est Temperature:  |                |                |                   |                       |                         |
| mpact Energy:   |                |                |                   |                       |                         |
|   |                |                | 4-                |                       |                         |
| % Shear:  |                |                |                   |                       |                         |
| % Shear:  |                |                |                   |                       |                         |
| % Shear:<br>.ateral Expansion:  |                |                |                   |                       |                         |
| 6 Shear:<br>ateral Expansion:   |                |                | OTHER TESTS       |                       |                         |
| % Shear: .ateral Expansion: Comments:   |                |                | OTHER TESTS       |                       |                         |
| % Shear: Lateral Expansion: Comments:  Test Type:                                   |                |                | 7.77              |                       |                         |
| % Shear: Lateral Expansion: Comments:  Test Type:                                   |                |                |                   |                       |                         |
| 6 Shear: .ateral Expansion: Comments:  Fest Type: Results: We certify that the st   | atements in th | his record are | e correct and tha | t the test welds were | e prepared, welded, and |
| 6 Shear: .ateral Expansion:  Comments:  Fest Type: Results:  We certify that the st | atements in th | his record are | e correct and tha |                       |                         |
| 6 Shear: .ateral Expansion: Comments:  Fest Type: Results: We certify that the st   | atements in th | his record are | e correct and tha | t the test welds were |                         |



| TVDF OF                    | PQR No. F12-X42               | -219                   |                    |                  | Orig. Issue Date  |                          | Revision Date                       |                      |
|----------------------------|-------------------------------|------------------------|--------------------|------------------|-------------------|--------------------------|-------------------------------------|----------------------|
| TYPE OF                    | WPS No. FW-A-II               |                        |                    |                  | Orig. Issue Date  |                          | Revision Date                       |                      |
| RECORD                     | API 1104 🗸 (                  | Other                  |                    |                  | ^                 |                          | *                                   |                      |
| DDG GEGG                   | Process Name: Shiel           | ded Metal              | Arc Welding (      | SMAW)            | Type of Process:  | Manual                   |                                     |                      |
| PROCESS                    | For: Bu                       | tt Welding             | Fillet             | Welding 🗸        |                   |                          |                                     |                      |
| PIPE                       | Material Specification:       | 12.375" C              | ).D X-42 - 0       | ).219" WT.       | API 5L            |                          |                                     |                      |
| DIAMETER-                  | API 1104 6.2.2                | Guidelines             | Under              | 2 3/8" OD        | 2 3/8"            | to 12 3/4" OD            | ⇒ 12·3                              | <del>/4" OD</del>    |
| MATERIAL                   | API 1104 5.4.2.2              | 2 Guidelines           | ✓ ≤ 42,00          | 00 PSI Yield     | > 42,00           | 00 to < 65,000 PSI Yield | ≥ 65,000                            | PSI Yield            |
| THICKNESS                  | API 1104 6.2.2                | Guidelines             | Under 3            | 3/16" thick      | 3/16"             | thru 3/4" thick          | Over 3/                             | 4" thick             |
| FILLER METALS              | AWS Electrode Nos: Et         | 5010                   | AWS Electrode Size | e: 1/8"          | AWS Specification | . A5.1                   | Filler Metal Group:                 | 1                    |
| FILLER IVIETALS            | AWS Electrode Nos:            |                        | AWS Electrode Size | 2:               | AWS Specification | ė.                       | Filler Metal Group:                 |                      |
| GAS                        | SHIELDING GAS: N/A            |                        |                    | FLOW RATE: N/A   | 7                 | FLUX: N/A                |                                     |                      |
| PREHEAT                    | Minimum Preheat Tem           | perature (F): 50       | ) <sup>0</sup>     | Interpass Temper | ature (F):        | Other:                   |                                     |                      |
|                            |                               | WEI                    | D AXIS             |                  | TE                | ECHNIQUE                 | DIREC                               | TION                 |
|                            | Flat (1G, 1F, 1FR)            |                        | Plate              |                  | Backhand          |                          | Vertical - Up                       |                      |
|                            | Horizontal (2G, 2F, 2FR)      |                        | Pipe               | V                | Forehand          | 7                        | Vertical - Down                     | 7                    |
| POSITION                   | Vertical (3G, 3F)             |                        | Rotated            |                  |                   |                          |                                     |                      |
|                            | Overhead (4G, 4F)             |                        | Fixed              | V                |                   |                          |                                     |                      |
|                            | Multiple (5G, 5F)             | 4                      | Inclined (6G, 6F)  |                  |                   |                          |                                     |                      |
|                            | Combination                   |                        |                    |                  |                   |                          |                                     |                      |
|                            | DIS                           | SPOSITION STYL         | E                  | M                | ETHOD -           |                          | ARC TYPE                            |                      |
| TECHNIQUE                  | Stringer Beads                | ]                      |                    | Multiple Pass    | 1                 | Single Arc               |                                     | Other:               |
|                            | Weave Beads                   |                        |                    | Single Pass      |                   | Multiple Arc             |                                     | outer.               |
| CLEANING                   | Base Material: Po             | ower 🗸                 | Hand               |                  | Weld: Power       | √ Han                    | nd 🔲                                |                      |
|                            |                               | BUT                    | WELD               |                  |                   | FILLE                    | T WELD                              |                      |
| Lichen                     | 37½° ± 2½° FO<br>30° + 5° 0   | R FITTINGS<br>FOR PIPE | 11. 16.1           |                  |                   | 1/16" ± 1/3              |                                     |                      |
| JOINT DESIGN               | /32" TO 1/16"<br>1/8" ± 1/16" |                        | 716"               |                  | 17'               | 1 TO 45°                 |                                     |                      |
|                            |                               |                        | Groove D           | esigns of        | f Test Cou        | upons                    |                                     |                      |
| 707 270 400                | Current Type: AC              |                        | DC 🗸               | Polarity:        | Straight/Negative | a B                      | Reverse/Positive                    | 7                    |
| ELECTRICAL<br>CHARACTERIS- | BEAD NO.                      | Passes                 | ELECTRODE NO. &    | Size             | VOLTS             | RANGE                    | MAXIMUM TIME  LAPSE ALLOWED  (Min.) | SPEED RANGE<br>(IPM) |
| TICS &                     | Root                          | 1                      | E6010              | 1/8"             | 20-24             | 75-130                   | 5                                   | 3-20                 |
| SEQUENCE OF                | Hot Pass                      | 1                      | E6010              | 1/8"             | 20-24             | 75-130                   | 5                                   | 3-20                 |
| BEADS                      | Fill                          | 1                      | E6010              | 1/8"             | 20-24             | 75-130                   | 5                                   | 3-20                 |
|                            | Сар                           | 1                      | E6010              | 1/8"             | 20-24             | 75-130                   | 5                                   | 3-20                 |

|                                | Specimen No.   | Width  | Thickness                | Area (in.^2)        | 100       | ite Total<br>d(Lbs.) | Ultima                           | te Unit Stress<br>(psi)  | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|--------------------------------|--|--|--------------------------|---------------------|-----------|----------------------|----------------------------------|--|---------------------------------------|--|
|                                | 1  |  |                          |                     |           |                      |                                  |  |                                       |  |
| TENSILE TEST                   | 2  |  |                          |                     |           |                      |                                  |  |                                       |  |
|                                | 3  |  |                          |                     |           |                      |                                  |  |                                       |  |
|                                | 4  |  |                          |                     |           |                      |                                  | - 1  |                                       | T.L.L.Q                                      |
|                                | Specimen No.   | Root Bend  | Face Bend                | Side Bend           |           | Bend                 | Acceptab                         | e  | Com                                   | ments  |
|                                | 5  | 180 Degrees  |                          |                     | Yes       |                      | No                               | 15   |                                       |  |
|                                | 6  | 180 Degrees  | 4                        |                     | Yes       |                      | No                               | 1  |                                       |  |
|                                | 7  | 180 Degrees  |                          |                     | Yes       | 1 14                 | No                               | 11 ++ 12 11  |                                       |  |
| GUIDED BEND                    | 8  | 180 Degrees  |                          |                     | Yes       |                      | No                               |  |                                       |  |
| TEST                           | 9  |  | 180 Degrees              |                     | Yes       | T                    | No                               |  |                                       |  |
|                                | 10   |  | 180 Degrees              |                     | Yes       |                      | No                               |  |                                       |  |
|                                | 11   |  | 180 Degrees              |                     | Yes       |                      | No                               |  |                                       |  |
|                                | 12   |  | 180 Degrees              |                     | Yés       | T                    | No                               | MITTER.  |                                       |  |
|                                | Specimen No.   | Accep  | table Yes/No             |                     |           |                      | Co                               | mments   |                                       |  |
|                                | 13   | Yes  | No                       |                     |           |                      |                                  |  |                                       |  |
| NICK BREAK                     | 14   | Yes  | No 🗍                     |                     |           |                      |                                  |  |                                       |  |
| TEST                           | 15   | Yes  | No                       |                     |           |                      |                                  |  |                                       |  |
|                                | 16   | Yes  | No 🗍                     |                     |           |                      |                                  |  |                                       |  |
|                                |  |  |                          |                     |           |                      |                                  |  |                                       |  |
| FILLET WELD                    | Satisfactory:  | Yes J  | No                       |                     | Penetrati | ion into Pa          | rent Meta                        | ıl:  | Yes J                                 | No 🗍   |
| FILLET WELD<br>TEST            | - Par C-13   |  | No ACCEPTABLE            |                     | -         | ion into Pa          | 100                              | ıl:  | Yes J<br>in.: NONE                    | No   |
| TEST                           | - Par C-13   | re Test FOUN   | C 1996   1   1   129   1 | License Number 8    | Length of |                      | 100                              | l:   |                                       |  |
|                                | Fillet Weld - Fractu   | re Test FOUN   | C 1996   1   1   129   1 | License Number 8    | Length of |                      | 100                              | ıl:  | in.: NONE                             |  |
| TEST                           | Fillet Weld - Fractu Welder Name: Ru Contractor: CHC   | sty Stutts Fabricating   | C 1996   1   1   129   1 |                     | Length of | f Percent o          | f Defect                         |  | in.: NONE Stencil Mark                | %:   |
| TEST                           | Fillet Weld - Fractu Welder Name: Ru Contractor: CHC   | sty Stutts Fabricating   | ACCEPTABLE               |                     | Length of | f Percent o          | f Defect                         |  | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the   | re Test FOUN<br>sty Stutts<br>Fabricating<br>statements in this                                | ACCEPTABLE               |                     | Length of | f Percent o          | f Defect                         |  | in.: NONE Stencil Mark                | %:   |
| TEST                           | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination  | re Test FOUN sty Stutts Fabricating statements in this ucted By: Results:                      | ACCEPTABLE               | that the test coupo | Length of | f Percent o          | f Defect                         |  | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination  | re Test FOUNI sty Stutts Fabricating statements in this ucted By: Results: Results (For Altern | P ACCEPTABLE             | that the test coupo | Length of | f Percent o          | f Defect                         |  | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test 6  | re Test FOUNI sty Stutts Fabricating statements in this ucted By: Results: Results (For Altern | P ACCEPTABLE             | that the test coupo | Length of | f Percent o          | f Defect                         | tested in according to the second sec | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Cond                                       | re Test FOUNI sty Stutts Fabricating statements in this ucted By: Results: Results (For Altern | P ACCEPTABLE             | that the test coupo | Length of | f Percent o          | ded, and                         | tested in according to the second sec | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | re Test FOUNI sty Stutts Fabricating statements in this ucted By: Results: Results (For Altern | record are correct and   | that the test coupo | Length of | f Percent o          | ded, and                         | tested in according to the second sec | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co                       | re Test FOUNI sty Stutts Fabricating statements in this ucted By: Results: Results (For Altern | record are correct and   | that the test coupo | Length of | f Percent o          | ded, and                         | tested in according to the second sec | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO CERTIFICATION | Fillet Weld - Fractu Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test I Mechanical Test Co Approved By: APPROVED | re Test FOUN<br>sty Stutts<br>Fabricating<br>statements in this<br>ucted By:<br>Results:       | record are correct and   | that the test coupo | Length of | f Percent o          | ded, and Laborato Organiza Date: | tested in according to the second sec | in.: NONE Stencil Mark                | %:   |



# **API 1104 COUPON TEST REPORT**

Page: 1 of

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:

**AWS Classification:** 

Manufacture:

**Electrode Diameter:** 

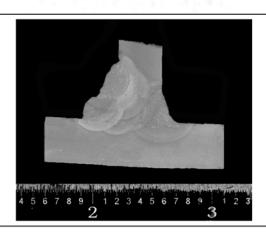
Current/Polarity:

**Current Range:** 

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Cap       |  |
|-----------|-----------|-----------|-----------|--|
| E6010     | E7010-P1  | E7010-P1  | E7010-P1  |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 1/8"      | 5/32"     | 5/32"     | 5/32"     |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 83 – 106  | 113 – 120 | 110 - 118 | 100 - 115 |  |
| 25 – 33   | 25 – 28   | 25 – 29   | 26-30     |  |
| 3.2 – 5.5 | 3.4 – 5.5 | 3.7 - 6.8 | 3.2 - 7.0 |  |



| A 9 A 2  |                     | TENSILE STRENGTH T  | EST  |                 |
|--|---------------------|---|--|-----------------|
| Coupon Number:   |                     |   |  |                 |
| Coupon Width:  |                     |   |  |                 |
| Coupon Thickness:  |                     |   |  |                 |
| Coupon Area: Maximum Load:   |                     |   |  |                 |
| ensile Strength:   |                     |   |  |                 |
| racture Location:  |                     |   |  |                 |
| racture Education.   |                     |   |  |                 |
| <u></u>  |                     | BEND TEST   |  |                 |
| Coupon Number:   |                     |   |  |                 |
| ype:   |                     |   |  |                 |
| Results:   |                     |   |  |                 |
|  |                     |   |  |                 |
|  |                     | NICK-RREAK TEST   |  |                 |
| Coupon Number:   | W24 NB1             | NICK-BREAK TEST<br>W24 NB2                                    |  | W24 NB4         |
| esults:  | W24 NB1<br>Pass (1) |   | W24 NB3<br>Pass (1)                                | W24 NB4<br>Pass |
| Coupon Number: Depth: Vidth:   |                     | W24 NB2<br>Pass   | W24 NB3<br>Pass (1)                                |                 |
| Coupon Number: Depth: Width: Notch Location:   |                     | W24 NB2<br>Pass   | W24 NB3<br>Pass (1)                                |                 |
| Coupon Number: Depth: Vidth: Votch Location: Test Temperature:   |                     | W24 NB2<br>Pass   | W24 NB3<br>Pass (1)                                |                 |
| Coupon Number: Depth: Width: Notch Location: Test Temperature: mpact Energy:   |                     | W24 NB2<br>Pass   | W24 NB3<br>Pass (1)                                |                 |
| Coupon Number: Depth: Vidth: Votch Location: Test Temperature: Impact Energy: 6 Shear:                                   |                     | W24 NB2<br>Pass   | W24 NB3<br>Pass (1)                                |                 |
| Coupon Number: Depth: Width: Notch Location: Test Temperature: mpact Energy: 6 Shear: Lateral Expansion:                 | Pass (1)            | W24 NB2 Pass  CHARPY TOUGHNESS                                | W24 NB3 Pass (1)  TEST                             | Pass            |
| Coupon Number: Depth: Vidth: Vidth: Votch Location: Test Temperature: Impact Energy: Shear: A Shear: A steral Expansion: | Pass (1)            | W24 NB2 Pass  CHARPY TOUGHNESS  present but were within the a | W24 NB3 Pass (1)  TEST                             | Pass            |
|  | Pass (1)            | W24 NB2 Pass  CHARPY TOUGHNESS                                | W24 NB3 Pass (1)  TEST  acceptable limits of API 1 | Pass            |



Page: 1 of 2

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:

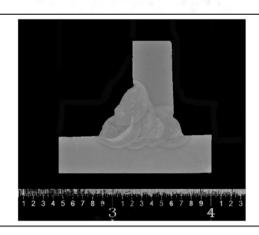
AWS Classification: Manufacture: Electrode Diameter:

Current/Polarity: Current Range: Voltage Range:

Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Fill      | Сар       |  |
|-----------|-----------|-----------|-----------|--|
| E6010     | E8010-P1  | E8010-P1  | E8010-P1  |  |
| Lincoln   | Lincoln   | Lincoln   | Lincoln   |  |
| 1/8"      | 5/32"     | 5/32"     | 5/32"     |  |
| DCEP      | DCEP      | DCEP      | DCEP      |  |
| 75 – 98   | 115 – 123 | 117 - 133 | 116 - 122 |  |
| 23 – 30   | 24 – 27   | 23 – 27   | 25 – 28   |  |
| 3.2 - 5.5 | 3.4 - 5.6 | 3.8 - 9.3 | 3.3 - 6.2 |  |



| Test Number: 10-   | -3                |                            | Page:                     | 2 of 2 |  |
|--|-------------------|----------------------------|---------------------------|--------|--|
| 5 9 2 2 <u>2</u>   |                   | TENSILE STRENGTH T         | EST                       | Z=-    |  |
| oupon Number:  |                   |                            |                           |        |  |
| oupon Width:   |                   |                            |                           |        |  |
| oupon Thickness:   |                   |                            |                           |        |  |
| oupon Area:  Maximum Load:   |                   |                            |                           |        |  |
| ensile Strength:   |                   |                            |                           |        |  |
| racture Location:  |                   | -                          |                           |        |  |
| acture Education.  |                   |                            |                           |        |  |
|  |                   | BEND TEST                  |                           |        |  |
| oupon Number:  |                   |                            |                           |        |  |
| ype:   |                   |                            |                           |        |  |
| esults:  |                   |                            |                           |        |  |
|  |                   | NICK-BREAK TEST            |                           |        |  |
| oupon Number:  | W26 NB1           | W26 NB2                    | W26 NB3 W26 NB4           |        |  |
| esults:  | Pass (1)          | Pass                       | Pass (1)                  | Pass   |  |
| oupon Number: epth: Vidth:   |                   |                            |                           |        |  |
| lotch Location:  |                   |                            |                           |        |  |
| est Temperature:<br>mpact Energy:  |                   |                            |                           |        |  |
| Shear:   |                   |                            |                           |        |  |
| ateral Expansion:  |                   |                            |                           |        |  |
| omments: (1) Indi  | ications were pre | sent but were within the a | cceptable limits of API 1 | 104    |  |
| - VE.ST  |                   | OTHER TESTS                |                           |        |  |
| Control of the Contro |                   |                            |                           |        |  |
|  | atements in this  | record are correct and tha |                           |        |  |



| TYPE OF       | PQR No. F6-X60-280  |                                     |                      |                   | Orig. Issue Date                  |                         | Revision Date                     |                      |  |
|---------------|---|-------------------------------------|----------------------|-------------------|-----------------------------------|-------------------------|-----------------------------------|----------------------|--|
|               | WPS No. FW-B-II   |                                     |                      |                   | Orig. Issue Date                  |                         | Revision Date                     |                      |  |
| RECORD        | API 1104  Other  Other  |                                     |                      |                   |                                   |                         |                                   |                      |  |
|               | Process Name: Shielded Metal Arc Welding (SMAW)  Type of Process: Manual        |                                     |                      |                   |                                   |                         |                                   |                      |  |
| PROCESS       | For: Butt Welding Fillet Welding  |                                     |                      |                   |                                   |                         |                                   |                      |  |
| BASE METAL    | Material Specification  | n: 6.625" O.                        | D X-60 - 0.2         | 280" WT. A        | PI 5L                             |                         | ,                                 |                      |  |
| DIAMETER-     | API 1104 6.2.2 Guidelines Under 2 3/8" OD                                       |                                     |                      |                   | 2 3/8" to 12 3/4" OD > 12 3/4" OD |                         |                                   | <del>/4" OD</del>    |  |
| MATERIAL      | API 1104 5.4.2  | 104 5.4.2.2 Guidelines              |                      |                   | > 42,00                           | 0 to < 65,000 PSI Yield | ≥ 65,000                          | ≥ 65,000 PSI Yield   |  |
| THICKNESS     | API 1104 6.2.   | 2 Guidelines                        | Under 3              | /16" thick        | √ 3/16" thru 3/4" thick           |                         | Over 3/                           | Over 3/4" thick      |  |
| FILLER METALS | AWS Electrode Nos: E6010 AWS Electrode Size:                                    |                                     |                      | : 1/8"            | AWS Specification: A5.1           |                         | Filler Metal Group: 1             |                      |  |
|               | AWS Electrode Nos: E7010 AWS Electrode Size:                                    |                                     |                      | : 1/8"            | AWS Specification:                | : A5.5                  | Filler Metal Group: 1             |                      |  |
| GAS           | SHIELDING GAS: N/A  |                                     |                      | FLOW RATE: N/A    |                                   | FLUX: N/A               |                                   |                      |  |
| PREHEAT       | Minimum Preheat Te  | emperature (F): 50                  | 0                    | Interpass Tempera | ature (F):                        | Other:                  |                                   | 1000                 |  |
|               | WELD AXIS   |                                     |                      |                   | TE                                | CHNIQUE                 | DIRECTION                         |                      |  |
|               | Flat (1G, 1F, 1FR)  |                                     | Plate                |                   | Backhand                          |                         | Vertical - Up                     |                      |  |
|               | Horizontal (2G, 2F, 2F  | FR)                                 | Pipe                 | V                 | Forehand                          | V                       | Vertical - Down                   | 7                    |  |
| POSITION      | Vertical (3G, 3F)   |                                     | Rotated              |                   |                                   |                         |                                   |                      |  |
|               | Overhead (4G, 4F) Fixed   |                                     |                      |                   |                                   |                         |                                   |                      |  |
|               | Multiple (5G, 5F)   | Multiple (5G, 5F) Inclined (6G, 6F) |                      |                   |                                   |                         |                                   |                      |  |
|               | Combination   |                                     |                      |                   |                                   |                         |                                   |                      |  |
|               |   | DISPOSITION STYL                    |                      | M                 | ETHOD                             |                         | ARC TYPE                          |                      |  |
| TECHNIQUE     | Stringer Beads  | ✓                                   |                      | Multiple Pass     | J                                 | Single Arc J            |                                   | Other:               |  |
|               | Weave Beads   |                                     |                      | Single Pass       |                                   | Multiple Arc            |                                   | other.               |  |
| CLEANING      | Base Material:  | Power 🗸                             | Hand                 |                   | Weld: Power                       | ✓ Han                   | d                                 |                      |  |
|               | 1 =   | вит                                 | WELD                 |                   | 4.0                               | FILLE                   | WELD 2                            |                      |  |
| JOINT DESIGN  | 37½' ± ½' FOR FITTINGS<br>30° + 5° 0 FOR PIPE<br>1/16" ± 1/32"<br>1/16" ± 1/32" |                                     |                      |                   |                                   |                         |                                   |                      |  |
|               | 17" TO 45°  |                                     |                      |                   |                                   |                         |                                   |                      |  |
|               | Groave Designs of Test Coupons  |                                     |                      |                   |                                   |                         |                                   |                      |  |
| 2012220121    | Current Type:   | AC                                  | DC 🗸                 | Polarity:         | Straight/Negative                 | 20020                   | Reverse/Positive                  | V                    |  |
| CHARACTERIS-  | BEAD NO. Passes   | Passes                              | ELECTRODE NO. & TYPE | Size              | VOLTS                             | RANGE AMPS              | MAXIMUM TIME LAPSE ALLOWED (Min.) | SPEED RANGE<br>(IPM) |  |
| TICS &        | Root  | 1                                   | E6010                | 1/8"              | 19-24                             | 75-130                  | 5                                 | 3-20                 |  |
| SEQUENCE OF   | Hot Pass  | 1                                   | E7010                | 1/8"              | 18-22                             | 65-140                  | 5                                 | 3-20                 |  |
| BEADS         | Fill  | 1                                   | E7010                | 1/8"              | 18-22                             | 65-140                  | 5                                 | 3-20                 |  |
|               | Сар   | 1                                   | E7010                | 1/8"              | 18-24                             | 65-140                  | 5                                 | 3-20                 |  |

(Over)

|                                | Specimen No.   | Width  | Thickness  | Area (in.^2)        |                      | te Total<br>(Lbs.) | Ultimate Unit Stress<br>(psi)      | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|--------------------------------|--|--|--|---------------------|----------------------|--------------------|------------------------------------|---------------------------------------|--|
| TENCH E TECT                   | 1  |  | 1  |                     |                      |                    |                                    |                                       |  |
| TENSILE TEST                   | 2  |  |  |                     |                      |                    |                                    |                                       |  |
|                                | 3  |  | 1  |                     |                      |                    |                                    |                                       |  |
|                                | 4  |  |  |                     |                      |                    |                                    |                                       |  |
|                                | Specimen No.   | Root Bend  | Face Bend  | Side Bend           |                      | Bend               | Acceptable                         | Com                                   | ments  |
|                                | 5  | 180 Degrees  |  |                     | Yes                  |                    | No                                 |                                       |  |
|                                | 6  | 180 Degrees  |  |                     | Yes                  |                    | No                                 |                                       |  |
| CUIDED DEND                    | 7  | 180 Degrees  |  |                     | Yes                  | 14                 | No                                 |                                       |  |
| GUIDED BEND                    | 8  | 180 Degrees  |  |                     | Yes                  |                    | No                                 |                                       |  |
| TEST                           | 9  |  | 180 Degrees  |                     | Yés                  |                    | No                                 |                                       |  |
|                                | 10   |  | 180 Degrees  |                     | Yes                  |                    | No                                 |                                       |  |
|                                | 11   |  | 180 Degrees  |                     | Yes                  |                    | No                                 |                                       |  |
|                                | 12   |  | 180 Degrees  |                     | Yés                  |                    | No                                 |                                       |  |
|                                | Specimen No.   | Accept   | able Yes/No  |                     |                      |                    | Comments                           |                                       |  |
| AUGU DDEAU                     | 13   | Yes  | No 🗍   |                     |                      |                    |                                    |                                       |  |
| NICK BREAK                     | 14   | Yes  | No 🗍   |                     |                      |                    |                                    |                                       |  |
| TEST                           | 15   | Yes  | No   |                     |                      |                    |                                    |                                       |  |
|                                | 16   | Yes  | No 🗍   |                     |                      |                    |                                    |                                       |  |
|                                | 10   | 163  | INU  |                     |                      |                    |                                    |                                       |  |
| FILLET WELD                    | Satisfactory:  | Yes J  | No   |                     | Penetrati            | on into Pa         | rent Metal:                        | Yes 🗸                                 | No 🗍   |
| FILLET WELD TEST               | Satisfactory:  | Yes J  |  |                     |                      | on into Pa         |                                    | Yes J                                 | No   |
| TEST                           | Satisfactory:  | Yes J  | No   | License Number 8    | Length of            | 1.00               |                                    |                                       |  |
|                                | Satisfactory:<br>Fillet Weld - Fractu  | Yes  Jure Test FOUND Justy Stutts  | No   | License Number 8    | Length of            | 1.00               |                                    | in.: NONE                             |  |
| TEST                           | Satisfactory: Fillet Weld - Fractu Welder Name: Ru Contractor: CHC   | Yes  Jure Test FOUND Justy Stutts Fabricating  | No D   |                     | Length of            | Percent o          |                                    | in.: NONE Stencil Mark                | %:   |
| TEST                           | Satisfactory: Fillet Weld - Fractu Welder Name: Ru Contractor: CHC   | Yes  In Test FOUND Sty Stutts Fabricating Statements in this   | No D   |                     | Length of            | Percent o          | f Defect                           | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Satisfactory: Fillet Weld - Fractu Welder Name: Ru Contractor: CHC We certify that the   | Yes   Tre Test FOUND  Sty Stutts  Fabricating  Statements in this  ucted By:   | No D   |                     | Length of            | Percent o          | f Defect                           | in.: NONE Stencil Mark                | %:   |
| TEST                           | Satisfactory: Fillet Weld - Fractu Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond   | Yes  In Test FOUND Isty Stutts Fabricating In Statements in this In Test FOUND In Test | No D   | that the test coupo | Length of<br>& State | Percent o          | f Defect                           | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Satisfactory: Fillet Weld - Fractu Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond   | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  | that the test coupo | Length of<br>& State | Percent o          | f Defect                           | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Satisfactory: Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test  | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  | that the test coupo | Length of<br>& State | Percent o          | f Defect                           | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Satisfactory: Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Mechanical Test Co                       | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  | that the test coupo | Length of<br>& State | Percent o          | f Defect  Ided, and tested in acco | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO               | Satisfactory: Fillet Weld - Fracture Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Mechanical Test Co                     | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  record are correct and tive Qualification of Gr | that the test coupo | Length of<br>& State | Percent o          | ded, and tested in acco            | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO CERTIFICATION | Satisfactory: Fillet Weld - Fracture Welder Name: Ru Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Mechanical Test Co                     | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  record are correct and tive Qualification of Gr | that the test coupo | Length of<br>& State | Percent o          | ded, and tested in acco            | in.: NONE Stencil Mark                | %:   |
| TEST WELDER INFO CERTIFICATION | Satisfactory: Fillet Weld - Fractu Welder Name: RU Contractor: CHC We certify that the 1104. Welding Test Cond Visual Examination Radiographic Test Mechanical Test Co Approved By: APPROVED | Yes   Tre Test FOUND  Sty Stutts  Fabricating  statements in this  ucted By: Results:  Results (For Alterna  | No ACCEPTABLE  record are correct and tive Qualification of Gr | that the test coupo | Length of<br>& State | Percent o          | Ided, and tested in acco           | in.: NONE Stencil Mark                | %:   |

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Page: 1 2

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

Welding Direction: Downhill Position: 5G, Fixed

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:

AWS Classification: Manufacture: **Electrode Diameter:** 

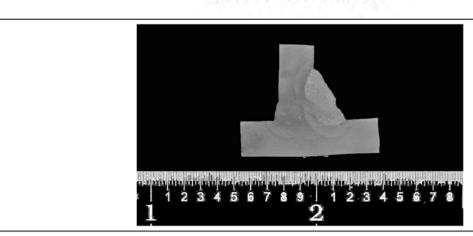
Current/Polarity: **Current Range:** Voltage Range:

Comments:

Travel Speed Range, ipm:

| Root      | Hot Pass  | Cap       |  |      |
|-----------|-----------|-----------|--|------|
| E6010     | E8010-P1  | E8010-P1  |  |      |
| Lincoln   | Lincoln   | Lincoln   |  |      |
| 1/8"      | 5/32"     | 5/32"     |  |      |
| DCEP      | DCEP      | DCEP      |  |      |
| 82 - 89   | 113 – 122 | 118 - 121 |  |      |
| 25 – 29   | 24 – 28   | 24 – 26   |  |      |
| 3.7 – 4.8 | 4.7 - 6.9 | 4.9 - 6.7 |  | - () |

#### FIGURE 1 - BEAD SEQUENCE



|  |             |           | 71.11.12.12.12.12        | Page                      | : 2 of 2 |
|--|-------------|-----------|--------------------------|---------------------------|----------|
| 15 St. 15 St.  |             | lo lo     | TENSILE STRENGTH TI      | EST                       | V        |
| Coupon Number:   |             |           |                          |                           |          |
| Coupon Width:  |             |           |                          |                           |          |
| oupon Thickness:   |             |           | 1                        |                           |          |
| oupon Area:  |             |           | +                        |                           |          |
| Maximum Load:<br>ensile Strength:  |             |           | +                        |                           |          |
| racture Location:  |             |           | +                        |                           |          |
| racture Location.  |             |           |                          |                           |          |
|  |             |           | BEND TEST                |                           |          |
| Coupon Number:   |             |           |                          |                           |          |
| ype:   |             |           |                          |                           |          |
| lesults:   |             |           |                          |                           |          |
|  |             |           | NICK-BREAK TEST          |                           |          |
| Coupon Number:   | W28 N       | NB1       | W28 NB2                  | W28 NB3                   | W28 NB4  |
| lesults:   | Pas         | _         | Pass (1)                 | Pass                      | Pass     |
|  |             |           | HARPY TOUGHNESS 1        | rest                      |          |
| epth:  |             | -         | HARPY TOUGHNESS 1        | TEST                      |          |
| Pepth: Vidth: lotch Location:  |             | (         | HARPY TOUGHNESS 1        | rest                      |          |
| Pepth: Vidth: Jotch Location: Fest Temperature:  |             |           | HARPY TOUGHNESS 1        | TEST                      |          |
| Pepth: Vidth: Iotch Location: est Temperature: mpact Energy:   |             |           | HARPY TOUGHNESS 1        | TEST                      |          |
| Pepth: Vidth: Votch Location: Test Temperature: mpact Energy: 6 Shear:   |             |           | HARPY TOUGHNESS 1        | TEST                      |          |
| Coupon Number: Depth: Vidth: Notch Location: Test Temperature: mpact Energy: 6 Shear: Lateral Expansion:   |             |           | HARPY TOUGHNESS 1        | TEST                      |          |
| Depth:  Width:  Wotch Location:  Test Temperature:  Impact Energy:  Shear:  ateral Expansion:  | lications w |           | tharpy TOUGHNESS 1       |                           | 1104     |
| Pepth: Vidth: Vidth: Viotch Location: Vest Temperature: Vest Tempe | lications w |           | nt but were within the a |                           | 1104     |
| Depth:  Width:  Wotch Location:  Test Temperature:  Impact Energy:  Shear:  ateral Expansion:  Comments: (1) Inc.  |             | ere prese |                          | cceptable limits of API 1 | 1104     |



# **Gas Operations**

# PROCEDURE QUALIFICATION RECORD (PQR)

|                     | PQR No. F8-X65   | -322                             |                      |                                       | Orig. Issue Date  |  | Revision Date                  |                      |
|---------------------|--|----------------------------------|----------------------|---------------------------------------|-------------------|--|--------------------------------|----------------------|
| TYPE OF RECORD      | WPS No. FW-C-I   | I                                |                      |                                       | Orig. Issue Date  |  | Revision Date                  |                      |
| CO # 00 10 15 5 100 | API 1104 🗸   | Other                            |                      |                                       |                   |  |                                |                      |
|                     | Process Name: Shie   | elded Metal                      | Arc Welding (SI      | MAW)                                  | Type of Process:  | Manual                                 |                                |                      |
| PROCESS             | For: E   | Butt Welding                     | Fillet \             | Welding J                             |                   |  |                                |                      |
| PIPE                | Material Specification                                     | 8.625" O.I                       | D X-65- 0.32         | 2" WT. API                            | 5L                |  |                                |                      |
| DIAMETER-           | API 1104 6.2.  | 2 Guidelines                     | Under 2              | 1-3/8" OD                             | 2-3/8             | ' to 12-3/4" OD                        | > 12-3                         | /4" OD               |
| MATERIAL            | API 1104 5.4.2   | .2 Guidelines                    | ≤ 42,00              | 0 PSI Yield                           | >42,0             | 00 to < 65,000 PSI Yield               | 65,000                         | SI Yield             |
| THICKNESS           | API 1104 6.2.2   | 2 Guidelines                     | Under 3              | /16" thick                            | 3/16"             | thru 3/4" thick                        | Over 3/                        | 4" thick             |
|                     | AWS Electrode Nos:   | E6010                            | AWS Electrode Size:  | 3/32"                                 | AWS Specification | : A5.1                                 | Filler Metal Group:            | 1                    |
| FILLER METALS       | AWS Electrode Nos: E                                       | 8010                             | AWS Electrode Size:  | 1/8"                                  | AWS Specification | a: A5.5                                | Filler Metal Group:            | 2                    |
| GAS                 | SHIELDING GAS: N/A   |                                  |                      | FLOW RATE: N/A                        |                   | FLUX: N/A                              |                                |                      |
| PREHEAT             | Minimum Preheat Te   | mperature (F): 50                | 0                    | Interpass Tempera                     | ature (F):        | Other:                                 |                                |                      |
|                     |  |                                  | LD AXIS              |                                       | 1                 | ECHNIQUE                               | DIREC                          | TION                 |
|                     | Flat (1G, 1F, 1FR)   |                                  | Plate                |                                       | Backhand          |  | Vertical - Up                  |                      |
|                     | Horizontal (2G, 2F, 2F                                     | R)                               | Pipe                 | \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ | Forehand          | 7                                      | Vertical - Down                |                      |
| POSITION            | Vertical (3G, 3F)  |                                  | Rotated              |                                       |                   |  | 1                              |                      |
|                     | Overhead (4G, 4F)  |                                  | Fixed                | <b>√</b>                              | 7                 |  |                                |                      |
|                     | Multiple (5G, 5F)  | ple (5G, SF) / Inclined (6G, 6F) |                      |                                       | 7                 |  |                                |                      |
|                     | Combination  |                                  |                      |                                       | _                 |  |                                |                      |
|                     | - 0  | DISPOSITION STYL                 | E                    | м                                     | ETHOD             |  | ARC TYPE                       |                      |
| TECHNIQUE           | Stringer Beads   | J.                               | Multiple Pass        |                                       | ✓ Single Arc ✓    |  |                                |                      |
|                     | Weave Beads  |                                  |                      | Single Pass                           |                   | Multiple Arc                           |                                | Other:               |
| CLEANING            | Base Material: P   | Power 🗸                          | Hand                 |                                       | Weld: Power       | √ Han                                  | d                              |                      |
|                     |  | вит                              | T WELD               |                                       |                   | FILLE                                  | T WELD                         |                      |
| JOINT DESIGN        | 371/2°± 21/2°F<br>30°+ 5° 0<br>1/32° TO 1/16<br>1/8°± 1/16 | FOR PIPE                         | V16"                 |                                       | 17                | 1/16" ± 1/32"  1/16" ± 1/32"  1 TO 45° | <b>一</b> 例                     |                      |
|                     | Comment Town   | A6 🗆                             |                      |                                       | Test Col          |  | Payarra/Parithya               | rai -                |
| ELECTRICAL          | Current Type: A  | AC                               | DC J                 | Polarity:                             | Straight/Negative | RANGE                                  | Reverse/Positive  MAXIMUM TIME | ✓                    |
| CHARACTERIS-        | BEAD NO.   | Passes                           | ELECTRODE NO. & TYPE | Size                                  | VOLTS             | AMPS                                   | LAPSE ALLOWED (Min.)           | SPEED RANGE<br>(IPM) |
| TICS &              | Root   | 1                                | E6010                | 1/8"                                  | 20-24             | 75-130                                 | 5                              | 3-20                 |
| SEQUENCE OF         | Hot Pass   | 1                                | E8010                | 1/8"                                  | 21-24             | 75-135                                 | 5                              | 3-20                 |
| BEADS               |  | 1                                |                      | 3/2                                   | ****              | 13,000                                 | 1                              | - ***                |
|                     | Fill   | 2                                | E8010                | 1/8"                                  | 20-24             | 75-135                                 | 5                              | 3-20                 |

|  | Specimen No.  | Width  | Thickness   | Area (in.^2)         | Ultimate Tot<br>Load(Lbs.) | and the second                          | ate Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or Weld |
|--|---|--|-------------|----------------------|----------------------------|---|--------------------------|---------------------------------------|---|
|  | i   |  |             |                      |                            |   |                          |                                       | 7 = 1                                     |
| TENSILE TEST   | 2   |  |             |                      |                            |   |                          |                                       |   |
|  | 3   |  |             |                      |                            |   |                          |                                       |   |
|  | 4   |  |             |                      |                            |   |                          |                                       |   |
|  | Specimen No.  | Root Bend  | Face Bend   | Side Bend            | В                          | end Acceptab                            | ole                      | Com                                   | ments                                     |
|  | 5   | 180 Degrees  |             |                      | Yes                        | No                                      |                          |                                       |   |
|  | 6   | 180 Degrees  |             |                      | Yes                        | No                                      |                          |                                       |   |
| CHIEFE PENE  | 7   | 180 Degrees  |             |                      | Yes                        | No                                      |                          |                                       |   |
| GUIDED BEND  | 8   | 180 Degrees  |             |                      | Yes                        | No.                                     |                          |                                       |   |
| TEST   | 9   |  | 180 Degrees |                      | Yes                        | No                                      | i in i                   |                                       |   |
|  | 10  |  | 180 Degrees |                      | Yes                        | No                                      |                          |                                       |   |
|  | 11  |  | 180 Degrees |                      | Yes                        | No                                      |                          |                                       |   |
|  | 12  |  | 180 Degrees |                      | Yes                        | No                                      |                          |                                       | - 1                                       |
|  | Specimen No.  | Accepta  | ble Yes/No  |                      |                            | C                                       | omments                  |                                       |   |
|  | 13  | Yes  | No          |                      |                            |   |                          |                                       |   |
| NICK BREAK TEST  | 14  | Yes  | No          |                      |                            |   |                          |                                       |   |
|  | 15  | Yes  | No          |                      |                            |   |                          |                                       |   |
|  | 16  | Yes  | No          |                      |                            |   |                          |                                       |   |
| FILLET WELD  | Satisfactory:   | Yes  | No.         |                      | A VANCOUS AND ADDRESS.     |   |                          |                                       |   |
| LILLET AAFED   | Satisfactory.   | Yes 🗸  | No          |                      | Penetration into           | Parent Meta                             | al:                      | Yes 🗸                                 | No  |
| TEST   |   | re Test FOUND A  |             |                      | Length of Perce            |   | al:                      | Yes   in.: NONE                       | No  |
| TEST   |   | re Test FOUND A  |             | License Number &     | Length of Perce            |   | al:                      |                                       |   |
| Contraction of the contraction o | Fillet Weld - Fractur   | re Test FOUND A  |             | License Number &     | Length of Perce            |   | al:                      | in.: NONE                             |   |
| TEST   | Fillet Weld - Fractur Welder Name: Ru: Contractor: CHC  | sty Stutts Fabricating   |             |                      | Length of Perce            | nt of Defect                            |                          | in.: NONE Stencil Mark                | %:  |
| TEST   | Fillet Weld - Fractur Welder Name: Ru: Contractor: CHC  | sty Stutts Fabricating   | ACCEPTABLE  |                      | Length of Perce            | nt of Defect                            |                          | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO   | Fillet Weld - Fractur Welder Name: Rus Contractor: CHC We certify that the  | re Test FOUND A sty Stutts Fabricating statements in this re-                      | ACCEPTABLE  |                      | Length of Perce            | nt of Defect                            |                          | in.: NONE Stencil Mark                | %:  |
| TEST   | Fillet Weld - Fractur  Welder Name: Rus  Contractor: CHC  We certify that the  Welding Test Condu   | sty Stutts  Fabricating  statements in this reducted By:  Results:                 | ACCEPTABLE  | nat the test coupons | Length of Perce            | nt of Defect                            |                          | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO   | Fillet Weld - Fractur  Welder Name: Rus  Contractor: CHC  We certify that the  Welding Test Condu   | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | nt of Defect                            |                          | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO   | Fillet Weld - Fractur Welder Name: RU: Contractor: CHC We certify that the Welding Test Condu Visual Examination Radiographic Test R  | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | nt of Defect                            | ested in accordar        | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO   | Fillet Weld - Fractur Welder Name: Rus Contractor: CHC We certify that the Welding Test Condu Visual Examination Radiographic Test R Mechanical Test Co                       | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | velded, and to                          | ested in accordar        | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO   | Fillet Weld - Fractur Welder Name: Rus Contractor: CHC We certify that the Welding Test Condu Visual Examination Radiographic Test R Mechanical Test Co Approved By:          | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | velded, and to                          | ested in accordar        | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO CERTIFICATION   | Fillet Weld - Fractur Welder Name: Rus Contractor: CHC We certify that the Welding Test Condu Visual Examination Radiographic Test R Mechanical Test Co Approved By:          | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | velded, and to                          | ested in accordar        | in.: NONE Stencil Mark                | %:  |
| TEST WELDER INFO CERTIFICATION   | Fillet Weld - Fractur Welder Name: RU: Contractor: CHC We certify that the Welding Test Condu Visual Examination Radiographic Test R Mechanical Test Co Approved By: APPROVED | re Test FOUND A sty Stutts  Fabricating  statements in this re- ucted By: Results: | ACCEPTABLE  | nat the test coupons | Length of Perce            | velded, and to  Laborat  Organiz  Date: | ested in accordar        | in.: NONE Stencil Mark                | %:  |

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Page: 1

of 2

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:

AWS Classification:
Manufacture:
Electrode Diameter:
Current/Polarity:
Current Range:

Voltage Range:

Travel Speed Range, ipm: Comments:

| Root       | Hot Pass  | Fill       | Cap       |  |
|------------|-----------|------------|-----------|--|
| E6010      | E8010-P1  | E8010-P1   | E8010-P1  |  |
| Lincoln    | Lincoln   | Lincoln    | Lincoln   |  |
| 1/8"       | 5/32"     | 5/32"      | 5/32"     |  |
| DCEP       | DCEP      | DCEP       | DCEP      |  |
| 88 – 106   | 106 - 109 | 117 - 145  | 114 - 124 |  |
| 23 – 27    | 28 – 29   | 25 – 28    | 24 – 27   |  |
| 5.1 - 14.9 | 8.2 - 9.6 | 6.6 - 10.6 | 5.3 - 6.9 |  |

#### FIGURE 1 - BEAD SEQUENCE



|                         |   | TENSILE STRENG       | TH TEST             | -  |                    |
|-------------------------|---|----------------------|---------------------|--|--------------------|
| Coupon Number:          |   |                      |                     |  |                    |
| Coupon Width:           |   |                      |                     |  |                    |
| Coupon Thickness:       |   |                      |                     |  |                    |
| Coupon Area:            |   |                      |                     |  |                    |
| Maximum Load:           |   |                      |                     |  |                    |
| Tensile Strength:       |   |                      |                     |  |                    |
| racture Location:       |   |                      |                     |  |                    |
|                         |   | BEND TES             | т                   |  |                    |
| Coupon Number:          |   | 52.12.123            | ·                   |  |                    |
| Гуре:                   |   |                      |                     |  |                    |
| Results:                |   |                      |                     |  |                    |
|                         |   | Salar Berlin         | 202                 |  |                    |
| Causan Number           | W29 NB1                                 | NICK-BREAK           | W29 N               | 102  | W29 NB4            |
| Coupon Number:          | Pass                                    | Pass                 | Pass                |  | Pass               |
| vesuits.                | 1 033                                   | 1 033                | ras                 | · .  | 1 033              |
|                         |   | <b>CHARPY TOUGHN</b> | ESS TEST            |  |                    |
| Coupon Number:          |   |                      |                     |  | - 1                |
| Depth:                  |   |                      | - 11                |  |                    |
| Width:                  |   | 1,1                  |                     |  |                    |
| Notch Location:         |   |                      |                     |  |                    |
| Test Temperature:       |   | 117                  |                     |  |                    |
| mpact Energy:           |   |                      |                     |  |                    |
| % Shear:                |   |                      |                     |  |                    |
| ateral Expansion:       |   |                      |                     |  |                    |
| Comments:               |   |                      |                     |  |                    |
|                         |   |                      |                     |  |                    |
|                         |   | OTHER TES            |                     |  |                    |
| Test Type:              |   |                      |                     |  |                    |
| Results:                |   |                      |                     |  |                    |
| We certify that the sta | atements in this r                      | ecord are correct an | d that the test wel | ds were nre  | nared, welded, and |
|                         |   | vith the requirement |                     | The second secon |                    |
|                         | 200722000000000000000000000000000000000 | 1 107 10 1 2 2 1 1   |                     | 1177 (41 7) 42   | 7-32               |
|                         |   |                      |                     |  |                    |



Page:

2

| 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:

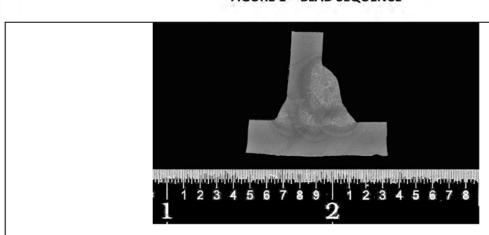
**AWS Classification:** Manufacture: **Electrode Diameter:** Current/Polarity: **Current Range:** 

Voltage Range: Travel Speed Range, ipm:

Comments:

| Root      | Hot Pass  | Cap       |  |     |
|-----------|-----------|-----------|--|-----|
| E7016     | E7018     | E7018     |  |     |
| Lincoln   | Lincoln   | Lincoln   |  |     |
| 3/32"     | 1/8"      | 1/8"      |  |     |
| DCEP      | DCEP      | DCEP      |  |     |
| 75 – 81   | 99 – 102  | 100 - 104 |  |     |
| 21 – 25   | 20 – 22   | 20 – 22   |  |     |
| 2.7 - 5.6 | 2.2 – 3.6 | 2.4 - 4.9 |  | 411 |

FIGURE 1 - BEAD SEQUENCE

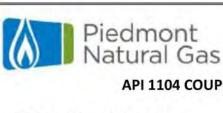


| Test Number: 13-  | 1                |                              | Page:                    | 2 of 2          |
|---|------------------|------------------------------|--------------------------|-----------------|
|   |                  | TENSILE STRENGTH TI          | EST                      |                 |
| Coupon Number:  |                  |                              |                          |                 |
| Coupon Width:   |                  |                              |                          |                 |
| Coupon Thickness:   |                  |                              |                          |                 |
| Coupon Area:  Maximum Load:   |                  |                              |                          |                 |
| ensile Strength:  |                  |                              |                          |                 |
| racture Location:   |                  |                              |                          |                 |
|   |                  |                              |                          |                 |
| Coupon Number:  | - i              | BEND TEST                    | <u> </u>                 |                 |
| ype:  |                  |                              |                          |                 |
| Results:  |                  |                              |                          |                 |
|   |                  | Villago do La Cara           |                          |                 |
|   | 14/20 1/24       | NICK-BREAK TEST              |                          | 11100 1100      |
| Coupon Number:  | W30 NB1<br>Pass  | W30 NB2<br>Pass              | W30 NB3<br>Pass          | W30 NB4<br>Pass |
|   |                  |                              | 4/15                     |                 |
| Coupon Number:  |                  | CHARPY TOUGHNESS 1           | rest                     |                 |
| Depth:  |                  |                              |                          |                 |
| Width:  |                  |                              |                          |                 |
| Notch Location:   |                  |                              |                          |                 |
| est Temperature:  |                  |                              |                          |                 |
| cot i ciliperatare.   |                  |                              |                          |                 |
|   |                  | A I                          |                          |                 |
| mpact Energy:<br>6 Shear:   |                  |                              |                          |                 |
| mpact Energy:<br>% Shear:   |                  |                              |                          | •               |
| mpact Energy: % Shear: ateral Expansion:  |                  |                              |                          | ·               |
| mpact Energy: 6 Shear: ateral Expansion:  |                  |                              |                          |                 |
| mpact Energy:  % Shear: .ateral Expansion:  Comments:   |                  | OTHER TESTS                  |                          |                 |
| mpact Energy: % Shear: .ateral Expansion: Comments:   |                  |                              |                          |                 |
| mpact Energy: 6 Shear: ateral Expansion: Comments:  |                  |                              |                          |                 |
| mpact Energy:  6 Shear: ateral Expansion:  Comments:  Fest Type: Results:  We certify that the st | atements in this | s record are correct and tha | t the test welds were pr |                 |
| mpact Energy: 6 Shear: ateral Expansion:  Comments:  Fest Type: Results:  We certify that the st  | atements in this |                              | t the test welds were pr |                 |
| mpact Energy:  6 Shear: ateral Expansion:  Comments:  Fest Type: Results:  We certify that the st | atements in this | s record are correct and tha | t the test welds were pr |                 |

1 of

2

Page:



| API 1104 | COUPON | TEST | REPORT |
|----------|--------|------|--------|
|----------|--------|------|--------|

Date: 10-07-16

Location:

Welder: Jeff A Ellis

Test Number: N16-02081

Welding Process: SMAW - Stringer Bead

Pipe Material: ASTM A572 Gr. 50 (Sleeve) to ASTM A135/795 Gr. A (Carrier Pipe)

Joint Design: Single "V" Butt Weld

Position: Horizontal (Fixed) Welding Direction: Horizontal

Filler Metal: Lincoln Fleetweld® 5P – E6010

Time Between Passes: 12 Minutes

Preheat Temperature: Ambient (65°F - 70°F) Interpass Temperature: 80°F

Post-weld Heat Treatment: N/A

Line-up Clamps: Yes

Comments:

# **WELDING PARAMETERS**

Pass:

AWS Classification:

Manufacture:

**Electrode Diameter:** 

Current/Polarity:

**Current Range:** 

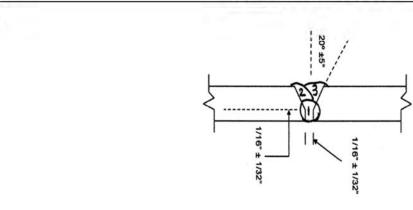
Comments:

Voltage Range:

Travel Speed Range, ipm:

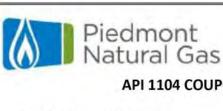
| 1          | 4         | 3         |      |
|------------|-----------|-----------|------|
| A5.1       | A5.1      | A5.1      | 11 0 |
| Lincoln    | Lincoln   | Lincoln   |      |
| 1/8"       | 3/32"     | 3/32"     |      |
| DCRP       | DCRP      | DCRP      |      |
| 72 - 75    | 75 - 80   | 80 - 84   |      |
| 20 - 22    | 22 - 24   | 24 -26    |      |
| 6 - 12 IPM | 4 - 8 IPM | 4 - 8 IPM |      |

# FIGURE 1 – BEAD SEQUENCE



| TENSILE STRENGTH TEST  | Test Number:                   | N16-02081 |          |            |                 |   | Page: | 2   | of : |
|--|--------------------------------|-----------|----------|------------|-----------------|---|-------|-----|------|
| Coupon Width:   1.00"   1.00"  |                                |           | 9        | TENSILE ST | RENGTH TEST     |   |       |     |      |
| Coupon Thickness:   0.186"   0.184"  | Coupon Number:                 |           | 1        |            | 2               |   |       |     |      |
| Coupon Area:   0.186"   0.184"   | Coupon Width:                  | 1         | .00"     | 1.         | 00"             |   |       |     |      |
| Maximum Load:   13,600   13,300  | Coupon Thickness:              | 0.        | 186"     | 0.1        | .84"            |   |       |     |      |
| Tensile Strength:   73,118   72,282  | Coupon Area:                   | 0.        | 186"     | 0.1        | .84"            |   |       |     |      |
| Base Material   Base Materia | Maximum Load:                  | 13        | ,600     | 13,        | 300             |   |       |     |      |
| Second   S | ensile Strength:               | 73        | ,118     | 72,        | 282             |   |       |     |      |
| Topon Number:   1  | racture Location:              | Base      | Material | Base N     | /laterial       |   |       |     |      |
| Face   |                                |           |          | BEN        | D TEST          |   |       |     |      |
| Face   | Coupon Number:                 | 1         | 2        |            |                 |   |       |     |      |
| NICK-BREAK TEST  Coupon Number: NB-1 NB-2  Results: Accept Accept  CHARPY TOUGHNESS TEST  Coupon Number: Notch Location: Fest Temperature: Fest Type: Fest Type:   | ype:                           | Face      | Face     | Root       | Root            |   |       |     |      |
| Coupon Number: NB-1 NB-2 Accept  CHARPY TOUGHNESS TEST  Coupon Number: Depth: Notch Location: Fest Temperature: Impact Energy: (1) 6 Shear: Lateral Expansion: Comments:  OTHER TESTS  | Results:                       | Accept    | Accept   | Accept     | Accept          |   |       |     |      |
| Coupon Number: NB-1 NB-2 Accept  CHARPY TOUGHNESS TEST  Coupon Number: Depth: Notch Location: Fest Temperature: Impact Energy: (1) 6 Shear: Lateral Expansion: Comments:  OTHER TESTS  |                                |           |          | NICK BE    | EAV TECT        |   |       |     |      |
| CHARPY TOUGHNESS TEST  Coupon Number: Depth: Width: Notch Location: Fest Temperature: mpact Energy: (1) 6 Shear: Lateral Expansion: Comments:  OTHER TESTS   | Coupon Number:                 | NI        | R-1      |            |                 |   |       |     |      |
| CHARPY TOUGHNESS TEST  Coupon Number: Depth: Depth: Nidth: Notch Location: Test Temperature: Impact Energy: (1) Shear: Cateral Expansion: Comments:  OTHER TESTS  Test Type:   |                                |           | NU.71    | - 22       |                 |   | -     |     |      |
| Coupon Number: Depth: Width: Width: Wotch Location: Fest Temperature: Impact Energy: (1) Fest Shear: Interest Expansion: Fest Type:  OTHER TESTS   |                                |           |          |            | No. of the last |   |       |     |      |
| Depth:  Width:  Notch Location:  Test Temperature:  mpact Energy: (1)  Shear:  ateral Expansion:  Comments:  OTHER TESTS   | Counon Number                  | F         | C        | HARPY TO   | JGHNESS TES     | Т |       | -   |      |
| Width:   |                                |           | _        |            |                 |   |       | -   |      |
| Notch Location:  Test Temperature:  Impact Energy: (1)  Software:  Instantial Expansion:  Comments:  OTHER TESTS  Test Type:   |                                | -         | _        |            |                 |   |       | -+- |      |
| Test Temperature: mpact Energy: (1) 6 Shear: ateral Expansion: Comments:  OTHER TESTS  Test Type:  |                                | -         | -        |            |                 |   | 1 1   |     |      |
| mpact Energy: (1) 6 Shear: ateral Expansion: Comments:  OTHER TESTS  Test Type:  |                                |           |          |            |                 |   |       |     |      |
| 6 Shear: ateral Expansion: Comments: OTHER TESTS Test Type:  | 그렇게 이번 하는 경우를 쓰는다는 생님          | -         |          |            |                 |   |       |     |      |
| ateral Expansion: Comments: OTHER TESTS Test Type:   |                                | -         |          |            |                 |   |       |     |      |
| OTHER TESTS  Test Type:  | o Jilcai.                      |           |          |            |                 |   |       |     |      |
| Test Type:   |                                |           | _        |            |                 |   |       |     |      |
| Test Type:   | ateral Expansion:              |           |          |            |                 |   |       |     |      |
| 17275117577 1  | ateral Expansion:              |           |          |            |                 |   |       |     |      |
| Deculte:   | ateral Expansion:<br>Comments: |           |          | OTHE       | R TESTS         |   |       |     |      |
| nesuits.   | ateral Expansion:<br>Comments: |           |          | 200        |                 |   |       |     |      |

Approved By:



Page:

2 1 of

Test Number: N16-02081

Date: 10-07-16

Location: 112 Verbena St., Charlotte NC

Welder: Jeff A Ellis

Welding Process: SMAW - Stringer Bead

Pipe Material: ASTM A572 Gr. 50 (Sleeve) to ASTM A135/795 Gr. A (Carrier Pipe)

Joint Design: Single "V" Butt Weld

Position: Horizontal (Fixed) Welding Direction: Horizontal

Filler Metal: Lincoln Fleetweld® 5P - E6010

Time Between Passes: 12 Minutes

Preheat Temperature: Ambient (65°F - 70°F) Interpass Temperature: 80°F

Post-weld Heat Treatment: N/A

Line-up Clamps: External

Comments:

#### WELDING PARAMETERS

| D | - | c | c |  |
|---|---|---|---|--|
| • | а | э | э |  |

AWS Classification:

Manufacture:

**Electrode Diameter:** 

Current/Polarity:

**Current Range:** 

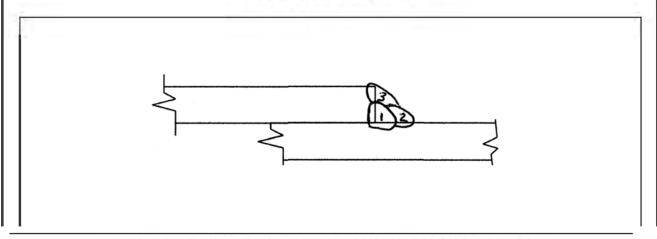
Voltage Range:

Travel Speed Range, ipm:

Comments:

| 1          | 2         | 3         |     |        |  |
|------------|-----------|-----------|-----|--------|--|
| A5.1       | A5.1      | A5.1      | 111 |        |  |
| Lincoln    | Lincoln   | Lincoln   |     |        |  |
| 1/8"       | 3/32"     | 3/32"     | 1   |        |  |
| DCRP       | DCRP      | DCRP      |     |        |  |
| 72 - 75    | 75 - 80   | 80 - 84   |     |        |  |
| 20 - 22    | 22 - 24   | 24 -26    |     |        |  |
| 6 - 12 IPM | 4 - 8 IPM | 4 - 8 IPM |     | 7/10/2 |  |

# FIGURE 1 - BEAD SEQUENCE



| Test Number:                            | N16-02081    |              |                |                   |           | Page:           | 2   | of 2      |
|---|--------------|--------------|----------------|-------------------|-----------|-----------------|-----|-----------|
|   |              |              | BENI           | D TEST            |           |                 |     |           |
| Coupon Number:                          | 1            | 2            | 3              | 4                 |           |                 |     |           |
| уре:                                    | Face         | Face         | Face           | Face              |           |                 |     |           |
| Results:                                | Accept       | Accept       | Accept         | Accept            |           |                 |     |           |
|   |              |              | NICK-BF        | REAK TEST         |           |                 |     |           |
| Coupon Number:                          | NE           | 3-1          | NE             | torieters between |           | NB-3            | N   | B-4       |
| Results:                                | Acc          | ept          | Acc            | ept               | А         | ccept           | Ac  | cept      |
|   |              |              | 0.000.0200.020 |                   |           |                 |     |           |
| and a known for a                       |              |              | 3040.50        | ETCH TEST         |           | 45.5            |     |           |
| Coupon Number:                          | ME           |              | ME             |                   |           | ME-3            |     | 1E-4      |
| Results:                                | Acc          | ері          | Acc            | ері               | A         | ccept           | AC  | cept      |
|   |              |              | Weld Har       | dness Test        |           |                 |     |           |
| Coupon 1                                | Koop (H      | K) Vid       | ckers (HV)     | Coup              | on 2      | Koop (HD)       | Vic | kers (HV) |
| Α                                       | 180          |              | 165            | Α                 |           | 196             | 1 = | 180       |
| В                                       | 213          |              | 200            | В                 |           | 178             |     | 162       |
| С                                       | 209          |              | 195            | С                 |           | 176             |     | 162       |
| D                                       | 184          |              | 169            | D                 |           | 192             |     | 176       |
| E<br>Average:                           | 209          |              | 195            | A.com             | -         | 178             |     | 162       |
| Average:                                | 199          |              | 185            | Avera             | age:      | 184             | 110 | 168       |
| Comments: Resu                          | ults were co | nverted from | m Knoop 500    | O-gram load       | to Vicker | s using ASTM E1 | 40  |           |
|   |              |              | 07117          |                   |           |                 |     |           |
| est Type:                               |              |              |                | R TESTS           |           |                 |     |           |
| 1 |              |              |                |                   |           |                 |     |           |
| Results:                                |              |              |                |                   |           |                 |     |           |

Approved By:





Page:

1 of

**Test Number:** 25CLH-B-1

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, API 5L X70, 0.33 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, API 5L X42, 0.31 C.E. (IIW) pipe

Joint Design:

Branch-groove and fillet weld with a 3/32 inch gap, 1/16 inch land and 45° bevel on

the branch

**Position:** 5G, branch and pipe

Welding Direction: Downhill-Root/Uphill-Rem.

Time Between Passes: 17 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (67°F)

Post-weld Heat Treatment: None used

Line-up Clamps: None used

Test Medium: Oil

**Test Medium Temperature:** 75 – 85°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

# WELDING PARAMETERS

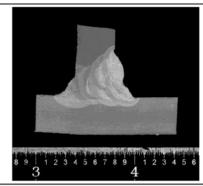
|                            | WEEDING PARAMETERS |             |             |             |  |  |  |  |
|----------------------------|--------------------|-------------|-------------|-------------|--|--|--|--|
| Pass:                      | Root               | Hot Pass    | Fills       | Caps        |  |  |  |  |
| AWS Classification:        | E6010              | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |  |
| Manufacture:               | Lincoln            | ESAB        | ESAB        | ESAB        |  |  |  |  |
| Electrode Diameter (in.):  | 1/8                | 3/32        | 3/32        | 3/32        |  |  |  |  |
| Current/Polarity:          | DCEP               | DCEP        | DCEP        | DCEP        |  |  |  |  |
| Current Range (amps):      | 80 – 103           | 91 – 93     | 90 – 100    | 89 – 91     |  |  |  |  |
| Voltage Range (volts):     | 23 – 32            | 22 – 25     | 21 – 26     | 21 – 24     |  |  |  |  |
| Travel Speed Range (ipm):  | 2.1 – 7.9          | 4.3 – 6.0   | 4.1 – 7.0   | 4.2 – 5.5   |  |  |  |  |
| Heat Input Range (kJ/in.): | 17.9 – 73.3        | 21.8 – 30.6 | 16.4 – 32.4 | 22.0 – 29.4 |  |  |  |  |
| Ave. Heat Input (kJ/in.):  | 43.6               | 26.8        | 25.7        | 26.4        |  |  |  |  |

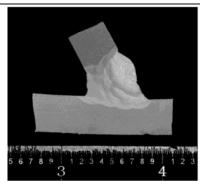


# DNV-GL

Test Number: 25CLH-B-1 Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE





#### **BEND TEST**

| Coupon Number: | 25CLH-B-1 FB3 | 25CLH-B-1 FB6 | 25CLH-B-1 FB9 | 25CLH-B-1 FB12 |
|----------------|---------------|---------------|---------------|----------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch       |
| Type:          | Face          | Face          | Face          | Face           |
| Results:       | Pass          | Pass          | Pass          | Pass           |

# **NICK-BREAK TEST**

| Coupon Number: | 25CLH-B-1 NB3 | 25CLH-B-1 NB6 | 25CLH-B-1 NB9 | 25CLH-B-1 NB12 |
|----------------|---------------|---------------|---------------|----------------|
| Results:       | Pass          | Pass          | Pass          | Pass           |

#### **MACRO-SECTION TEST**

| Coupon Number: | 25CLH-B-1 M3 | 25CLH-B-1 M6 | 25CLH-B-1 M9 | 25CLH-B-1 M12 |
|----------------|--------------|--------------|--------------|---------------|
| Results:       | Pass         | Pass         | Pass         | Pass          |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 25CLH-B-1 M3 | 25CLH-B-1 M12 |
|--------------------|--------------|---------------|
| Max. Hardness (1): | 291.6        | 303.7         |
| Ave. Hardness (2): | 267.1        | 292.0         |
| <b>~</b> ·         | (4) a 4i     |               |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 10/5/2015





Page:

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Test Number: 35LH

**Date:** 9/15/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 gap, 3/32 inch land and 45° bevel on the

branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 17 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Preheat Temperature:** Ambient (71°F) **Line-up Clamps:** None used

Test Medium: Water

**Test Medium Temperature:** 50 – 70°F

Test Medium Flow Rate: Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

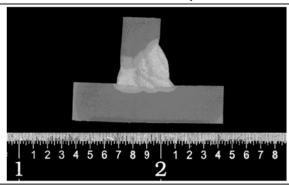
#### WEI DING DADAMETEDS

| WELDING PARAMETERS           |             |             |             |  |  |  |
|------------------------------|-------------|-------------|-------------|--|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):        | 85 – 89     | 89 – 90     | 89          |  |  |  |
| Voltage Range (volts):       | 22 – 25     | 21 – 24     | 22 – 24     |  |  |  |
| Travel Speed Range (ipm):    | 2.9 - 3.8   | 4.1 – 4.9   | 4.1 – 5.6   |  |  |  |
| Heat Input Range (kJ/in.):   | 30.3 – 44.7 | 24.5 – 29.0 | 21.1 – 29.8 |  |  |  |
| Average Heat Input (kJ/in.): | 36.2        | 27.0        | 25.7        |  |  |  |



Test Number: 35LH Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 35LH FB1 | 35LH FB2 | 35LH FB3 | 35LH FB4 |
|-----------------------|----------|----------|----------|----------|
| <b>Bend Diameter:</b> | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Type:                 | Face     | Face     | Face     | Face     |
| Results:              | Pass     | Pass     | Pass     | Pass     |

# **NICK-BREAK TEST**

| Coupon Number: | 35LH NB1 | 35LH NB2 | 35LH NB3 | 35LH NB4 |
|----------------|----------|----------|----------|----------|
| Results:       | Pass     | Pass     | Pass     | Pass     |

# **MACRO-SECTION TEST**

| Coupon Number: | 35LH M1 | 35LH M2 | 35LH M3 | 35LH M4 |
|----------------|---------|---------|---------|---------|
| Results:       | Pass    | Pass    | Pass    | Pass    |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 35LH M2 | 35LH M4 |
|--------------------|---------|---------|
| Max. Hardness (1): | 336.9   | 348.9   |
| Ave. Hardness (2): | 324.6   | 337.7   |
| <b>~</b>           | /4\     |         |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 9/15/2014





Page:

1 of

Test Number: 35LH-BW

**Date:** 9/15/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process:

Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 3/32 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 16 minutes between the root and hot pass, 1 hour to finish the weld

Preheat Temperature: Ambient (80°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

50 - 70°F **Test Medium Temperature:** 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WELDING PARAMETERS

|                              | *************************************** | 1 AITAIVIETERS |             |             |
|------------------------------|---|----------------|-------------|-------------|
| Pass:                        | Root                                    | Hot Pass       | Fills       | Caps        |
| AWS Classification:          | E7018 H4R                               | E7018 H4R      | E7018 H4R   | E7018 H4R   |
| Manufacture:                 | ESAB                                    | ESAB           | ESAB        | ESAB        |
| Electrode Diameter (in.):    | 3/32                                    | 3/32           | 3/32        | 3/32        |
| Current/Polarity:            | DCEP                                    | DCEP           | DCEP        | DCEP        |
| Current Range (amps):        | 82 – 90                                 | 90 – 99        | 89 – 90     | 89          |
| Voltage Range (volts):       | 20 – 25                                 | 23 – 26        | 21 – 23     | 21 – 23     |
| Travel Speed Range (ipm):    | 4.0 - 5.2                               | 3.8 – 5.0      | 3.7 – 5.3   | 4.1 – 5.5   |
| Heat Input Range (kJ/in.):   | 21.7 - 33.2                             | 30.5 – 34.2    | 22.1 – 32.2 | 20.8 – 28.8 |
| Average Heat Input (kJ/in.): | 26.8                                    | 33.1           | 27.1        | 25.5        |
|                              |   |                | 1 1 1       |             |

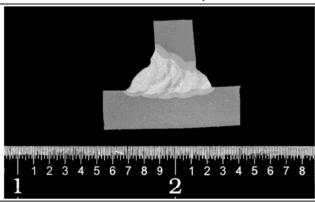
**Comments:** The root pass was a back weld and was deposited as the first pass





Test Number: 35LH-BW Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 35LH-BW FB1 | 35LH-BW FB2 | 35LH-BW FB3 | 35LH-BW FB4 |
|-----------------------|-------------|-------------|-------------|-------------|
| <b>Bend Diameter:</b> | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Type:                 | Face        | Face        | Face        | Face        |
| Results:              | Pass        | Pass        | Pass        | Pass        |

# **NICK-BREAK TEST**

| Coupon Number: | 35LH-BW NB1 | 35LH-BW NB2 | 35LH-BW NB3 | 35LH-BW NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

# **MACRO-SECTION TEST**

| Coupon Number: | 35LH-BW M1 | 35LH-BW M2 | 35LH-BW M3 | 35LH-BW M4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 35LH-BW M2                                | 35LH-BW M4 |
|--------------------|---|------------|
| Max. Hardness (1): | 342.2                                     | 367.6      |
| Ave. Hardness (2): | 326.4                                     | 346.5      |
| Commenter          | (1) Marriagona bandagos of a single inden | 1          |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 9/15/2014





Page:

1 of

Test Number: 48LH

**Date:** 9/15/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.250 inch wall, A516 Grade 70, 0.48 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

the branch

**Preheat Temperature:** Ambient (83°F)

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WEI DING DADAMETEDS

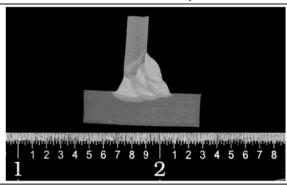
| WELDING PARAMETERS           |             |             |             |  |  |  |
|------------------------------|-------------|-------------|-------------|--|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):        | 88 – 94     | 87 – 92     | 83 – 84     |  |  |  |
| Voltage Range (volts):       | 22 – 26     | 22 – 24     | 22 – 23     |  |  |  |
| Travel Speed Range (ipm):    | 2.6 – 3.8   | 3.7 – 5.2   | 3.4 – 5.5   |  |  |  |
| Heat Input Range (kJ/in.):   | 31.2 – 56.8 | 24.0 – 35.1 | 25.2 – 33.7 |  |  |  |
| Average Heat Input (kJ/in.): | 43.3        | 28.3        | 28.3        |  |  |  |





Test Number: 48LH Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 48LH FB1 | 48LH FB2 | 48LH FB3 | 48LH FB4 |
|-----------------------|----------|----------|----------|----------|
| <b>Bend Diameter:</b> | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Type:                 | Face     | Face     | Face     | Face     |
| Results:              | Pass     | Pass     | Pass     | Pass     |

# **NICK-BREAK TEST**

| Coupon Number: | 48LH NB1 | 48LH NB2 | 48LH NB3 | 48LH NB4 |
|----------------|----------|----------|----------|----------|
| Results:       | Pass     | Pass     | Pass     | Pass     |

# **MACRO-SECTION TEST**

| Coupon Number: | 48LH M1 | 48LH M2 | 48LH M3 | 48LH M4 |
|----------------|---------|---------|---------|---------|
| Results:       | Pass    | Pass    | Pass    | Pass    |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 48LH M2 | 48LH M4 |
|--------------------|---------|---------|
| Max. Hardness (1): | 299.9   | 322.9   |
| Ave. Hardness (2): | 270.3   | 303.6   |
| <b>~</b> '         | /4\     |         |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 9/15/2014





Page: 1 of

Test Number: 42LH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 13 minutes between the root and hot pass, 1 hour to finish the weld

**Preheat Temperature:** Ambient (82°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

**Test Medium Temperature:** 

 $75 - 85^{\circ}F$ 

Test Medium Flow Rate: Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

**Comments:** Measured heat sink capacity time of 45, 48, 53, 55 and 49 seconds

# WEIDING PARAMETERS

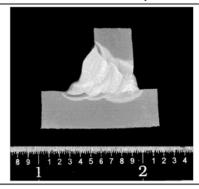
| WELDING PARAMETERS           |             |             |             |             |  |  |  |
|------------------------------|-------------|-------------|-------------|-------------|--|--|--|
| Pass:                        | Root        | Hot Pass    | Fills       | Caps        |  |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        | 3/32        |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):        | 86 – 90     | 91 – 92     | 90 – 94     | 89 – 92     |  |  |  |
| Voltage Range (volts):       | 23 – 26     | 22 – 24     | 22 – 25     | 22 – 23     |  |  |  |
| Travel Speed Range (ipm):    | 2.9 - 3.2   | 4.1 – 5.2   | 4.0 – 4.9   | 4.5 – 5.6   |  |  |  |
| Heat Input Range (kJ/in.):   | 38.7 – 44.8 | 24.1 – 30.9 | 25.8 – 32.7 | 21.6 – 28.0 |  |  |  |
| Average Heat Input (kJ/in.): | 42.6        | 27.9        | 28.0        | 24.8        |  |  |  |





Test Number: 42LH-O Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 42LH-O FB1 | 42LH-O FB2 | 42LH-O FB3 | 42LH-O FB4 |
|-----------------------|------------|------------|------------|------------|
| <b>Bend Diameter:</b> | 3.5 inch   | 3.5 inch   | 3.5 inch   | 3.5 inch   |
| Type:                 | Face       | Face       | Face       | Face       |
| Results:              | Pass       | Pass       | Pass       | Pass       |

# **NICK-BREAK TEST**

| Coupon Number: | 42LH-O NB1 | 42LH-O NB2 | 42LH-O NB3 | 42LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# **MACRO-SECTION TEST**

| Coupon Number: | 42LH-O NB1 | 42LH-O NB2 | 42LH-O NB3 | 42LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42LH-O M2 | 42LH-O M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 387.4     | 370.4     |
| Ave. Hardness (2): | 374.3     | 360.9     |
| <b>~</b> '         | /4\       |           |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015



**DNV·GL** 

**API 1104 COUPON TEST REPORT** 

Page:

Test Number: 40LH-B-1

**Date:** 4/3/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

**Welder:** Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, A106 Grade B, 0.30 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Joint Design:

Branch-groove and fillet weld with a 3/32 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** 5G, branch and pipe

Welding Direction:

Uphill

**Time Between Passes:** 104 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (39°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

50 - 70°F Test Medium Temperature:

Test Medium Flow Rate:

Approximately 3 gallons a minute

**Test Medium Pressure:** Water was not pressurized

#### WELDING PARAMETERS

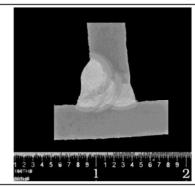
|                            | *************************************** |             |             |  |  |  |
|----------------------------|---|-------------|-------------|--|--|--|
| Pass:                      | Root                                    | Hot Pass    | Caps        |  |  |  |
| AWS Classification:        | E7018 H4R                               | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:               | ESAB                                    | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):  | 3/32                                    | 3/32        | 3/32        |  |  |  |
| Current/Polarity:          | DCEP                                    | DCEP        | DCEP        |  |  |  |
| Current Range (amps):      | 84 – 90                                 | 93 – 94     | 93 – 94     |  |  |  |
| Voltage Range (volts):     | 22 – 26                                 | 23 – 25     | 22 – 26     |  |  |  |
| Travel Speed Range (ipm):  | 2.0 – 3.5                               | 2.5 – 3.8   | 2.6 – 4.0   |  |  |  |
| Heat Input Range (kJ/in.): | 35.4 – 69.3                             | 34.3 – 53.2 | 33.1 – 52.8 |  |  |  |
| Ave. Heat Input (kJ/in.):  | 48.5                                    | 39.0        | 41.2        |  |  |  |
|                            |   |             |             |  |  |  |

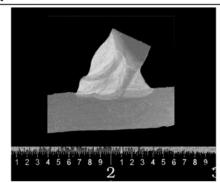


DNV-GL

Test Number: 40LH-B-1 Page: 2 of 2

# FIGURE 1 - BEAD SEQUENCE





#### **BEND TEST**

| Coupon Number: | 40LH-B-1 FB3 | 40LH-B-1 FB6 | 40LH-B-1 FB9 | 40LH-B-1 FB12 |
|----------------|--------------|--------------|--------------|---------------|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch      |
| Type:          | Face         | Face         | Face         | Face          |
| Results:       | Pass         | Pass         | Pass         | Pass          |

#### **NICK-BREAK TEST**

| Coupon Number: | 40LH-B-1 NB3 | 40LH-B-1 NB6 | 40LH-B-1 NB9 | 40LH-B-1 NB12 |
|----------------|--------------|--------------|--------------|---------------|
| Results:       | Pass         | Pass         | Pass         | Pass          |

# **MACRO-SECTION TEST**

| Coupon Number: | 40LH-B-1 M3 | 40LH-B-1 M6 | 40LH-B-1 M9 | 40LH-B-1 M12 |
|----------------|-------------|-------------|-------------|--------------|
| Results:       | Pass        | Pass        | Pass        | Pass         |

# VICKERS HAZ HARDNESS TEST, 10 kg

| Coupon Number:     | 40LH-B-1 M3 | 40LH-B-1 M12 |
|--------------------|-------------|--------------|
| Max. Hardness (1): | 260.0       | 295.4        |
| Ave. Hardness (2): | 239.3       | 282.2        |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/3/2014





Page:

1 of

Test Number: 42LH

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on the branch

Uphill

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

**Preheat Temperature:** Ambient (48°F)

 $50 - 70^{\circ}F$ Test Medium Temperature:

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WEI DING DADAMETEDS

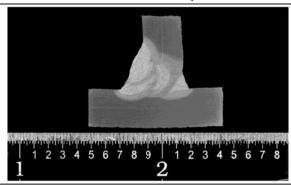
| WELDING PARAMETERS           |             |             |             |  |  |  |  |
|------------------------------|-------------|-------------|-------------|--|--|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |  |  |
| Current Range (amps):        | 85 – 93     | 88 – 89     | 88 – 94     |  |  |  |  |
| Voltage Range (volts):       | 23 – 25     | 22 – 23     | 22 – 24     |  |  |  |  |
| Travel Speed Range (ipm):    | 3.0 – 3.6   | 2.9 – 3.3   | 2.9 – 3.5   |  |  |  |  |
| Heat Input Range (kJ/in.):   | 35.5 – 43.6 | 36.3 – 41.8 | 34.6 – 42.7 |  |  |  |  |
| Average Heat Input (kJ/in.): | 38.7        | 39.0        | 39.5        |  |  |  |  |





Test Number: 42LH Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 42LH FB1 | 42LH FB2 | 42LH FB3 | 42LH FB4 |
|----------------|----------|----------|----------|----------|
| Bend Diameter: | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Type:          | Face     | Face     | Face     | Face     |
| Results:       | Pass     | Pass     | Pass     | Pass     |

# **NICK-BREAK TEST**

| <b>Coupon Number:</b> | 42LH NB1 | 42LH NB2 | 42LH NB3 | 42LH NB4 |
|-----------------------|----------|----------|----------|----------|
| Results:              | Pass     | Pass     | Pass     | Pass     |

# **MACRO-SECTION TEST**

| <b>Coupon Number:</b> | 42LH M1 | 42LH M2 | 42LH M3 | 42LH M4 |
|-----------------------|---------|---------|---------|---------|
| Results:              | Pass    | Pass    | Pass    | Pass    |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42LH M2                                | 42LH M4 |
|--------------------|--|---------|
| Max. Hardness (1): | 372.2                                  | 366.0   |
| Ave. Hardness (2): | 349.2                                  | 327.0   |
| Comments:          | (1) Maximum hardness of a single inder | nt      |

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

1 of

Test Number: 42LH-BW

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

**Date:** 10/5/2015

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 3/32 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 22 minutes between the root and hot pass, 1 hour to finish the weld

Preheat Temperature: Ambient (47°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

50 - 70°F **Test Medium Temperature:** 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WELDING PARAMETERS

|                              | *************************************** | . ,,        |             |             |
|------------------------------|---|-------------|-------------|-------------|
| Pass:                        | Root                                    | Hot Pass    | Fill        | Caps        |
| AWS Classification:          | E7018 H4R                               | E7018 H4R   | E7018 H4R   | E7018 H4R   |
| Manufacture:                 | ESAB                                    | ESAB        | ESAB        | ESAB        |
| Electrode Diameter (in.):    | 3/32                                    | 3/32        | 3/32        | 3/32        |
| Current/Polarity:            | DCEP                                    | DCEP        | DCEP        | DCEP        |
| Current Range (amps):        | 69 – 75                                 | 85 – 89     | 83 – 84     | 83 – 92     |
| Voltage Range (volts):       | 21 – 23                                 | 22 – 25     | 22 – 24     | 22 – 24     |
| Travel Speed Range (ipm):    | 2.1 – 2.8                               | 2.7 – 3.8   | 2.5 – 2.8   | 2.6 – 3.4   |
| Heat Input Range (kJ/in.):   | 35.5 – 44.4                             | 33.2 – 45.0 | 40.3 – 44.9 | 32.4 – 43.8 |
| Average Heat Input (kJ/in.): | 38.0                                    | 39.0        | 42.6        | 38.7        |
| _                            |   |             |             |             |

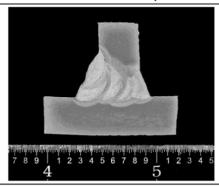
**Comments:** The root pass was a back weld and was deposited as the first pass





Test Number: 42LH-BW Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 42LH-BW FB1 | 42LH-BW FB2 | 42LH-BW FB3 | 42LH-BW FB4 |
|----------------|-------------|-------------|-------------|-------------|
| Bend Diameter: | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Туре:          | Face        | Face        | Face        | Face        |
| Results:       | Pass        | Pass        | Pass        | Pass        |

# **NICK-BREAK TEST**

| Coupon Number: | 42LH-BW NB1 | 42LH-BW NB2 | 42LH-BW NB3 | 42LH-BW NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

# **MACRO-SECTION TEST**

| Coupon Number: | 42LH-BW M1 | 42LH-BW M2 | 42LH-BW M3 | 42LH-BW M4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42LH-BW M2 | 42LH-BW M4 |
|--------------------|------------|------------|
| Max. Hardness (1): | 392.9      | 374.7      |
| Ave. Hardness (2): | 381.2      | 339.2      |
| <b>~</b>           | /4\ 0.4:   |            |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015





Page:

1 of

Test Number: 50LH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.250 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch Material: 0.250 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on the branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

**Preheat Temperature:** Ambient (77°F)

Test Medium: Oil

**Test Medium Temperature:** 

75 - 85°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

**Comments:** The heat sink capacity time was not measured

#### WEI DING DADAMETEDS

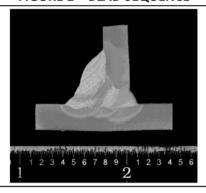
| WELDING PARAIVIETERS         |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 82 – 87     | 82 – 83     | 83 – 85     |  |  |
| Voltage Range (volts):       | 23 – 25     | 21 – 24     | 21 – 23     |  |  |
| Travel Speed Range (ipm):    | 2.5 – 3.4   | 2.6 – 2.9   | 2.7 – 3.6   |  |  |
| Heat Input Range (kJ/in.):   | 38.2 – 45.6 | 39.6 – 41.3 | 30.2 – 40.6 |  |  |
| Average Heat Input (kJ/in.): | 42.9        | 40.5        | 36.7        |  |  |





Test Number: 50LH-O Page: 2 of 2

# FIGURE 1 - BEAD SEQUENCE



#### **BEND TEST**

| <b>Coupon Number:</b> | 50LH-O FB1 | 50LH-O FB2 | 50LH-O FB3 | 50LH-O FB4 |
|-----------------------|------------|------------|------------|------------|
| <b>Bend Diameter:</b> | 3.5 inch   | 3.5 inch   | 3.5 inch   | 3.5 inch   |
| Type:                 | Face       | Face       | Face       | Face       |
| Results:              | Pass       | Pass       | Pass       | Pass       |

# **NICK-BREAK TEST**

| Coupon Number: | 50LH-O NB1 | 50LH-O NB2 | 50LH-O NB3 | 50LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# **MACRO-SECTION TEST**

| Coupon Number: | 50LH-O M1 | 50LH-O M2 | 50LH-O M3 | 50LH-O M4 |
|----------------|-----------|-----------|-----------|-----------|
| Results:       | Pass      | Pass      | Pass      | Pass      |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-O M2 | 50LH-O M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 297.7     | 290.3     |
| Ave. Hardness (2): | 285.7     | 274.9     |
|                    | (4) 5 6   |           |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

Test Number:

TBLH-B-1

**Date:** 4/3/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, A106 Grade B, 0.30 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

Joint Design:

the branch

**Position:** 5G, branch and pipe

Welding Direction: Uphill

Time Between Passes: 35 minutes between the root and hot pass, 6 hours to finish the weld

Post-weld Heat Treatment:

None used

**Preheat Temperature:** Ambient (41°F)

**Line-up Clamps:** None used

Test Medium: Water

 $50 - 70^{\circ}F$ 

Test Medium Temperature: **Test Medium Flow Rate:** 

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

#### WEI DING DADAMETERS

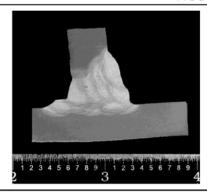
| WELDING PARAMETERS         |             |             |             |                     |             |             |  |  |
|----------------------------|-------------|-------------|-------------|---------------------|-------------|-------------|--|--|
| Pass:                      | Butter      | Temper      | Root        | Hot Pass            | Fills       | Caps        |  |  |
| 1 433.                     | Layer       | Layer       | 11001       | 11001 433           | 1 1115      | caps        |  |  |
| AWS Classification:        | E7018 H4R   | E7018 H4R   | E7018 H4R   | E7018 H4R E7018 H4R |             | E7018 H4R   |  |  |
| Manufacture:               | ESAB        | ESAB        | ESAB        | ESAB                | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):  | 3/32        | 3/32        | 3/32        | 3/32                | 3/32        | 3/32        |  |  |
| Current/Polarity:          | DCEP        | DCEP        | DCEP        | DCEP                | DCEP        | DCEP        |  |  |
| Current Range (amps):      | 88 – 89     | 87 – 88     | 79 – 92     | 88                  | 88          | 87 – 88     |  |  |
| Voltage Range (volts):     | 22 – 25     | 22 – 24     | 22 – 26     | 22 – 23             | 22 – 24     | 22 – 25     |  |  |
| Travel Speed Range (ipm):  | 6.8 – 10.3  | 4.0 – 6.2   | 2.0 – 3.6   | 3.9 – 5.2           | 4.1 – 6.5   | 4.0 - 5.6   |  |  |
| Heat Input Range (kJ/in.): | 12.0 – 17.3 | 20.2 – 30.2 | 32.1 – 63.8 | 22.9 – 31.0         | 18.6 – 28.9 | 22.1 – 29.3 |  |  |
| Ave. Heat Input (kJ/in.):  | 15.1        | 24.8        | 48.8        | 28.0                | 23.5        | 25.2        |  |  |

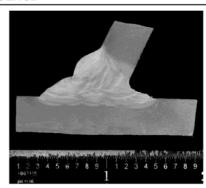


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Test Number: TBLH-B-1 Page: 2 of 2

# FIGURE 1 – BEAD SEQUENCE





#### **BEND TEST**

| Coupon Number:        | TBLH-B-1 FB3 | TBLH-B-1 FB6 | TBLH-B-1 FB9 | TBLH-B-1 FB12 |
|-----------------------|--------------|--------------|--------------|---------------|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch      |
| Type:                 | Face         | Face         | Face         | Face          |
| Results:              | Pass         | Pass         | Pass         | Pass          |

#### **NICK-BREAK TEST**

| <b>Coupon Number:</b> | TBLH-B-1 NB3 | TBLH-B-1 NB6 | TBLH-B-1 NB9 | TBLH-B-1 NB12 |
|-----------------------|--------------|--------------|--------------|---------------|
| Results:              | Pass         | Pass         | Pass         | Pass          |

#### **MACRO-SECTION TEST**

| Coupon Number:    | TBLH-B-1 M3 | TBLH-B-1 M6 | TBLH-B-1 M9 | TBLH-B-1 M12 |
|-------------------|-------------|-------------|-------------|--------------|
| Results:          | Pass        | Pass        | Pass        | Pass         |
| Max. Toe Spacing: | 0.100 inch  | 0.098 inch  | 0.088 inch  | 0.080 inch   |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | TBLH-B-1 M3 | TBLH-B-1 M12 |
|--------------------|-------------|--------------|
| Max. Hardness (1): | 278.5       | 289.6        |
| Ave. Hardness (2): | 259.1       | 249.1        |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/3/2014





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of

Test Number: 50LH-2

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.250 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Branch Material: 0.250 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Joint Design:

Branch-groove and fillet weld with a 3/32 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

**Time Between Passes:** 15 minutes between the root and hot pass, 1 hours to finish the weld

Post-weld Heat Treatment: None used

Line-up Clamps: None used

Preheat Temperature: Ambient (44°F)

Test Medium:

Water

**Test Medium Temperature:** 

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: The heat sink capacity time was not measured

#### WELDING PARAMETERS

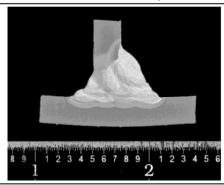
| Pass:                        | Butter      | Temper      | Root        | Hot Pass    | Caps        |  |
|------------------------------|-------------|-------------|-------------|-------------|-------------|--|
| 1 433.                       | Layer       | Layer       | Noot        | 11001 033   | caps        |  |
| AWS Classification:          | E7018 H4R   |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        | ESAB        | ESAB        |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        | 3/32        | 3/32        |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        | DCEP        |  |
| Current Range (amps):        | 87 – 89     | 87 – 89     | 79 – 80     | 90          | 89 – 90     |  |
| Voltage Range (volts):       | 21 – 23     | 21 – 23     | 22 – 24     | 21 – 23     | 21 – 23     |  |
| Travel Speed Range (ipm):    | 6.9 - 11.0  | 4.4 - 6.3   | 2.9 - 3.8   | 4.3 – 4.5   | 4.4 – 5.3   |  |
| Heat Input Range (kJ/in.):   | 10.6 – 17.9 | 19.0 – 26.7 | 29.6 – 38.9 | 26.0 – 27.9 | 22.5 – 27.0 |  |
| Average Heat Input (kJ/in.): | 14.9        | 23.3        | 34.7        | 26.9        | 24.0        |  |

**Comment:** A block welding sequence was used



Test Number: 50LH-2 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 50LH-2 FB1 | 50LH-2 FB2 | 50LH-2 FB3 | 50LH-2 FB4 |
|-----------------------|------------|------------|------------|------------|
| <b>Bend Diameter:</b> | 3.5 inch   | 3.5 inch   | 3.5 inch   | 3.5 inch   |
| Type:                 | Face       | Face       | Face       | Face       |
| Results:              | Pass       | Pass       | Pass       | Pass       |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-2 NB1 | 50LH-2 NB2 | 50LH-2 NB3 | 50LH-2 NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

# **MACRO-SECTION TEST**

| Coupon Number:    | 50LH-2 M1  | 50LH-2 M2  | 50LH-2 M3  | 50LH-2 M4  |
|-------------------|------------|------------|------------|------------|
| Results:          | Pass       | Pass       | Pass       | Pass       |
| Max. Toe Spacing: | 0.047 inch | 0.026 inch | 0.025 inch | 0.089 inch |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-2 M2 | 50LH-2 M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 305.1     | 355.6     |
| Ave. Hardness (2): | 275.3     | 308.1     |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015



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API 1104 COUPON TEST REPORT

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2

Test Number: 50LH-BW

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.250 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch Material: 0.250 in. wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

Joint Design:

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 12 minutes between the root and hot pass, 30 minutes to finish the weld

Post-weld Heat Treatment: None used

Line-up Clamps: None used

Test Medium: Water

**Preheat Temperature:** Ambient (48°F)

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate: Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

**Comments:** The heat sink capacity time was not measured

# WEIDING PARAMETERS

| WELDING PARAMETERS           |             |             |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|-------------|-------------|--|--|
| Pass:                        | Butter      | Temper      | Root        | Hot Pass    | Caps        |  |  |
| rass.                        | Layer       | Layer       | ROOL        | HOL Pass    | Caps        |  |  |
| AWS Classification:          | E7018 H4R   |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 80 – 83     | 80 – 81     | 79 – 82     | 84 – 89     | 89 – 90     |  |  |
| Voltage Range (volts):       | 21 – 23     | 21 – 23     | 20 – 24     | 21 – 24     | 22 – 24     |  |  |
| Travel Speed Range (ipm):    | 7.5 – 9.5   | 3.8 – 5.0   | 3.3 – 4.7   | 3.7 – 4.6   | 4.0 – 4.8   |  |  |
| Heat Input Range (kJ/in.):   | 11.1 – 15.1 | 21.4 – 27.8 | 22.0 - 31.3 | 26.5 – 29.6 | 25.5 – 31.9 |  |  |
| Average Heat Input (kJ/in.): | 12.9        | 25.1        | 26.3        | 27.8        | 27.9        |  |  |

**Comment:** The root pass was a back weld and was deposited as the first pass

All butter layer passes were deposited prior to any temper layer

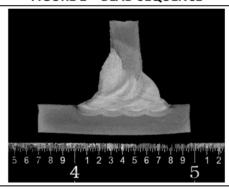
passes





Test Number: 50LH-BW Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 50LH-BW FB1 | 50LH-BW FB2 | 50LH-BW FB3 | 50LH-BW FB4 |
|----------------|-------------|-------------|-------------|-------------|
| Bend Diameter: | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Туре:          | Face        | Face        | Face        | Face        |
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-BW NB1 | 50LH-BW NB2 | 50LH-BW NB3 | 50LH-BW NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

## **MACRO-SECTION TEST**

| Coupon Number:    | 50LH-BW M1 | 50LH-BW M2 | 50LH-BW M3 | 50LH-BW M4 |
|-------------------|------------|------------|------------|------------|
| Results:          | Pass       | Pass       | Pass       | Pass       |
| Max. Toe Spacing: | 0.065 inch | 0.040 inch | 0.088 inch | 0037 inch  |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-BW M2 | 50LH-BW M4 |
|--------------------|------------|------------|
| Max. Hardness (1): | 372.6      | 414.0      |
| Ave. Hardness (2): | 323.4      | 366.3      |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015





Page:

**Test Number:** TBLH-B-1

**Date:** 4/3/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, A106 Grade B, 0.30 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** 5G, branch and pipe

Welding Direction: Uphill

Time Between Passes: 35 minutes between the root and hot pass, 6 hours to finish the weld

Post-weld Heat Treatment:

None used

**Line-up Clamps:** None used

Preheat Temperature: Ambient (41°F)

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

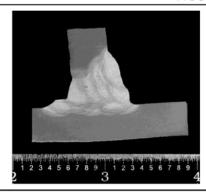
#### WEIDING DADAMETERS

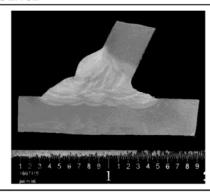
| WELDING PARAIVIETERS       |             |             |             |             |             |             |  |
|----------------------------|-------------|-------------|-------------|-------------|-------------|-------------|--|
| Pass:                      | Butter      | Temper      | Root        | Hot Pass    | Fills       | Caps        |  |
| 1 033.                     | Layer       | Layer       | Noot        | 11001 433   | 11113       | Сарз        |  |
| AWS Classification:        | E7018 H4R   |  |
| Manufacture:               | ESAB        | ESAB        | ESAB        | ESAB        | ESAB        | ESAB        |  |
| Electrode Diameter (in.):  | 3/32        | 3/32        | 3/32        | 3/32        | 3/32        | 3/32        |  |
| Current/Polarity:          | DCEP        | DCEP        | DCEP        | DCEP        | DCEP        | DCEP        |  |
| Current Range (amps):      | 88 – 89     | 87 – 88     | 79 – 92     | 88          | 88          | 87 – 88     |  |
| Voltage Range (volts):     | 22 – 25     | 22 – 24     | 22 – 26     | 22 – 23     | 22 – 24     | 22 – 25     |  |
| Travel Speed Range (ipm):  | 6.8 – 10.3  | 4.0 – 6.2   | 2.0 – 3.6   | 3.9 – 5.2   | 4.1 – 6.5   | 4.0 – 5.6   |  |
| Heat Input Range (kJ/in.): | 12.0 – 17.3 | 20.2 – 30.2 | 32.1 – 63.8 | 22.9 – 31.0 | 18.6 – 28.9 | 22.1 – 29.3 |  |
| Ave. Heat Input (kJ/in.):  | 15.1        | 24.8        | 48.8        | 28.0        | 23.5        | 25.2        |  |



Test Number: TBLH-B-1 Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE





#### **BEND TEST**

| Coupon Number:        | TBLH-B-1 FB3 | TBLH-B-1 FB6 | TBLH-B-1 FB9 | TBLH-B-1 FB12 |
|-----------------------|--------------|--------------|--------------|---------------|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch      |
| Type:                 | Face         | Face         | Face         | Face          |
| Results:              | Pass         | Pass         | Pass         | Pass          |

#### **NICK-BREAK TEST**

| <b>Coupon Number:</b> | TBLH-B-1 NB3 | TBLH-B-1 NB6 | TBLH-B-1 NB9 | TBLH-B-1 NB12 |
|-----------------------|--------------|--------------|--------------|---------------|
| Results:              | Pass         | Pass         | Pass         | Pass          |

#### **MACRO-SECTION TEST**

| Coupon Number:    | TBLH-B-1 M3 | TBLH-B-1 M6 | TBLH-B-1 M9 | TBLH-B-1 M12 |
|-------------------|-------------|-------------|-------------|--------------|
| Results:          | Pass        | Pass        | Pass        | Pass         |
| Max. Toe Spacing: | 0.100 inch  | 0.098 inch  | 0.088 inch  | 0.080 inch   |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | TBLH-B-1 M3 | TBLH-B-1 M12 |
|--------------------|-------------|--------------|
| Max. Hardness (1): | 278.5       | 289.6        |
| Ave. Hardness (2): | 259.1       | 249.1        |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/3/2014

Test Conducted By: Jim Winigman
Certified By: Matt Boring, P.E., CWI

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**API 1104 COUPON TEST REPORT** 

Page: 1 of

**Test Number:** 50LH-TW-2

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.125 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Branch Material: 0.125 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Joint Design: Branch-groove and fillet weld with a 1/8 inch gap and no bevel on the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 15 minutes between the root and hot pass, 30 minutes to finish the weld

**Preheat Temperature:** Ambient (44°F)

Post-weld Heat Treatment:

None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

**Comments:** The heat sink capacity time was not measured

#### WELDING PARAMETERS

| _                            |              |              |             |             |  |  |
|------------------------------|--------------|--------------|-------------|-------------|--|--|
| Pass:                        | Butter Layer | Temper Layer | Root        | Сар         |  |  |
| AWS Classification:          | E7018 H5     | E7018 H4R    | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | ESAB         | ESAB         | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 5/64         | 3/32         | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP         | DCEP         | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 62 – 66      | 63 – 96      | 89          | 89 – 90     |  |  |
| Voltage Range (volts):       | 21 – 23      | 20 – 23      | 21 – 23     | 22 – 23     |  |  |
| Travel Speed Range (ipm):    | 5.2 – 6.8    | 3.8 – 5.7    | 4.9 – 5.1   | 4.3 – 5.3   |  |  |
| Heat Input Range (kJ/in.):   | 12.8 – 16.2  | 15.5 – 30.2  | 23.4 – 24.4 | 23.0 – 27.4 |  |  |
| Average Heat Input (kJ/in.): | 14.4         | 24.8         | 23.9        | 25.8        |  |  |
|                              |              |              |             |             |  |  |

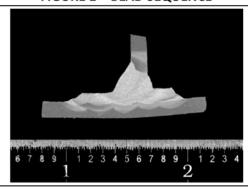
**Comment:** A block welding sequence was used





Test Number: 50LH-TW-2 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 50LH-TW-2 FB1 | 50LH-TW-2 FB2 | 50LH-TW-2 FB3 | 50LH-TW-2 FB4 |
|----------------|---------------|---------------|---------------|---------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch      |
| Type:          | Face          | Face          | Face          | Face          |
| Results:       | Pass          | Pass          | Pass          | Pass          |

## **NICK-BREAK TEST**

| Coupon Number: | 50LH-TW-2 NB1 | 50LH-TW-2 NB2 | 50LH-TW-2 NB3 | 50LH-TW-2 NB4 |
|----------------|---------------|---------------|---------------|---------------|
| Results:       | Pass          | Pass          | Pass          | Pass          |

## **MACRO-SECTION TEST**

| Coupon Number:    | 50LH-TW-2 M1 | 50LH-TW-2 M2 | 50LH-TW-2 M3 | 50LH-TW-2 M4 |
|-------------------|--------------|--------------|--------------|--------------|
| Results:          | Pass         | Pass         | Pass         | Pass         |
| Max. Toe Spacing: | 0.076 inch   | 0.095 inch   | 0.072 inch   | 0.108 inch   |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-TW-2 M2 | 50LH-TW-2 M4 |
|--------------------|--------------|--------------|
| Max. Hardness (1): | 307.3        | 343.1        |
| Ave. Hardness (2): | 283.8        | 304.4        |
|                    |              |              |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015



#### **API 1104 COUPON TEST REPORT**

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1 of

**Test Number:** 50LH-TW-3

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.125 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch Material: 0.125 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Joint Design: Branch-groove and fillet weld with a 1/8 inch gap and no bevel on the branch

Time Between Passes: 18 minutes between the root and hot pass, 30 minutes to finish the weld

Welding Direction: Uphill

**Preheat Temperature:** Ambient (72°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

**Position:** Fixed, both plates at 45°

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

**Comments:** The heat sink capacity time was not measured

## WEIDING DARAMETERS

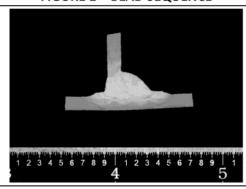
| WELDING PARAMETERS           |              |              |             |             |  |
|------------------------------|--------------|--------------|-------------|-------------|--|
| Pass:                        | Butter Layer | Temper Layer | Root        | Cap         |  |
| AWS Classification:          | E7018 H5     | E7018 H4R    | E7018 H4R   | E7018 H4R   |  |
| Manufacture:                 | ESAB         | ESAB         | ESAB        | ESAB        |  |
| Electrode Diameter (in.):    | 5/64         | 3/32         | 3/32        | 3/32        |  |
| Current/Polarity:            | DCEP         | DCEP         | DCEP        | DCEP        |  |
| Current Range (amps):        | 61 – 66      | 80 – 82      | 76 – 81     | 85 – 86     |  |
| Voltage Range (volts):       | 21 – 24      | 21 – 22      | 21 – 22     | 21 – 23     |  |
| Travel Speed Range (ipm):    | 8.9 – 13.0   | 5.5 – 8.9    | 3.9 – 4.5   | 4.2 – 5.0   |  |
| Heat Input Range (kJ/in.):   | 6.9 – 10.8   | 11.9 – 18.0  | 23.6 – 25.2 | 22.4 – 27.3 |  |
| Average Heat Input (kJ/in.): | 8.9          | 15.4         | 24.3        | 25.2        |  |

**Comment:** A block welding sequence was used



Test Number: 50LH-TW-3 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



## **BEND TEST**

| Coupon Number: | 50LH-TW-3 FB1 | 50LH-TW-3 FB2 | 50LH-TW-3 FB3 | 50LH-TW-3 FB4 |
|----------------|---------------|---------------|---------------|---------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch      |
| Туре:          | Face          | Face          | Face          | Face          |
| Results:       | Pass          | Pass          | Pass          | Pass          |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-TW-3 NB1 | 50LH-TW-3 NB2 | 50LH-TW-3 NB3 | 50LH-TW-3 NB4 |
|----------------|---------------|---------------|---------------|---------------|
| Results:       | Pass          | Pass          | Pass          | Pass          |

## **MACRO-SECTION TEST**

| Coupon Number:   | 50LH-TW-3 M1 | 50LH-TW-3 M2 | 50LH-TW-3 M3 | 50LH-TW-3 M4 |
|------------------|--------------|--------------|--------------|--------------|
| Results:         | Pass         | Pass         | Pass         | Pass         |
| Max. Toe Spacing | 0.079 inch   | 0.107 inch   | 0.080 inch   | 0.098 inch   |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-TW-3 M2 | 50LH-TW-3 M4 |
|--------------------|--------------|--------------|
| Max. Hardness (1): | 494.1        | 474.9        |
| Ave. Hardness (2): | 443.9        | 460.9        |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 10/5/2015





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**Test Number:** 25LH-S-1

**Date:** 4/22/2014

Location: Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine:

Miller CST 280

Pipe Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Sleeve Material: 14 inch O.D., 0.375 inch wall, API 5L X42, 0.41 C.E. (IIW) pipe

Joint Design: Circumferential fillet weld

Position: 5G

Welding Direction: Uphill

Time Between Passes: 15 minutes between the root and first cap pass, 2 hours to finish the weld

**Preheat Temperature:** Ambient (49°F)

Post-weld Heat Treatment: None used

Line-up Clamps:

None used

Test Medium: Water Test Medium Temperature:

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

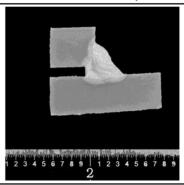
#### **WELDING PARAMETERS**

| WEEDINGTANAMETERS |  |  |  |  |
|-------------------|--|--|--|--|
| Root              | Caps   |  |  |  |
| E7018 H4R         | E7018 H4R  |  |  |  |
| ESAB              | ESAB   |  |  |  |
| 3/32              | 3/32   |  |  |  |
| DCEP              | DCEP   |  |  |  |
| 86                | 86 – 87  |  |  |  |
| 22 – 25           | 21 – 23  |  |  |  |
| 2.4 – 7.3         | 4.1 – 6.8  |  |  |  |
| 15.9 – 54.0       | 17.1 – 28.1  |  |  |  |
| 29.8              | 24.3   |  |  |  |
|                   | Root E7018 H4R ESAB 3/32 DCEP 86 22 - 25 2.4 - 7.3 15.9 - 54.0 |  |  |  |



Test Number: 25LH-S-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 25LH-S-1 FB1 | 25LH-S-1 FB2 | 25LH-S-1 FB3 | 25LH-S-1 FB4 |
|----------------|--------------|--------------|--------------|--------------|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:          | Face         | Face         | Face         | Face         |
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **NICK-BREAK TEST**

| Coupon Number: | 25LH-S-1 NB1 | 25LH-S-1 NB2 | 25LH-S-1 NB3 | 25LH-S-1 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **MACRO-SECTION TEST**

| <b>Coupon Number:</b> | 25LH-S-1 M1 | 25LH-S-1 M2 | 25LH-S-1 M3 | 25LH-S-1 M4 |
|-----------------------|-------------|-------------|-------------|-------------|
| Results:              | Pass        | Pass        | Pass        | Pass        |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 25LH-S-1 M2 | 25LH-S-1 M4 |
|--------------------|-------------|-------------|
| Max. Hardness (1): | 323.2       | 277.0       |
| Ave. Hardness (2): | 318.4       | 241.2       |
| <b>6</b>           | (4) 0 4     |             |

(1) Maximum hardness of a single indent
(2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 4/22/2014





Page:

1 of

Test Number: 35LH

**Date:** 9/15/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate Branch Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch-groove and fillet weld with a 1/8 gap, 3/32 inch land and 45° bevel on the

Joint Design:

branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 17 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Preheat Temperature:** Ambient (71°F) **Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

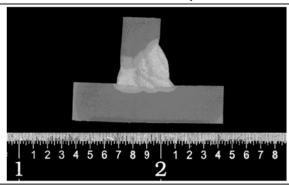
#### WEI DING DADAMETEDS

| WELDING PARAMETERS           |             |             |             |  |  |  |
|------------------------------|-------------|-------------|-------------|--|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |  |
| <b>AWS Classification:</b>   | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):        | 85 – 89     | 89 – 90     | 89          |  |  |  |
| Voltage Range (volts):       | 22 – 25     | 21 – 24     | 22 – 24     |  |  |  |
| Travel Speed Range (ipm):    | 2.9 – 3.8   | 4.1 – 4.9   | 4.1 – 5.6   |  |  |  |
| Heat Input Range (kJ/in.):   | 30.3 – 44.7 | 24.5 – 29.0 | 21.1 – 29.8 |  |  |  |
| Average Heat Input (kJ/in.): | 36.2        | 27.0        | 25.7        |  |  |  |



Test Number: 35LH Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 35LH FB1 | 35LH FB2 | 35LH FB3 | 35LH FB4 |
|----------------|----------|----------|----------|----------|
| Bend Diameter: | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Type:          | Face     | Face     | Face     | Face     |
| Results:       | Pass     | Pass     | Pass     | Pass     |

## **NICK-BREAK TEST**

| Coupon Number: | 35LH NB1 | 35LH NB2 | 35LH NB3 | 35LH NB4 |
|----------------|----------|----------|----------|----------|
| Results:       | Pass     | Pass     | Pass     | Pass     |

## **MACRO-SECTION TEST**

| Coupon Number: | 35LH M1 | 35LH M2 | 35LH M3 | 35LH M4 |
|----------------|---------|---------|---------|---------|
| Results:       | Pass    | Pass    | Pass    | Pass    |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 35LH M2 | 35LH M4 |
|--------------------|---------|---------|
| Max. Hardness (1): | 336.9   | 348.9   |
| Ave. Hardness (2): | 324.6   | 337.7   |
| <b>~</b> ·         | /4\     |         |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 9/15/2014





Page:

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Test Number: 48LH

**Date:** 9/15/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.250 inch wall, A516 Grade 70, 0.48 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

the branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

**Preheat Temperature:** Ambient (83°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

 $50 - 70^{\circ}F$ Test Medium Temperature:

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WEI DING DADAMETEDS

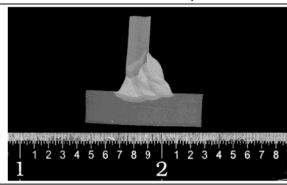
| WELDING PARAMETERS |   |   |  |  |  |  |
|--------------------|---|---|--|--|--|--|
| Root               | Hot Pass  | Caps  |  |  |  |  |
| E7018 H4R          | E7018 H4R   | E7018 H4R   |  |  |  |  |
| ESAB               | ESAB  | ESAB  |  |  |  |  |
| 3/32               | 3/32  | 3/32  |  |  |  |  |
| DCEP               | DCEP  | DCEP  |  |  |  |  |
| 88 – 94            | 87 – 92   | 83 – 84   |  |  |  |  |
| 22 – 26            | 22 – 24   | 22 – 23   |  |  |  |  |
| 2.6 - 3.8          | 3.7 – 5.2   | 3.4 – 5.5   |  |  |  |  |
| 31.2 – 56.8        | 24.0 – 35.1   | 25.2 – 33.7   |  |  |  |  |
| 43.3               | 28.3  | 28.3  |  |  |  |  |
|                    | Root<br>E7018 H4R<br>ESAB<br>3/32<br>DCEP<br>88 – 94<br>22 – 26<br>2.6 – 3.8<br>31.2 – 56.8 | Root Hot Pass E7018 H4R E7018 H4R ESAB ESAB 3/32 3/32 DCEP DCEP 88 - 94 87 - 92 22 - 26 22 - 24 2.6 - 3.8 3.7 - 5.2 31.2 - 56.8 24.0 - 35.1 |  |  |  |  |





Test Number: 48LH Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 48LH FB1 | 48LH FB2 | 48LH FB3 | 48LH FB4 |
|----------------|----------|----------|----------|----------|
| Bend Diameter: | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Type:          | Face     | Face     | Face     | Face     |
| Results:       | Pass     | Pass     | Pass     | Pass     |

## **NICK-BREAK TEST**

| Coupon Number: | 48LH NB1 | 48LH NB2 | 48LH NB3 | 48LH NB4 |
|----------------|----------|----------|----------|----------|
| Results:       | Pass     | Pass     | Pass     | Pass     |

## **MACRO-SECTION TEST**

| Coupon Number: | 48LH M1 | 48LH M2 | 48LH M3 | 48LH M4 |
|----------------|---------|---------|---------|---------|
| Results:       | Pass    | Pass    | Pass    | Pass    |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 48LH M2 | 48LH M4 |
|--------------------|---------|---------|
| Max. Hardness (1): | 299.9   | 322.9   |
| Ave. Hardness (2): | 270.3   | 303.6   |
|                    | (4) 6   |         |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 9/15/2014





Page: 1 of

Test Number: 42LH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

Joint Design:

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 13 minutes between the root and hot pass, 1 hour to finish the weld

Preheat Temperature: Ambient (82°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

 $75 - 85^{\circ}F$ **Test Medium Temperature:** 

Test Medium Flow Rate: Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

Comments: Measured heat sink capacity time of 45, 48, 53, 55 and 49 seconds

#### WEI DING DADAMETEDS

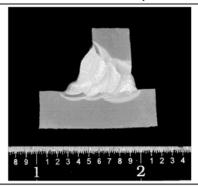
| WELDING PARAMETERS           |             |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|-------------|--|--|
| Pass:                        | Root        | Hot Pass    | Fills       | Caps        |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 86 – 90     | 91 – 92     | 90 – 94     | 89 – 92     |  |  |
| Voltage Range (volts):       | 23 – 26     | 22 – 24     | 22 – 25     | 22 – 23     |  |  |
| Travel Speed Range (ipm):    | 2.9 - 3.2   | 4.1 – 5.2   | 4.0 – 4.9   | 4.5 – 5.6   |  |  |
| Heat Input Range (kJ/in.):   | 38.7 – 44.8 | 24.1 – 30.9 | 25.8 – 32.7 | 21.6 – 28.0 |  |  |
| Average Heat Input (kJ/in.): | 42.6        | 27.9        | 28.0        | 24.8        |  |  |





Test Number: 42LH-O Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 42LH-O FB1 | 42LH-O FB2 | 42LH-O FB3 | 42LH-O FB4 |
|----------------|------------|------------|------------|------------|
| Bend Diameter: | 3.5 inch   | 3.5 inch   | 3.5 inch   | 3.5 inch   |
| Туре:          | Face       | Face       | Face       | Face       |
| Results:       | Pass       | Pass       | Pass       | Pass       |

## **NICK-BREAK TEST**

| Coupon Number: | 42LH-O NB1 | 42LH-O NB2 | 42LH-O NB3 | 42LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

## **MACRO-SECTION TEST**

| Coupon Number: | 42LH-O NB1 | 42LH-O NB2 | 42LH-O NB3 | 42LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42LH-O M2 | 42LH-O M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 387.4     | 370.4     |
| Ave. Hardness (2): | 374.3     | 360.9     |
| <b>~</b> '         | /4\       |           |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page: 1 of

Test Number: 40LH-S-1

**Date:** 4/22/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Sleeve Material: 14 inch O.D., 0.375 inch wall, A106 Grade B, 0.41 C.E. (IIW) pipe

Joint Design: Circumferential fillet weld

**Position:** 5G

Welding Direction: Uphill

**Time Between Passes:** 60 minutes between the root and first cap pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (65°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** 

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

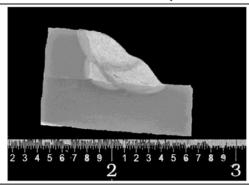
#### WELDING PARAMETERS

| WEEDINGTANAMETERS |   |
|-------------------|---|
| Root              | Caps  |
| E7018 H4R         | E7018 H4R   |
| ESAB              | ESAB  |
| 3/32              | 3/32  |
| DCEP              | DCEP  |
| 84 – 85           | 84 – 85   |
| 21 – 24           | 21 – 24   |
| 2.5 – 3.6         | 2.3 – 3.8   |
| 32.2 – 44.2       | 30.0 –48.6  |
| 36.5              | 39.5  |
|                   | Root E7018 H4R ESAB 3/32 DCEP 84 - 85 21 - 24 2.5 - 3.6 32.2 - 44.2 |



Test Number: 40LH-S-1 Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 40LH-S-1 FB1 | 40LH-S-1 FB2 | 40LH-S-1 FB3 | 40LH-S-1 FB4 |
|----------------|--------------|--------------|--------------|--------------|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:          | Face         | Face         | Face         | Face         |
| Results:       | Pass         | Pass         | Pass         | Pass         |

## **NICK-BREAK TEST**

| Coupon Number: | 40LH-S-1 NB1 | 40LH-S-1 NB2 | 40LH-S-1 NB3 | 40LH-S-1 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **MACRO-SECTION TEST**

| Coupon Number: | 40LH-S-1 M1 | 40LH-S-1 M2 | 40LH-S-1 M3 | 40LH-S-1 M4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 40LH-S-1 M2 | 40LH-S-1 M4 |  |
|--------------------|-------------|-------------|--|
| Max. Hardness (1): | 255.8       | 286.1       |  |
| Ave. Hardness (2): | 237.6       | 249.3       |  |
|                    |             |             |  |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/22/2014





Page:

1 of

Test Number: 42LH

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on Joint Design:

the branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

**Preheat Temperature:** Ambient (48°F)

**Test Medium Temperature:** 50 – 70°F

Test Medium Flow Rate: Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: Measured heat sink capacity time of 11, 10, 11, 10.5, 11.5 and 12 seconds

#### WEI DING DADAMETEDS

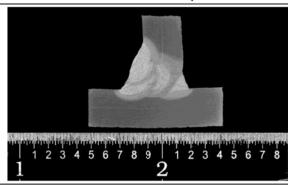
| WELDING PARAMETERS           |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 85 – 93     | 88 – 89     | 88 – 94     |  |  |
| Voltage Range (volts):       | 23 – 25     | 22 – 23     | 22 – 24     |  |  |
| Travel Speed Range (ipm):    | 3.0 - 3.6   | 2.9 – 3.3   | 2.9 – 3.5   |  |  |
| Heat Input Range (kJ/in.):   | 35.5 – 43.6 | 36.3 – 41.8 | 34.6 – 42.7 |  |  |
| Average Heat Input (kJ/in.): | 38.7        | 39.0        | 39.5        |  |  |





Test Number: 42LH Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 42LH FB1 | 42LH FB2 | 42LH FB3 | 42LH FB4 |
|-----------------------|----------|----------|----------|----------|
| <b>Bend Diameter:</b> | 3.5 inch | 3.5 inch | 3.5 inch | 3.5 inch |
| Туре:                 | Face     | Face     | Face     | Face     |
| Results:              | Pass     | Pass     | Pass     | Pass     |

## **NICK-BREAK TEST**

| Coupon Number: | 42LH NB1 | 42LH NB2 | 42LH NB3 | 42LH NB4 |
|----------------|----------|----------|----------|----------|
| Results:       | Pass     | Pass     | Pass     | Pass     |

## **MACRO-SECTION TEST**

| <b>Coupon Number:</b> | 42LH M1 | 42LH M2 | 42LH M3 | 42LH M4 |
|-----------------------|---------|---------|---------|---------|
| Results:              | Pass    | Pass    | Pass    | Pass    |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42LH M2                                | 42LH M4 |
|--------------------|--|---------|
| Max. Hardness (1): | 372.2                                  | 366.0   |
| Ave. Hardness (2): | 349.2                                  | 327.0   |
| Comments:          | (1) Maximum hardness of a single inder | nt      |

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

1 of

Test Number: 50LH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.250 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch Material: 0.250 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on the branch

**Preheat Temperature:** Ambient (77°F)

**Position:** Fixed, both plates at 45°

**Welding Direction:** 

Uphill

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

**Test Medium Temperature:** 

75 - 85°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

**Comments:** The heat sink capacity time was not measured

#### WEI DING DADAMETEDS

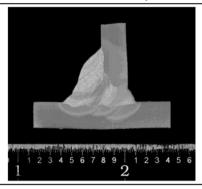
| WELDING PARAMETERS           |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|--|--|
| Pass:                        | Root        | Hot Pass    | Caps        |  |  |
| AWS Classification:          | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 82 – 87     | 82 – 83     | 83 – 85     |  |  |
| Voltage Range (volts):       | 23 – 25     | 21 – 24     | 21 – 23     |  |  |
| Travel Speed Range (ipm):    | 2.5 - 3.4   | 2.6 – 2.9   | 2.7 – 3.6   |  |  |
| Heat Input Range (kJ/in.):   | 38.2 – 45.6 | 39.6 – 41.3 | 30.2 – 40.6 |  |  |
| Average Heat Input (kJ/in.): | 42.9        | 40.5        | 36.7        |  |  |





Test Number: 50LH-O Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 50LH-O FB1 | 50LH-O FB2        | 50LH-O FB3 | 50LH-O FB4 |
|-----------------------|------------|-------------------|------------|------------|
| <b>Bend Diameter:</b> | 3.5 inch   | 3.5 inch 3.5 inch |            | 3.5 inch   |
| Type:                 | Face       | Face              | Face       | Face       |
| Results:              | Pass       | Pass              | Pass       | Pass       |

## **NICK-BREAK TEST**

| Coupon Number: | 50LH-O NB1 | 50LH-O NB2 | 50LH-O NB3 | 50LH-O NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

## **MACRO-SECTION TEST**

| Coupon Number: | 50LH-O M1 | 50LH-O M2 | 50LH-O M3 | 50LH-O M4 |
|----------------|-----------|-----------|-----------|-----------|
| Results:       | Pass      | Pass      | Pass      | Pass      |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-O M2 | 50LH-O M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 297.7     | 290.3     |
| Ave. Hardness (2): | 285.7     | 274.9     |
|                    | (4) 5 6   |           |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

1 of

**Test Number:** TBLH-S-1

**Date:** 4/22/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Sleeve Material: 14 inch O.D., 0.375 inch wall, A106 Grade B, 0.41 C.E. (IIW) pipe

Joint Design: Circumferential fillet weld

**Position:** 5G

Welding Direction: Uphill

**Time Between Passes:** 19 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (49°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

#### WELDING PARAMETERS

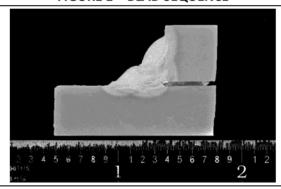
| Pass:                      | Butter Layer   | Temper Layer | Caps        |  |  |  |
|----------------------------|----------------|--------------|-------------|--|--|--|
| AWS Classification:        | E7018 H4R      | E7018 H4R    | E7018 H4R   |  |  |  |
| Manufacture:               | ESAB           | ESAB         | ESAB        |  |  |  |
| Electrode Diameter (in.):  | 3/32           | 3/32         | 3/32        |  |  |  |
| Current/Polarity:          | DCEP           | DCEP         | DCEP        |  |  |  |
| Current Range (amps):      | 73 <b>–</b> 77 | 81           | 81          |  |  |  |
| Voltage Range (volts):     | 21 – 24        | 21 – 25      | 21 – 23     |  |  |  |
| Travel Speed Range (ipm):  | 6.0 – 8.5      | 3.0 – 5.6    | 3.7 – 5.2   |  |  |  |
| Heat Input Range (kJ/in.): | 12.0 – 16.4    | 20.3 – 28.0  | 19.8 – 29.4 |  |  |  |
| Ave.e Heat Input (kJ/in.): | 14.3           | 25.8         | 24.6        |  |  |  |





Test Number: TBLH-S-1 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | TBLH-S-1 FB1   | TBLH-S-1 FB2      | TBLH-S-1 FB3 | TBLH-S-1 FB4 |
|----------------|----------------|-------------------|--------------|--------------|
| Bend Diameter: | 3.5 inch       | 3.5 inch 3.5 inch |              | 3.5 inch     |
| Type:          | Face Face Face |                   | Face         | Face         |
| Results:       | Pass           | Pass              | Pass         | Pass         |

#### **NICK-BREAK TEST**

| Coupon Number: | TBLH-S-1 NB1 | TBLH-S-1 NB2 | TBLH-S-1 NB3 | TBLH-S-1 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

## **MACRO-SECTION TEST**

| Coupon Number:    | oupon Number: TBLH-S-1 M1 |            | TBLH-S-1 M3 | TBLH-S-1 M4<br>Pass |  |
|-------------------|---------------------------|------------|-------------|---------------------|--|
| Results: Pass     |                           | Pass       | Pass        |                     |  |
| Max. Toe Spacing: | 0.060 inch                | 0.058 inch | 0.079 inch  | 0.014 inch          |  |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | TBLH-S-1 M2 | TBLH-S-1 M4 |
|--------------------|-------------|-------------|
| Max. Hardness (1): | 278.9       | 222.4       |
| Ave. Hardness (2): | 248.3       | 212.4       |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indent at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/22/2014





2

#### **API 1104 COUPON TEST REPORT**

Page:

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Test Number: 50LH-2

**Date:** 10/5/2015

Location: Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.250 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Branch Material: 0.250 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Branch-groove and fillet weld with a 3/32 inch gap, 3/32 inch land and 45° bevel on

Joint Design:

the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

**Time Between Passes:** 15 minutes between the root and hot pass, 1 hours to finish the weld

Post-weld Heat Treatment: None used

Line-up Clamps:

**Preheat Temperature:** Ambient (44°F) None used

Test Medium:

Water

**Test Medium Temperature:** 

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: The heat sink capacity time was not measured

#### WELDING PARAMETERS

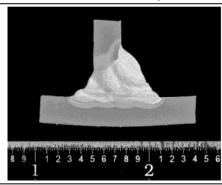
| Pass:                        | Butter      | Temper      | Root        | Hot Pass    | Caps        |  |
|------------------------------|-------------|-------------|-------------|-------------|-------------|--|
|                              | Layer       | Layer       |             |             |             |  |
| AWS Classification:          | E7018 H4R   |  |
| Manufacture:                 | ESAB        | ESAB        | ESAB        | ESAB        | ESAB        |  |
| Electrode Diameter (in.):    | 3/32        | 3/32        | 3/32        | 3/32        | 3/32        |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        | DCEP        |  |
| Current Range (amps):        | 87 – 89     | 87 – 89     | 79 – 80     | 90          | 89 – 90     |  |
| Voltage Range (volts):       | 21 – 23     | 21 – 23     | 22 – 24     | 21 – 23     | 21 – 23     |  |
| Travel Speed Range (ipm):    | 6.9 – 11.0  | 4.4 – 6.3   | 2.9 - 3.8   | 4.3 – 4.5   | 4.4 – 5.3   |  |
| Heat Input Range (kJ/in.):   | 10.6 – 17.9 | 19.0 – 26.7 | 29.6 – 38.9 | 26.0 – 27.9 | 22.5 – 27.0 |  |
| Average Heat Input (kJ/in.): | 14.9        | 23.3        | 34.7        | 26.9        | 24.0        |  |

**Comment:** A block welding sequence was used



Test Number: 50LH-2 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 50LH-2 FB1 | 50LH-2 FB2 | 50LH-2 FB3 | 50LH-2 FB4 |
|-----------------------|------------|------------|------------|------------|
| <b>Bend Diameter:</b> | 3.5 inch   | 3.5 inch   | 3.5 inch   | 3.5 inch   |
| Type:                 | Face       | Face       | Face       | Face       |
| Results:              | Pass       | Pass       | Pass       | Pass       |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-2 NB1 | 50LH-2 NB2 | 50LH-2 NB3 | 50LH-2 NB4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

## **MACRO-SECTION TEST**

| Coupon Number:    | 50LH-2 M1  | 50LH-2 M2  | 50LH-2 M3  | 50LH-2 M4  |
|-------------------|------------|------------|------------|------------|
| Results:          | Pass       | Pass       | Pass       | Pass       |
| Max. Toe Spacing: | 0.047 inch | 0.026 inch | 0.025 inch | 0.089 inch |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-2 M2 | 50LH-2 M4 |
|--------------------|-----------|-----------|
| Max. Hardness (1): | 305.1     | 355.6     |
| Ave. Hardness (2): | 275.3     | 308.1     |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015





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of

**Test Number:** TBLH-S-1

**Date:** 4/22/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 12.75 inch O.D., 0.375 inch wall, A106 Grade B, 0.31 C.E. (IIW) pipe

Sleeve Material: 14 inch O.D., 0.375 inch wall, A106 Grade B, 0.41 C.E. (IIW) pipe

Joint Design: Circumferential fillet weld

**Position:** 5G

Welding Direction: Uphill

**Time Between Passes:** 19 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (49°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

Test Medium Flow Rate:

Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

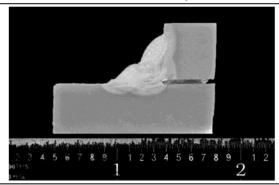
#### WELDING PARAMETERS

| Pass:                                  | Butter Layer   | Temper Layer | Caps        |  |  |  |  |
|--|----------------|--------------|-------------|--|--|--|--|
| AWS Classification:                    | E7018 H4R      | E7018 H4R    | E7018 H4R   |  |  |  |  |
| Manufacture:                           | ESAB           | ESAB         | ESAB        |  |  |  |  |
| Electrode Diameter (in.): 3/32         |                | 3/32         | 3/32        |  |  |  |  |
| Current/Polarity:                      | DCEP           | DCEP         | DCEP        |  |  |  |  |
| Current Range (amps):                  | 73 <b>–</b> 77 | 81           | 81          |  |  |  |  |
| Voltage Range (volts):                 | 21 – 24        | 21 – 25      | 21 – 23     |  |  |  |  |
| Travel Speed Range (ipm): 6.0 – 8.5    |                | 3.0 – 5.6    | 3.7 – 5.2   |  |  |  |  |
| Heat Input Range (kJ/in.): 12.0 – 16.4 |                | 20.3 – 28.0  | 19.8 – 29.4 |  |  |  |  |
| Ave.e Heat Input (kJ/in.):             | 14.3           | 25.8         | 24.6        |  |  |  |  |



Test Number: TBLH-S-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | TBLH-S-1 FB1 | TBLH-S-1 FB2 | TBLH-S-1 FB3 | TBLH-S-1 FB4 |
|----------------|--------------|--------------|--------------|--------------|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:          | Face         | Face         | Face         | Face         |
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **NICK-BREAK TEST**

| Coupon Number: | TBLH-S-1 NB1 | TBLH-S-1 NB2 | TBLH-S-1 NB3 | TBLH-S-1 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

## **MACRO-SECTION TEST**

| Coupon Number:    | TBLH-S-1 M1 | TBLH-S-1 M2 | TBLH-S-1 M3 | TBLH-S-1 M4 |
|-------------------|-------------|-------------|-------------|-------------|
| Results:          | Pass        | Pass        | Pass        | Pass        |
| Max. Toe Spacing: | 0.060 inch  | 0.058 inch  | 0.079 inch  | 0.014 inch  |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | TBLH-S-1 M2 | TBLH-S-1 M4 |
|--------------------|-------------|-------------|
| Max. Hardness (1): | 278.9       | 222.4       |
| Ave. Hardness (2): | 248.3       | 212.4       |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indent at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 4/22/2014





Page:

1 of

**Test Number:** 50LH-TW-2

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.125 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Branch Material: 0.125 inch wall, API 5L X52, 0.51 C.E. (IIW) pipe flattened into plate

Joint Design: Branch-groove and fillet weld with a 1/8 inch gap and no bevel on the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 15 minutes between the root and hot pass, 30 minutes to finish the weld

**Preheat Temperature:** Ambient (44°F)

Post-weld Heat Treatment:

None used

**Line-up Clamps:** None used

Test Medium: Water

**Test Medium Temperature:** 

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

Comments: The heat sink capacity time was not measured

#### WELDING PARAMETERS

| _                            |                     |              |             |             |
|------------------------------|---------------------|--------------|-------------|-------------|
| Pass:                        | <b>Butter Layer</b> | Temper Layer | Root        | Cap         |
| AWS Classification:          | E7018 H5            | E7018 H4R    | E7018 H4R   | E7018 H4R   |
| Manufacture:                 | ESAB                | ESAB         | ESAB        | ESAB        |
| Electrode Diameter (in.):    | 5/64                | 3/32         | 3/32        | 3/32        |
| Current/Polarity:            | DCEP                | DCEP         | DCEP        | DCEP        |
| Current Range (amps):        | 62 – 66             | 63 – 96      | 89          | 89 – 90     |
| Voltage Range (volts):       | 21 – 23             | 20 – 23      | 21 – 23     | 22 – 23     |
| Travel Speed Range (ipm):    | 5.2 – 6.8           | 3.8 – 5.7    | 4.9 – 5.1   | 4.3 – 5.3   |
| Heat Input Range (kJ/in.):   | 12.8 – 16.2         | 15.5 – 30.2  | 23.4 – 24.4 | 23.0 – 27.4 |
| Average Heat Input (kJ/in.): | 14.4                | 24.8         | 23.9        | 25.8        |
|                              |                     |              |             |             |

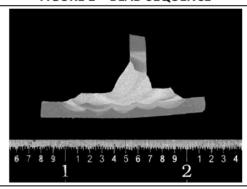
Comment: A block welding sequence was used





Test Number: 50LH-TW-2 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 50LH-TW-2 FB1 | 50LH-TW-2 FB2 | 50LH-TW-2 FB3 | 50LH-TW-2 FB4 |
|----------------|---------------|---------------|---------------|---------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch      |
| Туре:          | Face          | Face          | Face          | Face          |
| Results:       | Pass          | Pass          | Pass          | Pass          |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-TW-2 NB1 | 50LH-TW-2 NB2 | 50LH-TW-2 NB3 | 50LH-TW-2 NB4 |
|----------------|---------------|---------------|---------------|---------------|
| Results:       | Pass          | Pass          | Pass          | Pass          |

## **MACRO-SECTION TEST**

| Coupon Number:    | 50LH-TW-2 M1 | 50LH-TW-2 M2 | 50LH-TW-2 M3 | 50LH-TW-2 M4 |
|-------------------|--------------|--------------|--------------|--------------|
| Results:          | Pass         | Pass         | Pass         | Pass         |
| Max. Toe Spacing: | 0.076 inch   | 0.095 inch   | 0.072 inch   | 0.108 inch   |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-TW-2 M2 | 50LH-TW-2 M4 |
|--------------------|--------------|--------------|
| Max. Hardness (1): | 307.3        | 343.1        |
| Ave. Hardness (2): | 283.8        | 304.4        |
|                    |              |              |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 10/5/2015



#### **API 1104 COUPON TEST REPORT**

Page:

1 of

**Test Number:** 50LH-TW-3

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.125 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate

Branch Material: 0.125 inch wall, API 5L X52, 0.52 C.E. (IIW) pipe flattened into plate Joint Design: Branch-groove and fillet weld with a 1/8 inch gap and no bevel on the branch

**Position:** Fixed, both plates at 45°

Welding Direction: Uphill

Time Between Passes: 18 minutes between the root and hot pass, 30 minutes to finish the weld

**Preheat Temperature:** Ambient (72°F)

**Post-weld Heat Treatment:** None used

**Line-up Clamps:** None used

Test Medium: Water

Test Medium Temperature:

 $50 - 70^{\circ}F$ 

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

**Comments:** The heat sink capacity time was not measured

#### WEIDING PARAMETERS

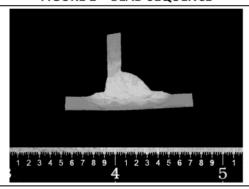
| WEEDING FARAMETERS           |              |              |             |             |  |
|------------------------------|--------------|--------------|-------------|-------------|--|
| Pass:                        | Butter Layer | Temper Layer | Root        | Cap         |  |
| AWS Classification:          | E7018 H5     | E7018 H4R    | E7018 H4R   | E7018 H4R   |  |
| Manufacture:                 | ESAB         | ESAB         | ESAB        | ESAB        |  |
| Electrode Diameter (in.):    | 5/64         | 3/32         | 3/32        | 3/32        |  |
| Current/Polarity:            | DCEP         | DCEP         | DCEP        | DCEP        |  |
| Current Range (amps):        | 61 – 66      | 80 – 82      | 76 – 81     | 85 – 86     |  |
| Voltage Range (volts):       | 21 – 24      | 21 – 22      | 21 – 22     | 21 – 23     |  |
| Travel Speed Range (ipm):    | 8.9 - 13.0   | 5.5 – 8.9    | 3.9 – 4.5   | 4.2 – 5.0   |  |
| Heat Input Range (kJ/in.):   | 6.9 - 10.8   | 11.9 – 18.0  | 23.6 – 25.2 | 22.4 – 27.3 |  |
| Average Heat Input (kJ/in.): | 8.9          | 15.4         | 24.3        | 25.2        |  |

**Comment:** A block welding sequence was used



Test Number: 50LH-TW-3 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE



## **BEND TEST**

| Coupon Number: | 50LH-TW-3 FB1 | 50LH-TW-3 FB2 | 50LH-TW-3 FB3 | 50LH-TW-3 FB4 |
|----------------|---------------|---------------|---------------|---------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch      |
| Туре:          | Face          | Face          | Face          | Face          |
| Results:       | Pass          | Pass          | Pass          | Pass          |

#### **NICK-BREAK TEST**

| Coupon Number: | 50LH-TW-3 NB1 | 50LH-TW-3 NB2 | 50LH-TW-3 NB3 | 50LH-TW-3 NB4 |
|----------------|---------------|---------------|---------------|---------------|
| Results:       | Pass          | Pass          | Pass          | Pass          |

## **MACRO-SECTION TEST**

| Coupon Number:   | 50LH-TW-3 M1 | 50LH-TW-3 M2 | 50LH-TW-3 M3 | 50LH-TW-3 M4 |
|------------------|--------------|--------------|--------------|--------------|
| Results:         | Pass         | Pass         | Pass         | Pass         |
| Max. Toe Spacing | 0.079 inch   | 0.107 inch   | 0.080 inch   | 0.098 inch   |

# VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 50LH-TW-3 M2 | 50LH-TW-3 M4 |
|--------------------|--------------|--------------|
| Max. Hardness (1): | 494.1        | 474.9        |
| Ave. Hardness (2): | 443.9        | 460.9        |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 10/5/2015





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1 of

**Test Number:** 25CLH-B-1

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, API 5L X70, 0.33 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, API 5L X42, 0.31 C.E. (IIW) pipe Branch-groove and fillet weld with a 3/32 inch gap, 1/16 inch land and 45° bevel on

Joint Design:

the branch

**Position:** 5G, branch and pipe

Welding Direction: Downhill-Root/Uphill-Rem.

**Time Between Passes:** 17 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (67°F)

Post-weld Heat Treatment: None used

Line-up Clamps: None used

Test Medium: Oil

**Test Medium Temperature:** 75 – 85°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

#### WELDING PARAMETERS

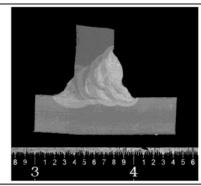
| WELDING FARAMETERS         |             |             |             |             |  |
|----------------------------|-------------|-------------|-------------|-------------|--|
| Pass:                      | Root        | Hot Pass    | Fills       | Caps        |  |
| AWS Classification:        | E6010       | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |
| Manufacture:               | Lincoln     | ESAB        | ESAB        | ESAB        |  |
| Electrode Diameter (in.):  | 1/8         | 3/32        | 3/32        | 3/32        |  |
| Current/Polarity:          | DCEP        | DCEP        | DCEP        | DCEP        |  |
| Current Range (amps):      | 80 – 103    | 91 – 93     | 90 – 100    | 89 – 91     |  |
| Voltage Range (volts):     | 23 – 32     | 22 – 25     | 21 – 26     | 21 – 24     |  |
| Travel Speed Range (ipm):  | 2.1 – 7.9   | 4.3 – 6.0   | 4.1 – 7.0   | 4.2 – 5.5   |  |
| Heat Input Range (kJ/in.): | 17.9 – 73.3 | 21.8 – 30.6 | 16.4 – 32.4 | 22.0 – 29.4 |  |
| Ave. Heat Input (kJ/in.):  | 43.6        | 26.8        | 25.7        | 26.4        |  |

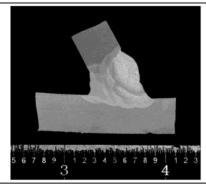




Test Number: 25CLH-B-1 Page: 2 of 2

## FIGURE 1 - BEAD SEQUENCE





## **BEND TEST**

| Coupon Number: | 25CLH-B-1 FB3 | 25CLH-B-1 FB6 | 25CLH-B-1 FB9 | 25CLH-B-1 FB12 |
|----------------|---------------|---------------|---------------|----------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch       |
| Type:          | Face          | Face          | Face          | Face           |
| Results:       | Pass          | Pass          | Pass          | Pass           |

## **NICK-BREAK TEST**

| Coupon Number: | 25CLH-B-1 NB3 | 25CLH-B-1 NB6 | 25CLH-B-1 NB9 | 25CLH-B-1 NB12 |
|----------------|---------------|---------------|---------------|----------------|
| Results:       | Pass          | Pass          | Pass          | Pass           |

## **MACRO-SECTION TEST**

| Coupon Number: | 25CLH-B-1 M3 | 25CLH-B-1 M6 | 25CLH-B-1 M9 | 25CLH-B-1 M12 |
|----------------|--------------|--------------|--------------|---------------|
| Results:       | Pass         | Pass         | Pass         | Pass          |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 25CLH-B-1 M3 | 25CLH-B-1 M12 |
|--------------------|--------------|---------------|
| Max. Hardness (1): | 291.6        | 303.7         |
| Ave. Hardness (2): | 267.1        | 292.0         |
| <b>~</b>           | (4) 0.4      |               |

(1) Maximum hardness of a single indent (2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page: 1 of

Test Number: 35CLH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 1/8 inch land and 45° bevel on the

branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** Downhill-Root/Uphill-Rem.

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

**Preheat Temperature:** Ambient (67°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

 $75 - 85^{\circ}F$ **Test Medium Temperature:** 

Test Medium Flow Rate: Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

Comments:

Measured heat sink capacity time of 45, 48, 53, 55 and 49 seconds

#### WEI DING DADAMETEDS

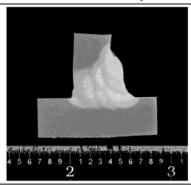
| WELDING PARAMETERS           |             |             |             |             |
|------------------------------|-------------|-------------|-------------|-------------|
| Pass:                        | Root        | Hot Pass    | Fills       | Caps        |
| AWS Classification:          | E6010       | E7018 H4R   | E7018 H4R   | E7018 H4R   |
| Manufacture:                 | Lincoln     | ESAB        | ESAB        | ESAB        |
| Electrode Diameter (in.):    | 1/8         | 3/32        | 3/32        | 3/32        |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        |
| Current Range (amps):        | 79 – 83     | 97 – 99     | 87 – 88     | 87 – 89     |
| Voltage Range (volts):       | 24 – 26     | 23 – 24     | 21 – 23     | 21 – 23     |
| Travel Speed Range (ipm):    | 4.0 - 4.4   | 4.2 - 5.0   | 4.1 – 5.5   | 4.1 – 5.4   |
| Heat Input Range (kJ/in.):   | 27.5 – 30.1 | 28.1 – 33.4 | 21.1 – 28.6 | 21.2 – 28.3 |
| Average Heat Input (kJ/in.): | 28.8        | 29.6        | 24.7        | 25.2        |





Test Number: 35CLH-O Page: 2 of 2

## FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 35CLH-O FB1 | 35CLH-O FB2 | 35CLH-O FB3 | 35CLH-O FB4 |
|-----------------------|-------------|-------------|-------------|-------------|
| <b>Bend Diameter:</b> | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Type:                 | Face        | Face        | Face        | Face        |
| Results:              | Pass        | Pass        | Pass        | Pass        |

## **NICK-BREAK TEST**

| Coupon Number: | 35CLH-O NB1 | 35CLH-O NB2 | 35CLH-O NB3 | 35CLH-O NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **MACRO-SECTION TEST**

| Coupon Number: | 35CLH-O M1 | 35CLH-O M2 | 35CLH-O M3 | 35CLH-O M4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

## VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 35CLH-O M2 | 35CLH-O M4 |
|--------------------|------------|------------|
| Max. Hardness (1): | 230.2      | 270.6      |
| Ave. Hardness (2): | 220.5      | 249.8      |
|                    | (4) 5.6    | _          |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

Date: 10/5/2015





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of 2

**Test Number:** 25CLH-S-1

**Date:** 8/29/2016

Location: Kiefner Mechanical Test Lab, Worthington, Ohio Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 12.75 inch O.D., 0.375 inch wall, API 5L X42, 0.41 C.E. (IIW) pipe

Sleeve Material: 12.75 inch O.D., 0.250 inch wall, API 5L X60, 0.28 C.E. (IIW) pipe

Joint Design: Circumferential fillet weld

Position: 5G

Welding Direction: Downhill-Root/Uphill-Rem.

**Time Between Passes:** 19 minutes between the root and first cap pass, 2 hours to finish the weld

**Preheat Temperature:** Ambient (79°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil **Test Medium Temperature:** 75 – 85°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Oil was not pressurized

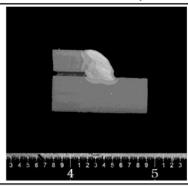
#### WELDING PARAMETERS

| Pass:                      | Root        | Caps        |  |  |
|----------------------------|-------------|-------------|--|--|
| <b>AWS Classification:</b> | E6010       | E7018 H4R   |  |  |
| Manufacture:               | Lincoln     | ESAB        |  |  |
| Electrode Diameter (in.):  | 1/8         | 3/32        |  |  |
| Current/Polarity:          | DCEP        | DCEP        |  |  |
| Current Range (amps):      | 86 – 92     | 92 – 95     |  |  |
| Voltage Range (volts):     | 20 – 29     | 22 – 25     |  |  |
| Travel Speed Range (ipm):  | 4.1 – 8.4   | 3.7 – 6.6   |  |  |
| Heat Input Range (kJ/in.): | 16.2 – 34.8 | 19.5 – 35.5 |  |  |
| Ave. Heat Input (kJ/in.):  | 24.1        | 23.7        |  |  |
|                            |             |             |  |  |



Test Number: 25CLH-S-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number:        | 25CLH-S-1 FB1 | 25CLH-S-1 FB2 | 25CLH-S-1 FB3 | 25CLH-S-1 FB4 |
|-----------------------|---------------|---------------|---------------|---------------|
| <b>Bend Diameter:</b> | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch      |
| Type:                 | Face          | Face          | Face          | Face          |
| Results:              | Pass          | Pass          | Pass          | Pass          |

#### **NICK-BREAK TEST**

| Coupon Number: | 25CLH-S-1 NB1 | 25CLH-S-1 NB2 | 25CLH-S-1 NB3 | 25CLH-S-1 NB4 |
|----------------|---------------|---------------|---------------|---------------|
| Results:       | Pass          | Pass          | Pass          | Pass          |

#### **MACRO-SECTION TEST**

| Coupon Number: | 25CLH-S-1 M1 | 25CLH-S-1 M2 | 25CLH-S-1 M3 | 25CLH-S-1 M4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 25CLH-S-1 M2 | 25CLH-S-1 M4 |
|--------------------|--------------|--------------|
| Max. Hardness (1): | 283.6        | 332.0        |
| Ave. Hardness (2): | 267.2        | 305.7        |
| <u> </u>           | (4) 5 6      |              |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 8/29/2016

Test Conducted By: Jeff Balka
Certified By: Matt Boring, P.E., CWI





Page: 1 of

Test Number: 35CLH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.35 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 1/8 inch land and 45° bevel on the

branch

**Position:** Fixed, both plates at 45°

**Welding Direction:** Downhill-Root/Uphill-Rem.

Time Between Passes: 15 minutes between the root and hot pass, 1 hour to finish the weld

**Preheat Temperature:** Ambient (67°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

75 - 85°F

**Test Medium Temperature:** 

Test Medium Flow Rate: Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

Comments: Measured heat sink capacity time of 45, 48, 53, 55 and 49 seconds

#### WEI DING DADAMETEDS

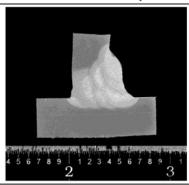
| WELDING PARAMETERS           |             |             |             |             |  |  |  |
|------------------------------|-------------|-------------|-------------|-------------|--|--|--|
| Pass:                        | Root        | Hot Pass    | Fills       | Caps        |  |  |  |
| AWS Classification:          | E6010       | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:                 | Lincoln     | ESAB        | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):    | 1/8         | 3/32        | 3/32        | 3/32        |  |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):        | 79 – 83     | 97 – 99     | 87 – 88     | 87 – 89     |  |  |  |
| Voltage Range (volts):       | 24 – 26     | 23 – 24     | 21 – 23     | 21 – 23     |  |  |  |
| Travel Speed Range (ipm):    | 4.0 - 4.4   | 4.2 – 5.0   | 4.1 – 5.5   | 4.1 – 5.4   |  |  |  |
| Heat Input Range (kJ/in.):   | 27.5 – 30.1 | 28.1 – 33.4 | 21.1 – 28.6 | 21.2 – 28.3 |  |  |  |
| Average Heat Input (kJ/in.): | 28.8        | 29.6        | 24.7        | 25.2        |  |  |  |





Test Number: 35CLH-O Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 35CLH-O FB1 | 35CLH-O FB2 | 35CLH-O FB3 | 35CLH-O FB4 |
|----------------|-------------|-------------|-------------|-------------|
| Bend Diameter: | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Type:          | Face        | Face        | Face        | Face        |
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **NICK-BREAK TEST**

| Coupon Number: | 35CLH-O NB1 | 35CLH-O NB2 | 35CLH-O NB3 | 35CLH-O NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **MACRO-SECTION TEST**

| Coupon Number: | 35CLH-O M1 | 35CLH-O M2 | 35CLH-O M3 | 35CLH-O M4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

#### VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 35CLH-O M2 | 35CLH-O M4 |
|--------------------|------------|------------|
| Max. Hardness (1): | 230.2      | 270.6      |
| Ave. Hardness (2): | 220.5      | 249.8      |
|                    | (4) 5.6    | _          |

Comments: (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

1 of

**Test Number:** 40CLH-B-2

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.375 inch wall, API 5L X70, 0.33 C.E. (IIW) pipe

Branch Material: 12.75 inch O.D., 0.375 inch wall, API 5L X42, 0.31 C.E. (IIW) pipe Branch-groove and fillet weld with a 3/32 inch gap, 1/16 inch land and 45° bevel on

Joint Design:

the branch

**Position:** 5G, branch and pipe

**Welding Direction:** Downhill-Root/Uphill-Rem.

Time Between Passes: 20 minutes between the root and hot pass, 5 hours to finish the weld

Post-weld Heat Treatment: None used

Line-up Clamps: None used

**Preheat Temperature:** Ambient (62°F)

Test Medium: Oil

**Test Medium Temperature:** 50 – 70°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

WELDING PARAMETERS

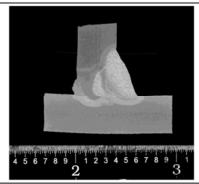
| WEEDING PARAMETERS         |             |             |             |  |  |  |
|----------------------------|-------------|-------------|-------------|--|--|--|
| Pass:                      | Root        | Hot Pass    | Caps        |  |  |  |
| AWS Classification: E6010  |             | E7018 H4R   | E7018 H4R   |  |  |  |
| Manufacture:               | Lincoln     | ESAB        | ESAB        |  |  |  |
| Electrode Diameter (in.):  | 1/8         | 3/32        | 3/32        |  |  |  |
| Current/Polarity:          | DCEP        | DCEP        | DCEP        |  |  |  |
| Current Range (amps):      | 80 – 101    | 78 – 89     | 81 – 89     |  |  |  |
| Voltage Range (volts):     | 23 – 31     | 21 – 25     | 22 – 27     |  |  |  |
| Travel Speed Range (ipm):  | 2.6 – 6.0   | 2.5 – 3.7   | 2.6 – 3.7   |  |  |  |
| Heat Input Range (kJ/in.): | 22.1 – 54.1 | 33.7 – 51.0 | 32.3 – 48.4 |  |  |  |
| Ave. Heat Input (kJ/in.):  | 37.1        | 41.2        | 41.6        |  |  |  |

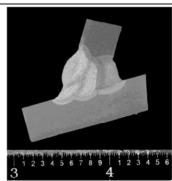




Test Number: 40CLH-B-2 Page: 2 of 2

#### FIGURE 1 - BEAD SEQUENCE





#### **BEND TEST**

| Coupon Number: | 40CLH-B-2 FB3 | 40CLH-B-2 FB6 | 40CLH-B-2 FB9 | 40CLH-B-2 FB12 |
|----------------|---------------|---------------|---------------|----------------|
| Bend Diameter: | 3.5 inch      | 3.5 inch      | 3.5 inch      | 3.5 inch       |
| Type:          | Face          | Face          | Face          | Face           |
| Results:       | Fail          | Pass          | Pass          | Pass           |

#### **NICK-BREAK TEST**

| Coupon Number: | 40CLH-B-2 NB3 | 40CLH-B-2 NB6 | 40CLH-B-2 NB9 | 40CLH-B-2 NB12 |
|----------------|---------------|---------------|---------------|----------------|
| Results:       | Pass          | Pass          | Pass          | Pass           |

#### **MACRO-SECTION TEST**

| Coupon Number: | 40CLH-B-2 M3 | 40CLH-B-2 M6 | 40CLH-B-2 M9 | 40CLH-B-2 M12 |
|----------------|--------------|--------------|--------------|---------------|
| Results:       | Pass         | Pass         | Pass         | Pass          |

#### VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 40CLH-B-2 M3                           | 40CLH-B-2 M12 |
|--------------------|--|---------------|
| Max. Hardness (1): | 238.4                                  | 285.7         |
| Ave. Hardness (2): | 234.6                                  | 273.6         |
| Comments:          | (1) Maximum hardness of a single inden | t             |

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





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Test Number: 42CLH-O

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Branch Material: 0.375 inch wall, A516 Grade 70, 0.42 C.E. (IIW) plate

Joint Design:

Branch-groove and fillet weld with a 1/8 inch gap, 3/32 inch land and 45° bevel on

the branch

Preheat Temperature: Ambient (73°F)

**Position:** Fixed, both plates at 45°

**Welding Direction:** Downhill-Root/Uphill-Rem.

Time Between Passes: 17 minutes between the Root and Hot Pass, 1 hour to finish the weld

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Oil

75 - 85°F

Test Medium Temperature:

Test Medium Flow Rate: Approximately 3 gallons a minute

**Test Medium Pressure:** Oil was not pressurized

**Comments:** Measured heat sink capacity time of 45, 48, 53, 55 and 49 seconds

#### WEI DING DADAMETEDS

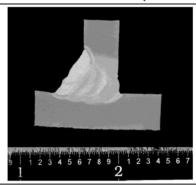
| WELDING PARAMETERS           |             |             |             |             |  |  |
|------------------------------|-------------|-------------|-------------|-------------|--|--|
| Pass:                        | Root        | Hot Pass    | Fills       | Caps        |  |  |
| AWS Classification:          | E6010       | E7018 H4R   | E7018 H4R   | E7018 H4R   |  |  |
| Manufacture:                 | Lincoln     | ESAB        | ESAB        | ESAB        |  |  |
| Electrode Diameter (in.):    | 1/8         | 3/32        | 3/32        | 3/32        |  |  |
| Current/Polarity:            | DCEP        | DCEP        | DCEP        | DCEP        |  |  |
| Current Range (amps):        | 92 – 95     | 91 – 93     | 87 – 89     | 87 – 90     |  |  |
| Voltage Range (volts):       | 25 – 27     | 22 – 26     | 22 – 24     | 22 – 24     |  |  |
| Travel Speed Range (ipm):    | 4.2 – 5.5   | 2.9 – 3.6   | 2.7 – 3.1   | 2.9 – 3.3   |  |  |
| Heat Input Range (kJ/in.):   | 26.4 – 33.9 | 37.3 – 43.7 | 39.7 – 44.4 | 36.5 – 43.2 |  |  |
| Average Heat Input (kJ/in.): | 30.8        | 40.2        | 41.5        | 38.6        |  |  |





Test Number: 42CLH-O Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **BEND TEST**

| Coupon Number: | 42CLH-O FB1 | 42CLH-O FB2 | 42CLH-O FB3 | 42CLH-O FB4 |
|----------------|-------------|-------------|-------------|-------------|
| Bend Diameter: | 3.5 inch    | 3.5 inch    | 3.5 inch    | 3.5 inch    |
| Type:          | Face        | Face        | Face        | Face        |
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **NICK-BREAK TEST**

| Coupon Number: | 42CLH-O NB1 | 42CLH-O NB2 | 42CLH-O NB3 | 42CLH-O NB4 |
|----------------|-------------|-------------|-------------|-------------|
| Results:       | Pass        | Pass        | Pass        | Pass        |

#### **MACRO-SECTION TEST**

| Coupon Number: | 42CLH-O M1 | 42CLH-O M2 | 42CLH-O M3 | 42CLH-O M4 |
|----------------|------------|------------|------------|------------|
| Results:       | Pass       | Pass       | Pass       | Pass       |

#### VICKERS HAZ HARDNESS TEST (HV), 10 kg

| Coupon Number:     | 42CLH-O M2 | 42CLH-O M4 |
|--------------------|------------|------------|
| Max. Hardness (1): | 327.2      | 231.3      |
| Ave. Hardness (2): | 289.6      | 224.12     |
|                    | (4) 6      | _          |

**Comments:** (1) Maximum hardness of a single indent

(2) Average of five indents at weld toe

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

**Test Number:** X42LH-LS-1

**Date:** 5/29/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Joint Design:

Sleeve Material: 14 inch O.D., 0.375 inch wall, API 5L X42, 0.41 C.E. (IIW) pipe

Long seam on a 1/8 inch backing bar with a 3/8 inch gap, no land and 20° bevel on

the sleeve

Position: 5G

Welding Direction: Horizontal

**Time Between Passes:** 16 minutes between the root and hot pass, 3 hours to finish the weld

**Preheat Temperature:** Ambient (52°F)

Post-weld Heat Treatment: None used

Line-up Clamps: None used

**Test Medium:** Water flowing through the run pipe

**Test Medium Temperature:**  $40-60^{\circ}$ F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

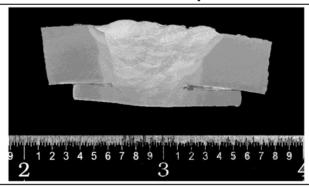
#### WELDING DADAMETERS

| WELDING PARAMETERS        |           |           |           |            |  |  |
|---------------------------|-----------|-----------|-----------|------------|--|--|
| Pass:                     | Root      | Hot Pass  | Fills     | Caps       |  |  |
| AWS Classification:       | E7018 H4R | E7018 H4R | E7018 H4R | E7018 H4R  |  |  |
| Manufacture:              | ESAB      | ESAB      | ESAB      | ESAB       |  |  |
| Electrode Diameter (in.): | 3/32      | 3/32      | 3/32      | 3/32       |  |  |
| Current/Polarity:         | DCEP      | DCEP      | DCEP      | DCEP       |  |  |
| Current Range (amps):     | 84 – 86   | 84 – 89   | 87 – 88   | 86 – 87    |  |  |
| Voltage Range (volts):    | 21 – 25   | 24 – 26   | 21 – 23   | 21 – 24    |  |  |
| Travel Speed Range (ipm): | 4.7 – 7.8 | 4.1 – 5.6 | 4.4 – 9.9 | 5.7 – 10.0 |  |  |



Test Number: X42LH-LS-1 Page: 2 of 2

#### FIGURE 1 -BEAD SEQUENCE



#### **TENSILE TEST**

| Coupon Number:     | X42LH-LS-1 T1           | X42LH-LS-1 T2           |
|--------------------|-------------------------|-------------------------|
| Coupon Width:      | 0.966 inch              | 0.800 inch              |
| Coupon Thickness:  | 0.386 inch              | 0.384 inch              |
| Coupon Area:       | 0.373 inch <sup>2</sup> | 0.307 inch <sup>2</sup> |
| Maximum Load:      | 28,766 lb.              | 24,636 lb.              |
| Tensile Strength:  | 77,120 psi              | 80,249 psi              |
| Fracture Location: | Sleeve                  | Sleeve                  |

#### **BEND TEST**

| Coupon Number: | X42LH-LS-1 FB1 | X42LH-LS-1 FB2 | X42LH-LS-1 RB1 | X42LH-LS-1 RB2 |
|----------------|----------------|----------------|----------------|----------------|
| Bend Diameter: | 3.5 inch       | 3.5 inch       | 3.5 inch       | 3.5 inch       |
| Type:          | Face           | Face           | Root           | Root           |
| Results:       | Pass           | Pass           | Pass           | Pass           |

#### **NICK-BREAK TEST**

| Coupon Number: | X42LH-LS-1 NB1 | X42LH-LS-1 NB2 |
|----------------|----------------|----------------|
| Results:       | Pass           | Pass           |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 5/29/2014





Page:

**Test Number:** X60LH-LS-1

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Sleeve Material: 12.75 inch O.D., 0.375 inch wall, API 5L X60, 0.43 C.E. (IIW) pipe

Long seam on a 1/16 inch backing bar with a 3/32 inch gap, no land and 20° bevel on

Joint Design:

the sleeve

Position: 5G

Welding Direction: Horizontal

**Time Between Passes:** 46 minutes between the root and hot pass, 2 hours to finish the weld

Post-weld Heat Treatment: None used

**Preheat Temperature:** Ambient (69°F) Line-up Clamps: None used

**Test Medium:** Water flowing through the run pipe

**Test Medium Temperature:**  $40-60^{\circ}$ F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

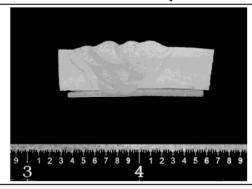
#### WEIDING PARAMETERS

| WELDING PARAWETERS        |            |           |           |            |  |  |
|---------------------------|------------|-----------|-----------|------------|--|--|
| Pass:                     | Root       | Hot Pass  | Fills     | Caps       |  |  |
| AWS Classification:       | E7018 H4R  | E7018 H4R | E7018 H4R | E7018 H4R  |  |  |
| Manufacture:              | ESAB       | ESAB      | ESAB      | ESAB       |  |  |
| Electrode Diameter (in.): | 1/8        | 1/8       | 1/8       | 1/8        |  |  |
| Current/Polarity:         | DCEP       | DCEP      | DCEP      | DCEP       |  |  |
| Current Range (amps):     | 91 – 92    | 92 – 102  | 102 – 103 | 102 – 103  |  |  |
| Voltage Range (volts):    | 21 – 22    | 20 – 22   | 20 – 22   | 20 – 22    |  |  |
| Travel Speed Range (ipm): | 6.6 - 10.2 | 5.9 – 9.2 | 6.4 – 8.1 | 6.3 – 12.0 |  |  |



Test Number: X60LH-LS-1 Page: 2 of 2

#### FIGURE 1 -BEAD SEQUENCE



#### **TENSILE TEST**

| Coupon Number:     | X60LH-LS-1 T1 X60LH-LS-1 T2 |                         |  |
|--------------------|-----------------------------|-------------------------|--|
| Coupon Width:      | 1.009 inch                  | 1.023 inch              |  |
| Coupon Thickness:  | 0.360 in.ch                 | 0.360 inch              |  |
| Coupon Area:       | 0.363 inch <sup>2</sup>     | 0.368 inch <sup>2</sup> |  |
| Maximum Load:      | 31,259 lb.                  | 32,502 lb.              |  |
| Tensile Strength:  | 86,113 psi                  | 88,321 psi              |  |
| Fracture Location: | Sleeve                      | Sleeve                  |  |

#### **BEND TEST**

| Coupon Number: | X60LH-LS-1 FB1 | X60LH-LS-1 FB2 | X60LH-LS-1 RB1 | X60LH-LS-1 RB2 |
|----------------|----------------|----------------|----------------|----------------|
| Bend Diameter: | 3.5 inch       | 3.5 inch       | 3.5 inch       | 3.5 inch       |
| Type:          | Face           | Face           | Root           | Root           |
| Results:       | Pass           | Pass           | Pass           | Pass           |

#### **NICK-BREAK TEST**

| Coupon Number: X60LH-LS-1 NB1 |      | X60LH-LS-1 NB2 |  |
|-------------------------------|------|----------------|--|
| Results:                      | Pass | Pass           |  |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 10/5/2015





Page:

Test Number:

X65LH-LS-7018-1

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Sleeve Material: 12.75 inch O.D., 0.250 inch wall, API 5L X65 pipe

Long seam on a 1/16 inch backing bar with a 3/32 inch gap, no land and 30° bevel on

Joint Design:

the sleeve

Position: 5G

Welding Direction: Horizontal

Time Between Passes: 31 minutes between the root and first cap pass, 1 hour to finish the weld

**Preheat Temperature:** Ambient (71°F)

Post-weld Heat Treatment: None used

Line-up Clamps:

None used

**Test Medium:** Water flowing through the run pipe

**Test Medium Temperature:** 50 – 70°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

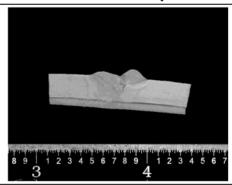
#### WELDING PARAMETERS

| Pass:                     | Root      | Caps       |
|---------------------------|-----------|------------|
| AWS Classification:       | E7018 H4R | E7018 H4R  |
| Manufacture:              | ESAB      | ESAB       |
| Electrode Diameter (in.): | 1/8       | 1/8        |
| Current/Polarity:         | DCEP      | DCEP       |
| Current Range (amps):     | 91 – 92   | 91 – 92    |
| Voltage Range (volts):    | 21 – 22   | 19 – 23    |
| Travel Speed Range (ipm): | 6.1 – 6.2 | 4.4 – 12.0 |
|                           |           |            |



Test Number: X65LH-LS-7018-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **TENSILE TEST**

| Coupon Number:     | X65LH-LS-7018-1 T1                              | X65LH-LS-7018-1 T2 |
|--------------------|---|--------------------|
| Coupon Width:      | 1.023 inch                                      | 0.984 inch         |
| Coupon Thickness:  | 0.217 inch                                      | 0.222 inch         |
| Coupon Area:       | 0.222 inch <sup>2</sup> 0.218 inch <sup>2</sup> |                    |
| Maximum Load:      | 19,687 lb.                                      | 17,801 lb.         |
| Tensile Strength:  | 88,678 psi                                      | 81,657 psi         |
| Fracture Location: | Sleeve Sleeve                                   |                    |

### BEND TEST

| Coupon Number:        | X65LH-LS-7018-1 | X65LH-LS-7018-1 | X65LH-LS-7018-1 | X65LH-LS-7018-1 |
|-----------------------|-----------------|-----------------|-----------------|-----------------|
|                       | FB1             | FB2             | RB1             | RB2             |
| <b>Bend Diameter:</b> | 3.5 inch        | 3.5 inch        | 3.5 inch        | 3.5 inch        |
| Type:                 | Face            | Face            | Root            | Root            |
| Results:              | Pass            | Pass            | Pass            | Pass            |

#### **NICK-BREAK TEST**

| Coupon Number: | X65LH-LS-7018-1 NB1 | X65LH-LS-7018-1 NB2 |  |
|----------------|---------------------|---------------------|--|
| Results:       | Pass                | Pass                |  |

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015





Page:

Test Number:

X65LH-LS-8018-1

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Sleeve Material: 12.75 inch O.D., 0.250 inch wall, API 5L X65 pipe

Long seam on a 1/16 inch backing bar with a 3/32 inch gap, no land and 30° bevel on

Joint Design:

the sleeve

Position: 5G

Welding Direction: Horizontal

Time Between Passes:

73 minutes between the root and first cap pass, 1 hour to finish the weld **Preheat Temperature:** Ambient (70°F)

Post-weld Heat Treatment: None used

Line-up Clamps: None used

**Test Medium:** Water flowing through the run pipe

**Test Medium Temperature:** 50 – 70°F

**Test Medium Flow Rate:** Approximately 3 gallons a minute

Test Medium Pressure: Water was not pressurized

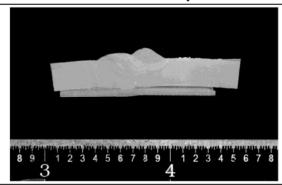
#### WELDING PARAMETERS

| Pass:                     | Root         | Caps         |  |  |  |
|---------------------------|--------------|--------------|--|--|--|
| AWS Classification:       | E8018-C3 H4R | E8018-C3 H4R |  |  |  |
| Manufacture:              | ESAB         | ESAB         |  |  |  |
| Electrode Diameter (in.): | 1/8          | 1/8          |  |  |  |
| Current/Polarity:         | DCEP         | DCEP         |  |  |  |
| Current Range (amps):     | 91 – 92      | 91 – 93      |  |  |  |
| Voltage Range (volts):    | 21 – 24      | 19 – 23      |  |  |  |
| Travel Speed Range (ipm): | 4.5 – 5.7    | 3.8 – 10.3   |  |  |  |
|                           |              |              |  |  |  |



Test Number: X65LH-LS-8018-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **TENSILE TEST**

| Coupon Number:     | X65LH-LS-8018-1 T1      | X65LH-LS-8018-1 T2      |
|--------------------|-------------------------|-------------------------|
| Coupon Width:      | 1.005 inch              | 0.980 inch              |
| Coupon Thickness:  | 0.221 inch              | 0.217 inch              |
| Coupon Area:       | 0.222 inch <sup>2</sup> | 0.213 inch <sup>2</sup> |
| Maximum Load:      | 18,062 lb. 18,446 lb.   |                         |
| Tensile Strength:  | 81,360 psi              | 86,600 psi              |
| Fracture Location: | Sleeve Sleeve           |                         |

#### **BEND TEST**

| Coupon Number:        | X65LH-LS-8018-1 | X65LH-LS-8018-1 | X65LH-LS-8018-1 | X65LH-LS-8018-1 |
|-----------------------|-----------------|-----------------|-----------------|-----------------|
|                       | FB1             | FB2             | RB1             | RB2             |
| <b>Bend Diameter:</b> | 3.5 inch        | 3.5 inch        | 3.5 inch        | 3.5 inch        |
| Type:                 | Face            | Face            | Root            | Root            |
| Results:              | Pass            | Pass            | Pass            | Pass            |

#### **NICK-BREAK TEST**

| Coupon Number: | X65LH-LS-8018-1 NB1 | X65LH-LS-8018-1 NB2 |  |
|----------------|---------------------|---------------------|--|
| Results:       | Pass                | Pass                |  |

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 20th Edition of API 1104 and the 21st Edition of API 1104

**Date:** 10/5/2015





Page:

**Test Number:** X70LH-LS-7018-1

**Date:** 11/24/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Position: 5G

Sleeve Material: 20 inch O.D., 0.500 inch wall, API 5L X70, 0.29 C.E. (IIW) pipe

Long seam on a 1/2 inch backing bar with a 5/32 inch gap, no land and 30° bevel on

Joint Design:

the sleeve

Welding Direction: Horizontal

Time Between Passes: 21 minutes between the root and hot Pass, 1 hours to finish the weld

**Preheat Temperature:** Ambient (75°F)

Post-weld Heat Treatment: None used

Line-up Clamps: None used

Test Medium: Air

Test Medium Temperature: Ambient

Test Medium Flow Rate: Not flowing

Test Medium Pressure: Air was not pressurized

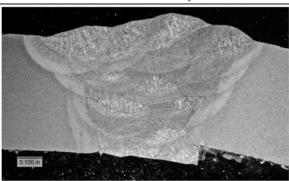
#### VALED DINIC DADAMETED

| WELDING PARAMETERS        |           |           |            |           |
|---------------------------|-----------|-----------|------------|-----------|
| Pass:                     | Root      | Hot Pass  | Fills      | Caps      |
| AWS Classification:       | E7018 H4R | E7018 H4R | E7018 H4R  | E7018 H4R |
| Manufacture:              | ESAB      | ESAB      | ESAB       | ESAB      |
| Electrode Diameter (in.): | 1/8       | 1/8       | 1/8        | 3/32      |
| Current/Polarity:         | DCEP      | DCEP      | DCEP       | DCEP      |
| Current Range (amps):     | 97 – 111  | 121 – 124 | 121 – 126  | 122 – 125 |
| Voltage Range (volts):    | 22 – 24   | 21 – 23   | 21 – 22    | 21 – 22   |
| Travel Speed Range (ipm): | 5.2 – 6.4 | 5.8 – 7.3 | 5.0 – 10.9 | 7.4 – 8.6 |



Test Number: X70LH-LS-7018-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **TENSILE TEST**

| <b>Coupon Number:</b> X70LH-LS-7018-1 T1 X70LH-LS-7018-1 T2         |  |
|---|--|
| Coupon Width: 0.960 inch 0.973 inch                                 |  |
| Coupon Thickness: 0.485 inch 0.486 inch                             |  |
| <b>Coupon Area:</b> 0.466 inch <sup>2</sup> 0.473 inch <sup>2</sup> |  |
| <b>Maximum Load:</b> 43,429 lb. 44,332 lb.                          |  |
| <b>Tensile Strength:</b> 93,195 psi 93,725 psi                      |  |
| Fracture Location: Weld (1) Weld (1)                                |  |

**Comment:** (1) The weld meets the acceptance criteria of API 1104 Section 5.6.3.3.

#### **BEND TEST**

| Causan Number  | X70LH-LS-7018-1 | X70LH-LS-7018-1 | X70LH-LS-7018-1 | X70LH-LS-7018-1 |  |
|----------------|-----------------|-----------------|-----------------|-----------------|--|
| Coupon Number: | FB1             | FB2             | RB1             | RB2             |  |
| Bend Diameter: | 3.5 inch        | 3.5 inch        | 3.5 inch        | 3.5 inch        |  |
| Type:          | Face            | Face            | Root            | Root            |  |
| Results:       | Pass            | Pass            | Pass            | Pass            |  |

#### **NICK-BREAK TEST**

| Coupon Number: | X70LH-LS-7018-1 NB1 | X70LH-LS-7018-1 NB2 |
|----------------|---------------------|---------------------|
| Results:       | Pass                | Pass                |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 11/24/2015

Test Conducted By: Gerald McDaniel
Certified By: Matt Boring, P.E., CWI





Page: 1

**Test Number:** 7018LS-1

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

**Date:** 5/29/2014

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.688 inch wall, API 5L X70, 0.36 C.E. (IIW) pipe

Joint Design: Butt joint with a 3/32 inch gap, 3/32 inch land and 30° bevel on the pipe

Position: 5G

Welding Direction: Uphill

**Time Between Passes:** 17 minutes between the root and hot Pass, 5 hours to finish the weld

**Preheat Temperature:** Ambient (56°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Root and hot pass deposited on air and the remainder deposited on water

**Test Medium Temperature:** Air was ambient and water was 50 – 70°F

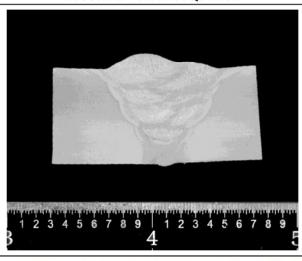
**Test Medium Flow Rate:** Air was not flowing and water was approximately 3 gallons a minute

**Test Medium Pressure:** Air and water was not pressurized

#### WELDING PARAMETERS

| Pass:                     | Root      | Hot Pass  | Fills     | Caps      |
|---------------------------|-----------|-----------|-----------|-----------|
| AWS Classification:       | E7016 H4  | E7018 H4R | E7018 H4R | E7018 H4R |
| Manufacture:              | ESAB      | ESAB      | ESAB      | ESAB      |
| Electrode Diameter (in.): | 3/32      | 1/8       | 1/8       | 3/32      |
| Current/Polarity:         | DCEP      | DCEP      | DCEP      | DCEP      |
| Current Range (amps):     | 65 – 74   | 99 – 102  | 105 – 109 | 103 – 104 |
| Voltage Range (volts):    | 20 – 23   | 21 – 22   | 20 – 23   | 21 – 22   |
| Travel Speed Range (ipm): | 2.1 – 4.1 | 2.9 – 4.7 | 2.9 – 5.8 | 2.3 – 3.9 |

#### FIGURE 1 – BEAD SEQUENCE







| <b>Test Number:</b> | 7018LS-1 | - | age: | 2 | of | 2 |
|---------------------|----------|---|------|---|----|---|
|                     |          |   |      |   |    |   |

#### **TENSILE TEST**

| Coupon Number:     | 7018LS-1 T1             | 7018LS-1 T2             | 7018LS-1 T3             | 7018LS-1 T4             |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Coupon Width:      | 1.110 inch              | 1.060 inch              | 0.865 inch              | 0.935 inch              |
| Coupon Thickness:  | 0.660 inch              | 0.660 inch              | 0.678 inch              | 0.677 inch              |
| Coupon Area:       | 0.733 inch <sup>2</sup> | 0.700 inch <sup>2</sup> | 0.586 inch <sup>2</sup> | 0.633 inch <sup>2</sup> |
| Maximum Load:      | 71,700 lb.              | 68,400 lb.              | 54,987 lb.              | 63,806 lb.              |
| Tensile Strength:  | 97,817 psi              | 97,714 psi              | 93,800 psi              | 100,800 psi             |
| Fracture Location: | Pipe                    | Pipe                    | Pipe                    | Pipe                    |

#### **BEND TEST**

| Coupon Number:        | 7018LS-1 SB1 | 7018LS-1 SB2 | 7018LS-1 SB3 | 7018LS-1 SB4 |
|-----------------------|--------------|--------------|--------------|--------------|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:                 | Side         | Side         | Side         | Side         |
| Results:              | Pass         | Pass         | Pass         | Pass         |

| Coupon Number:        | 7018LS-1 SB5 | 7018LS-1 SB6 | 7018LS-1 SB7 | 7018LS-1 SB8 |
|-----------------------|--------------|--------------|--------------|--------------|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:                 | Side         | Side         | Side         | Side         |
| Results:              | Pass         | Pass         | Pass         | Pass         |

#### **NICK-BREAK TEST**

| Coupon Number: | 7018LS-1 NB1 | 7018LS-1 NB2 | 7018LS-1 NB3 | 7018LS-1 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **CHARPY TOUGHNESS TEST**

| Coupon Number:         | 7018LS-1    | 7018LS-1    | 7018LS-1   | 7018LS-1   | 7018LS-1   | 7018LS-1   |
|------------------------|-------------|-------------|------------|------------|------------|------------|
|                        | H1          | H2          | Н3         | W1         | W2         | W3         |
| Depth:                 | 0.394 inch  | 0.394 inch  | 0.394 inch | 0.394 inch | 0.394 inch | 0.394 inch |
| Width:                 | 0.394 inch  | 0.394 inch  | 0.394 inch | 0.394 inch | 0.394 inch | 0.394 inch |
| <b>Notch Location:</b> | HAZ         | HAZ         | HAZ        | Centerline | Centerline | Centerline |
| Test Temperature:      | -20°F       | -20°F       | -20°F      | -20°F      | -20°F      | -20°F      |
| Impact Energy:         | 139.0 ft-lb | 160.0 ft-lb | 65.0 ft-lb | 22.0 ft-lb | 29.0 ft-lb | 28.5 ft-lb |
| % Shear:               | 67          | 66          | 47         | 41         | 38         | 31         |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 5/29/2014





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**Test Number:** 

7018LS-2

**Date:** 10/5/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 20 inch O.D., 0.500 inch wall, API 5L X70 pipe

Joint Design: Butt joint with a 3/32 inch gap, 3/32 inch land and 30° bevel on the pipe Position: 5G

Welding Direction: Uphill

**Time Between Passes:** 21 minutes between the root and hot pass, 4 hours to finish the weld

**Preheat Temperature:** Ambient (90°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Air

Test Medium Temperature: Ambient

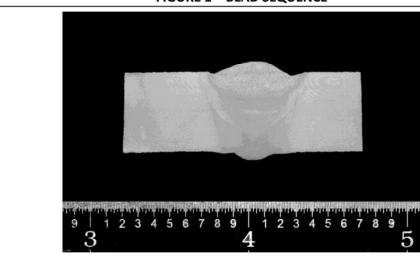
Test Medium Flow Rate: Air was not flowing

**Test Medium Pressure:** Air was not pressure

#### WELDING PARAMETERS

| *************************************** |           |           |           |           |  |  |  |
|---|-----------|-----------|-----------|-----------|--|--|--|
| Pass:                                   | Root      | Hot Pass  | Fills     | Caps      |  |  |  |
| AWS Classification:                     | E7016 H4  | E7018 H4R | E7018 H4R | E7018 H4R |  |  |  |
| Manufacture:                            | Lincoln   | ESAB      | ESAB      | ESAB      |  |  |  |
| Electrode Diameter (in.):               | 3/32      | 3/32      | 1/8       | 1/8       |  |  |  |
| Current/Polarity:                       | DCEP      | DCEP      | DCEP      | DCEP      |  |  |  |
| Current Range (amps):                   | 72 – 79   | 96 – 97   | 112 – 113 | 106 – 113 |  |  |  |
| Voltage Range (volts):                  | 20 – 23   | 21 – 22   | 22 – 23   | 21 – 23   |  |  |  |
| Travel Speed Range (ipm):               | 2.8 – 4.7 | 2.4 – 3.4 | 2.7 – 4.9 | 2.8 – 3.7 |  |  |  |

#### FIGURE 1 – BEAD SEQUENCE







| <b>Test Number:</b> | 7018LS-2 | Page: | 2 | of | 2 |
|---------------------|----------|-------|---|----|---|
|                     |          |       |   |    |   |

#### **TENSILE TEST**

| Coupon Number:     | 7018LS-2 T1             | 7018LS-2 T2             | 7018LS-2 T3             | 7018LS-2 T4             |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Coupon Width:      | 1.153 inch              | 1.129 inch              | 1.076 inch              | 1.066 inch              |
| Coupon Thickness:  | 0.510 inch              | 0.513 inch              | 0.502 inch              | 0.510 inch              |
| Coupon Area:       | 0.588 inch <sup>2</sup> | 0.579 inch <sup>2</sup> | 0.540 inch <sup>2</sup> | 0.544 inch <sup>2</sup> |
| Maximum Load:      | 48,569 lb.              | 48,173 lb.              | 45,468 lb.              | 46,566 lb.              |
| Tensile Strength:  | 82,600 psi              | 83,200 psi              | 84,200 psi              | 85,600 psi              |
| Fracture Location: | Pipe                    | Pipe                    | Pipe                    | Pipe                    |

#### **BEND TEST**

| Coupon Number:        | 7018LS-2 FB1 | 7018LS-2 FB2 | 7018LS-2 FB3 | 7018LS-2 FB4 |
|-----------------------|--------------|--------------|--------------|--------------|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:                 | Face         | Face         | Face         | Face         |
| Results:              | Pass         | Pass         | Pass         | Pass         |

| Coupon Number: | 7018LS-2 RB1 | 7018LS-2 RB2 | 7018LS-2 RB3 | 7018LS-2 RB4 |
|----------------|--------------|--------------|--------------|--------------|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |
| Type:          | Root         | Root         | Root         | Root         |
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **NICK-BREAK TEST**

| Coupon Number: | 7018LS-2 NB1 | 7018LS-2 NB2 | 7018LS-2 NB3 | 7018LS-2 NB4 |
|----------------|--------------|--------------|--------------|--------------|
| Results:       | Pass         | Pass         | Pass         | Pass         |

#### **CHARPY TOUGHNESS TEST**

| Coupon Number:           | 7018LS-2   | 7018LS-2   | 7018LS-2   | 7018LS-2   | 7018LS-2   | 7018LS-2   |
|--------------------------|------------|------------|------------|------------|------------|------------|
|                          | H1         | H2         | Н3         | W1         | W2         | W3         |
| Depth:                   | 0.394 inch |
| Width:                   | 0.394 inch |
| Notch Location:          | HAZ        | HAZ        | HAZ        | Centerline | Centerline | Centerline |
| <b>Test Temperature:</b> | -20°F      | -20°F      | -20°F      | -20°F      | -20°F      | -20°F      |
| Impact Energy:           | 76.0 ft-lb | 70.0 ft-lb | 22.5 ft-lb | 18.0 ft-lb | 82.0 ft-lb | 96.0 ft-lb |
| % Shear:                 | 47         | 41         | 22         | 21         | 42         | 46         |

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:** 10/5/2015

Test Conducted By: Jim Winigman

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





Page: 1

Test Number: X70LH-LS-8018-1

**Date:** 11/24/2015

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine:

Miller CST 280

Position: 5G

Sleeve Material: 20 inch O.D., 0.500 inch wall, API 5L X70, 0.29 C.E. (IIW) pipe

Long seam on a 1/2 inch backing bar with a 3/16 inch gap, no and 30° bevel on the

Joint Design:

sleeve

Welding Direction: Horizontal

**Time Between Passes:** 48 minutes between the root and hot pass, 2 hours to finish the weld

**Preheat Temperature:** Ambient (75°F)

Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Air

Test Medium Temperature:

**Ambient** 

Test Medium Flow Rate: Not flowing

Test Medium Pressure: Air was no pressurized

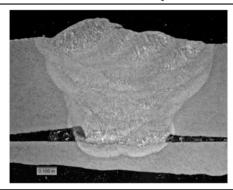
#### WELDING DADAMETERS

| WELDING PARAMETERS        |              |              |              |              |  |  |  |
|---------------------------|--------------|--------------|--------------|--------------|--|--|--|
| Pass:                     | Root         | Hot Pass     | Fills        | Caps         |  |  |  |
| AWS Classification:       | E8018-C3 H4R | E8018-C3 H4R | E8018-C3 H4R | E8018-C3 H4R |  |  |  |
| Manufacture:              | ESAB         | ESAB         | ESAB         | ESAB         |  |  |  |
| Electrode Diameter (in.): | 1/8          | 1/8          | 1/8          | 3/32         |  |  |  |
| Current/Polarity:         | DCEP         | DCEP         | DCEP         | DCEP         |  |  |  |
| Current Range (amps):     | 111 – 113    | 119 – 122    | 119 – 123    | 120 – 123    |  |  |  |
| Voltage Range (volts):    | 21 – 24      | 21 – 23      | 21 – 23      | 21 – 23      |  |  |  |
| Travel Speed Range (ipm): | 4.0 – 8.5    | 6.0 – 7.0    | 6.3 – 9.4    | 5.9 – 10.0   |  |  |  |



Test Number: X70LH-LS-8018-1 Page: 2 of 2

#### FIGURE 1 – BEAD SEQUENCE



#### **TENSILE TEST**

| Coupon Number:     | X70LH-LS-8018-1 T1      | X70LH-LS-8018-1 T2      |  |
|--------------------|-------------------------|-------------------------|--|
| Coupon Width:      | 0.947 inch              | 0.987 inch              |  |
| Coupon Thickness:  | 0.481 inch              | 0.488 inch              |  |
| Coupon Area:       | 0.456 inch <sup>2</sup> | 0.482 inch <sup>2</sup> |  |
| Maximum Load:      | 41,598 lb.              | 45,270 lb.              |  |
| Tensile Strength:  | 91,224 psi              | 93,921 psi              |  |
| Fracture Location: | Weld (1)                | Weld (1)                |  |

**Comment:** (1) The weld meets the acceptance criteria of API 1104 Section 5.6.3.3.

#### **BEND TEST**

| Counan Number         | X70LH-LS-8018-1 | X70LH-LS-8018-1 | X70LH-LS-8018-1 | X70LH-LS-8018-1 |  |
|-----------------------|-----------------|-----------------|-----------------|-----------------|--|
| Coupon Number:        | FB1             | FB2             | RB1             | RB2             |  |
| <b>Bend Diameter:</b> | 3.5 inch        | 3.5 inch        | 3.5 inch        | 3.5 inch        |  |
| Type:                 | Face            | Face            | Root            | Root            |  |
| Results:              | Pass            | Pass            | Pass            | Pass            |  |

#### **NICK-BREAK TEST**

| Coupon Number: | X70LH-LS-8018-1 NB1 | X70LH-LS-8018-1 NB2 |
|----------------|---------------------|---------------------|
| Results:       | Pass                | Pass                |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 5/29/2014



**DNV·GL** 

#### API 1104 COUPON TEST REPORT

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of

2

Test Number: 8018LS-1

**Date:** 5/29/2014

**Location:** Kiefner Mechanical Test Lab, Worthington, Ohio

**Welder:** Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW

Welding Machine: Miller CST 280

Pipe Material: 24 inch O.D., 0.688 inch wall, API 5L X70, 0.36 C.E. (IIW) pipe

Joint Design: Butt joint with a 3/32inch gap, 3/32 inch land and 30° bevel on the pipe

Position: 5G

Welding Direction: Uphill

**Time Between Passes:** 17 minutes between the root and hot pass, 4 hours to finish the weld

**Preheat Temperature:** Ambient (56°F)

**Post-weld Heat Treatment:** 

None used

**Line-up Clamps:** None used

Test Medium: Root and hot pass deposited on air and the remainder deposited on water

**Test Medium Temperature:** Air was ambient and the water was 50 – 70°F

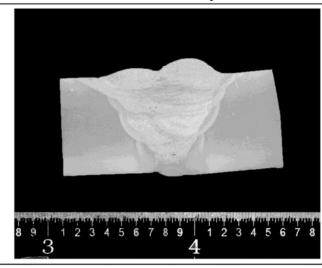
**Test Medium Flow Rate:** Air was not flowing and water was approximately 3 gallons a minute

Test Medium Pressure: Air and water was no pressurized

#### **WELDING PARAMETERS**

| Pass:                     | Root      | Hot Pass     | Fills        | Caps         |  |  |
|---------------------------|-----------|--------------|--------------|--------------|--|--|
| AWS Classification:       | E7016 H4  | E8018-C3 H4R | E8018-C3 H4R | E8018-C3 H4R |  |  |
| Manufacture:              | ESAB      | ESAB         | ESAB         | ESAB         |  |  |
| Electrode Diameter (in.): | 3/32      | 1/8          | 1/8          | 3/32         |  |  |
| Current/Polarity:         | DCEP      | DCEP         | DCEP         | DCEP         |  |  |
| Current Range (amps):     | 66 – 75   | 102 – 103    | 104 – 109    | 103          |  |  |
| Voltage Range (volts):    | 20 – 23   | 21 – 22      | 20 – 22      | 20 – 22      |  |  |
| Travel Speed Range (ipm): | 2.0 – 4.2 | 3.6 – 4.2    | 2.9 – 6.4    | 2.7 – 5.1    |  |  |

#### FIGURE 1 – BEAD SEQUENCE





| Test Number: | 8018LS-1 | Page: | 2 | of | 2 |
|--------------|----------|-------|---|----|---|
|              |          |       |   |    |   |

#### **TENSILE TEST**

| Coupon Number:     | 8018LS-1 T1             | 8018LS-1 T2             | 8018LS-1 T3             | 8018LS-1 T4             |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Coupon Width:      | 1.031 inch              | 1.150 inch              | 0.932 inch              | 0.922 inch              |
| Coupon Thickness:  | 0.640 inch              | 0.670 inch              | 0.675 inch              | 0.679 inch              |
| Coupon Area:       | 0.660 inch <sup>2</sup> | 0.771 inch <sup>2</sup> | 0.629 inch <sup>2</sup> | 0.626 inch <sup>2</sup> |
| Maximum Load:      | 66,198 lb.              | 70,800 lb.              | 59,503 lb.              | 58,719 lb.              |
| Tensile Strength:  | 100,300 psi             | 91,829 psi              | 94,600 psi              | 93,800 psi              |
| Fracture Location: | Pipe                    | Pipe                    | Pipe                    | Pipe                    |

#### **BEND TEST**

| Coupon Number:        | 8018LS-1 SB1 | 8018LS-1 SB2 | 8018LS-1 SB3 | 8018LS-1 SB4 |  |
|-----------------------|--------------|--------------|--------------|--------------|--|
| <b>Bend Diameter:</b> | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |  |
| Type:                 | Side         | Side         | Side         | Side         |  |
| Results:              | Pass         | Pass         | Pass         | Pass         |  |

| Coupon Number: | 8018LS-1 SB5 | 8018LS-1 SB6 | 8018LS-1 SB7 | 8018LS-1 SB8 |  |
|----------------|--------------|--------------|--------------|--------------|--|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |  |
| Type:          | Side         | Side         | Side         | Side         |  |
| Results:       | Pass         | Pass         | Pass         | Pass         |  |

#### **NICK-BREAK TEST**

| Coupon Number: | oupon Number: 8018LS-1 NB1 |      | 8018LS-1 NB3 | 8018LS-1 NB4 |  |
|----------------|----------------------------|------|--------------|--------------|--|
| Results:       | Pass                       | Pass | Pass         | Pass         |  |

#### **CHARPY TOUGHNESS TEST**

| Coupon Number:    | 8018LS-1    | 8018LS-1   | 8018LS-1    | 8018LS-1               | 8018LS-1   | 8018LS-1   |
|-------------------|-------------|------------|-------------|------------------------|------------|------------|
|                   | H1          | H2         | Н3          | W1                     | W2         | W3         |
| Depth:            | 0.394 inch  | 0.394 inch | 0.394 inch  | h 0.394 inch 0.394 inc |            | 0.394 inch |
| Width:            | 0.394 inch  | 0.394 inch | 0.394 inch  | 0.394 inch             | 0.394 inch | 0.394 inch |
| Notch Location:   | HAZ         | HAZ        | HAZ         | Centerline             | Centerline | Centerline |
| Test Temperature: | -20°F       | -20°F      | -20°F       | -20°F                  | -20°F      | -20°F      |
| Impact Energy:    | 113.0 ft-lb | 48.0 ft-lb | 108.0 ft-lb | 49.0 ft-lb             | 56.0 ft-lb | 59.5 ft-lb |
| % Shear:          | 57          | 33         | 48          | 49                     | 49         | 57         |

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 20<sup>th</sup> Edition of API 1104 and the 21<sup>st</sup> Edition of API 1104

**Date:** 5/29/2014



### API 1104 COUPON TEST REPORT Page: 1 of 2

**Test Number:** 8018LS-2 **Date:** 10/5/2015

Location: Kiefner Mechanical Test Lab, Worthington, Ohio

Welder: Jeremy Didion, Apeks Fabrication

Welding Process: Manual SMAW Welding Machine: Miller CST 280

Pipe Material: 20 inch O.D., 0.500 inch wall, API 5L X70 pipe

**Joint Design:** Butt joint with a 3/32 inch gap, 3/32 inch land and 30° bevel

Position: 5G Welding Direction: Uphill

**Time Between Passes:** 21 minutes between the root and hot pass, 4 hours to finish the weld

Preheat Temperature: Ambient (90°F) Post-weld Heat Treatment: None used

**Line-up Clamps:** None used

Test Medium: Air

Test Medium Temperature: Ambient

Test Medium Flow Rate: Air was not flowing
Test Medium Pressure: Air was not pressurized

#### **WELDING PARAMETERS**

| Pass:                     | Root      | Hot Pass     | Fills        | Caps         |  |  |  |  |
|---------------------------|-----------|--------------|--------------|--------------|--|--|--|--|
| AWS Classification:       | E7016 H4  | E8018-C3 H4R | E8018-C3 H4R | E8018-C3 H4R |  |  |  |  |
| Manufacture:              | Lincoln   | ESAB         | ESAB         | ESAB         |  |  |  |  |
| Electrode Diameter (in.): | 3/32      | 1/8          | 1/8          | 1/8          |  |  |  |  |
| Current/Polarity:         | DCEP      | DCEP         | DCEP         | DCEP         |  |  |  |  |
| Current Range (amps):     | 74 – 78   | 107 – 108    | 112 – 115    | 113 – 114    |  |  |  |  |
| Voltage Range (volts):    | 20 – 23   | 21 – 22      | 21 – 23      | 21 – 23      |  |  |  |  |
| Travel Speed Range (ipm): | 3.1 – 4.6 | 3.5 – 4.8    | 3.1 – 5.3    | 2.5 – 4.1    |  |  |  |  |

#### FIGURE 1 – BEAD SEQUENCE

Macro Section Not Available



| Test Number: | 8018LS-2 | Page: 2 of 2 |  |
|--------------|----------|--------------|--|

#### **TENSILE TEST**

| Coupon Number:     | 8018LS-2 T1             | 8018LS-2 T2             | 8018LS-2 T3             | 8018LS-2 T4             |
|--------------------|-------------------------|-------------------------|-------------------------|-------------------------|
| Coupon Width:      | 1.130 inch              | 1.130 inch              | 1.076 inch              | 1.128 inch              |
| Coupon Thickness:  | 0.506 inch              | 0.505 inch              | 0.506 inch              | 0.501 inch              |
| Coupon Area:       | 0.572 inch <sup>2</sup> | 0.571 inch <sup>2</sup> | 0.544 inch <sup>2</sup> | 0.565 inch <sup>2</sup> |
| Maximum Load:      | 51,308 lb.              | 46,879 lb.              | 46,294 lb.              | 47,291 lb.              |
| Tensile Strength:  | 89,700 psi              | 82,100 psi              | 85,100 psi              | 83,700 psi              |
| Fracture Location: | Pipe                    | Pipe                    | Pipe                    | Pipe                    |

#### **BEND TEST**

| Coupon Number:        | 8018LS-2 FB1  | 8018LS-2 FB2 | 8018LS-2 FB3 | 8018LS-2 FB4 |  |
|-----------------------|---------------|--------------|--------------|--------------|--|
| <b>Bend Diameter:</b> | 3.5 inch      | 3.5 inch     | 3.5 inch     | 3.5 inch     |  |
| Type:                 | Side          | Side         | Side         | Side         |  |
| Results:              | Results: Pass |              | Pass         | Pass         |  |

| Coupon Number: | 8018LS-2 RB1 | 8018LS-2 RB2 | 8018LS-2 RB3 | 8018LS-2 RB4 |  |
|----------------|--------------|--------------|--------------|--------------|--|
| Bend Diameter: | 3.5 inch     | 3.5 inch     | 3.5 inch     | 3.5 inch     |  |
| Туре:          | Side         | Side         | Side         | Side         |  |
| Results:       | Pass         | Pass         | Pass         | Pass         |  |

#### **NICK-BREAK TEST**

| Coupon Number: | coupon Number: 8018LS-2 NB1 |      | 8018LS-2 NB3 | 8018LS-2 NB4 |  |
|----------------|-----------------------------|------|--------------|--------------|--|
| Results:       | Pass                        | Pass | Pass         | Pass         |  |

#### **CHARPY TOUGHNESS TEST**

| Coupon Number:         | 8018LS-2   | 8018LS-2   | LS8018-2   | 8018LS-2   | 801LS8-2   | 8018LS-2   |
|------------------------|------------|------------|------------|------------|------------|------------|
|                        | H1         | H2         | Н3         | W1         | W2         | W3         |
| Depth:                 | 0.394 inch |
| Width:                 | 0.394 inch |
| <b>Notch Location:</b> | HAZ        | HAZ        | HAZ        | Centerline | Centerline | Centerline |
| Test Temperature:      | -20°F      | -20°F      | -20°F      | -20°F      | -20°F      | -20°F      |
| Impact Energy:         | 24.0 ft-lb | 33.0 ft-lb | 53.5 ft-lb | 76.5 ft-lb | 40.0 ft-lb | 70.0 ft-lb |
| % Shear:               | 26         | 37         | 39         | 45         | 41         | 52         |

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:** 10/5/2015



|                | PQR No. M-1-GRB-179                       |                     |                   | Orig. Issue Date Revision Date |                                 |                          |                               |                |
|----------------|---|---------------------|-------------------|--------------------------------|---------------------------------|--------------------------|-------------------------------|----------------|
| TYPE OF        | WPS No. M-BV                              | V-1-A-I             |                   |                                | Orig. Issue Date                |                          | Revision Date                 |                |
| RECORD         | API 1104 🗸                                | Other               |                   |                                | *                               |                          | -90                           |                |
| 222222         | Metal Iner                                | rt Gas (MIG)        |                   |                                | Type of Process                 | Manual                   |                               |                |
| PROCESS        | For:                                      | Butt Welding        | / Fillet          | Welding                        |                                 |                          |                               |                |
| PIPE           | Material Specificati                      | ion: 1.315" O.D     | ) GR-B - 0.17     | 9" WT. API 5                   | Ĺ                               |                          |                               |                |
| DIAMETER       | API 1104 6.2                              | 2.2 Guidelines      | ✓ Under           | 2-3/8" OD                      | 2-3/8"                          | to 12-3/4" OD            | > 12-3                        | /4" OD         |
| MATERIAL       | API 1104 5.4                              | .2.2 Guidelines     | ✓ ≤ 42,00         | 00 PSI Yield                   | > 42,00                         | 00 to < 65,000 PSI Yield | ≥ 65,000                      | PSI Yield      |
| THICKNESS      | API 1104 6.2                              | 2.2 Guidelines      | ✓ Under 3         | 3/16" thick                    | 3/16"                           | thru 3/4" thick          | Over 3/                       | 4" thick       |
| FILLED MACTALS | AWS Electrode No                          | s: ER70S-3          | AWS Electrode Siz | e: 0.035"                      | AWS Specification               | n: A5.18                 | Filler Metal Group:           | 5 <sup>b</sup> |
| FILLER METALS  | Wire Feed Rate (IF                        | м): 170-200         |                   |                                |                                 |                          |                               |                |
| GAS            | 75/25 Argon/                              | CO2                 |                   | 40 cfm                         |                                 |                          |                               |                |
| PREHEAT        | Minimum Preheat                           | Temperature (F): 50 | 00                | Interpass Tem                  | perature (F): >100 <sup>0</sup> | Other:                   |                               |                |
|                |   | WEI                 | D AXIS            |                                | TE                              | CHNIQUE                  | DIREC                         | CTION          |
|                | Flat (1G, 1F, 1FR)                        | J                   | Plate             |                                | Backhand                        | 4                        | Vertical - Up                 |                |
|                | Horizontal (2G, 2F,                       | 2FR)                | Pipe              | 1                              | Forehand                        |                          | Vertical - Down               | <b>V</b>       |
| POSITION       | Vertical (3G, 3F)                         |                     | Rotated           | 4                              |                                 |                          |                               |                |
|                | Overhead (4G, 4F)                         |                     | Fixed             |                                |                                 |                          |                               |                |
|                | Multiple (5G, 5F)                         |                     | Inclined (6G, 6F) |                                |                                 |                          |                               |                |
|                | Combination                               |                     |                   | 7                              |                                 |                          |                               |                |
|                | 1   | DISPOSITION STYL    | E                 | M                              | ETHOD                           | -                        | ARC TYPE                      |                |
| TECHNIQUE      | Stringer Beads                            | 4                   |                   | Multiple Pass                  | <b>√</b>                        | Single Arc               |                               | Other:         |
|                | Weave Beads                               |                     |                   | Single Pass                    |                                 | Multiple Arc             |                               |                |
| CLEANING       | Base Material:                            | Power 🗸             | Hand              |                                | Weld: Power                     | ✓ Har                    | nd 🔲                          |                |
|                |   | BUT                 | T WELD            |                                |                                 | FILLE                    | TWELD                         |                |
|                | 371/2' ± 21/2' FOR FITTINGS //16" ± 1/32" |                     |                   |                                |                                 |                          |                               |                |
|                | 30° + 5°                                  | 0 FOR PIPE          |                   |                                |                                 |                          | 32                            | 7 7 1          |
| JOINT DESIGN   |   | 1.                  |                   |                                |                                 |                          |                               |                |
|                | <u> </u>                                  |                     |                   |                                |                                 |                          |                               | 1              |
|                | 1/32" TO 1/1                              | 1/32" TO 1/16"      |                   |                                |                                 |                          |                               |                |
|                |   |                     |                   |                                |                                 |                          |                               |                |
|                | 1/8" ± 1/1                                | 17" TO 45°          |                   |                                |                                 |                          |                               |                |
|                |   |                     |                   |                                |                                 |                          |                               |                |
|                |   |                     | Groove D          | esigns of                      | Test Cou                        | upons                    |                               |                |
|                | Current Type:                             | AC                  | DC 🗸              | Polarity:                      | Straight/Negative               |                          | Reverse/Positive              | <b>V</b>       |
| ELECTRICAL     | BEAD NO.                                  | Passes              | ELECTRODE NO. &   | Size                           |                                 | RANGE                    | MAXIMUM TIME<br>LAPSE ALLOWED | SPEED RANGE    |
| CHARACTERIS-   | BEAD NO.                                  | rasses              | TYPE              | 3120                           | VOLTS                           | AMPS                     | (Min.)                        | (IPM)          |
| TICS &         | Root                                      | 1                   | ER70S-3           | 0.035                          | 15-19                           |                          | 5                             | 12             |
| SEQUENCE OF    | Hot Pass                                  | 1                   | ER70S-3           | 0.035                          | 15-19                           |                          | 5                             | 12             |
| BEADS          | Fill                                      |                     |                   |                                |                                 |                          |                               |                |
|                | Сар                                       | 1                   | ER70S-3           | 0.035                          | 15-19                           |                          | 5                             | 12             |

|               | Specimen No.  | v              | Vidth                   | TH          | ickness     | Area (in.^2)        | 100000000000000000000000000000000000000 | ate Total<br>d(Lbs.) | Ultima             | ate Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|---------------|---|----------------|-------------------------|-------------|-------------|---------------------|---|----------------------|--------------------|--------------------------|---------------------------------------|--|
| TENCH E TECT  | 1   |                | 0.87                    |             | 0.24        | 0.21                | 7                                       | 613                  |                    | 36461                    | Ductile                               | Base Metal                                   |
| TENSILE TEST  | 2   |                |                         |             |             |                     |   |                      |                    |                          |                                       |  |
|               | 3   |                |                         |             |             |                     |   |                      |                    |                          |                                       |  |
|               | 4   |                |                         |             |             |                     |   |                      |                    |                          |                                       |  |
| V .           | Specimen No.  | Roc            | ot Bend                 | Fa          | ce Bend     | Side Bend           |   | Bend                 | Acceptab           | ile                      | Com                                   | ments  |
|               | 5   | 180            | Degrees                 |             |             |                     | Yes                                     | 1                    | No                 |                          |                                       |  |
|               | 6   | 180            | Degrees                 |             |             |                     | Yes                                     | 4                    | No                 |                          |                                       |  |
| GUIDED BEND   | 7   | 180            | Degrees                 |             |             |                     | Yes                                     |                      | No                 |                          |                                       |  |
| TEST          | 8   | 180            | Degrees                 |             |             |                     | Yes                                     |                      | No                 |                          |                                       |  |
| 1231          | 9   |                |                         | 180         | Degrees     |                     | Yes                                     |                      | No                 |                          |                                       |  |
| 1             | 10  | 11-            |                         | 180         | Degrees     |                     | Yes.                                    |                      | No                 |                          |                                       |  |
|               | 11  |                |                         | 180         | Degrees     |                     | Yes                                     |                      | No                 |                          |                                       |  |
|               | 12  |                |                         | 180         | Degrees     |                     | Yes                                     |                      | No                 |                          |                                       |  |
|               | Specimen No.  |                | Accept                  | able Yes/N  | No          |                     |   |                      | C                  | omments                  |                                       |  |
| NICK BREAK    | 13  | Yes            | 1                       | No          |             |                     |   |                      |                    |                          |                                       |  |
| TEST          | 14  | Yes            | 1                       | No          |             |                     |   |                      |                    |                          |                                       |  |
| TEST          | 15  | Yes            |                         | No          |             |                     |   |                      |                    |                          |                                       |  |
|               | 16  | Yes            |                         | No          |             |                     |   |                      |                    |                          |                                       |  |
| FILLET WELD   | Satisfactory:   | Yes            |                         | No          |             |                     | Penetrat                                | tion into Pa         | rent Met           | al:                      | Yes                                   | No .   |
| TEST          | Fillet Weld - Fracti  | ure Test       |                         |             |             |                     | Length o                                | f Percent o          | f Defect           |                          | in.:                                  | %:   |
| WELDER INFO   | Chris Job   |                | ergy                    |             |             | License Number 8    | & State                                 | J00-43               | 35-53              | 3                        | Stencil Mark                          |  |
| CERTIFICATION | We certify that the<br>1104.<br>Welding Test Cond   |                |                         |             | correct and | that the test coupo | ns were pre                             | epared, we           | lded, and          | tested in accor          | dance with the requi                  | rements of API                               |
| CERTIFICATION | Visual Examination  | n Results:     | Satisfacto              | ry          |             |                     |   |                      |                    |                          |                                       |  |
| CENTIFICATION | Radiographic Test   | t Results (Fo  | or Alterna              | tive Qualif |             | roove Welds by Radi | iography):                              | NA                   |                    |                          |                                       |  |
| CERTIFICATION | Radiographic Test<br>Mechanical Test C  | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif |             | roove Welds by Radi | iography):                              | NA                   |                    | ory Test No:             |                                       |  |
| CERTIFICATION | Radiographic Test<br>Mechanical Test C<br>Approved By: Wa                                       | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi | iography):                              | NA                   | Organiz            | ation: Terracor          | o Consultants                         |  |
| CERTIFICATION | Radiographic Test<br>Mechanical Test C  | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi | iography):                              | NA                   |                    | ation: Terracor          | n Consultants                         |  |
| REMARKS       | Radiographic Test<br>Mechanical Test C<br>Approved By: Wa                                       | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi | iography):                              | NA                   | Organiz            | ation: Terracor          | n Consultants                         |  |
| REMARKS       | Radiographic Test<br>Mechanical Test C<br>Approved By: Wa                                       | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi |   | NA Prified Wel       | Organiz<br>Date: 5 | ation: Terracor<br>/7/15 | n Consultants                         |  |
|               | Radiographic Test<br>Mechanical Test C<br>Approved By: Wa<br>APPROVED                           | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi |   |                      | Organiz<br>Date: 5 | ation: Terracor<br>/7/15 | o Consultants                         |  |
| REMARKS       | Radiographic Test<br>Mechanical Test C<br>Approved By: Wa<br>APPROVED<br>By: Walter C. Dun      | t Results (Fo  | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi |   |                      | Organiz<br>Date: 5 | ation: Terracor<br>/7/15 | n Consultants                         |  |
| REMARKS       | Radiographic Test Mechanical Test C Approved By: Wa APPROVED  By: Walter C. Dun Company/Organiz | t Results (For | or Alterna<br>By: Walte | tive Qualif | ord         | roove Welds by Radi |   |                      | Organiz  Date: 5   | ation: Terracor<br>/7/15 | o Consultants                         |  |



| TYPE OF        | PQR No. M-2-X          | 42-154             |                    |               | Orig. Issue Date                |   | Revision Date              |                |
|----------------|------------------------|--------------------|--------------------|---------------|---------------------------------|---|----------------------------|----------------|
| TYPE OF        | WPS No. M-BW           | /-2-A-I            |                    |               | Orig. Issue Date                |   | Revision Date              |                |
| RECORD         | API 1104 🗸             | Other              |                    |               | ^_                              |   |                            |                |
| 22222          | Metal Inert            | Gas (MIG)          | *                  |               | Type of Process                 | Manual                                      |                            |                |
| PROCESS        | For:                   | Butt Welding       | √ Fillet V         | Velding       |                                 |   |                            |                |
| PIPE           | Material Specification | on: 2.375" O.I     | D. X - X-42 -0.15  | 4" WT. API    | 5L                              |   |                            |                |
| DIAMETER       | API 1104 6.2           | .2 Guidelines      | Under 2            | -3/8" OD      | √ 2-3/8"                        | to 12-3/4" OD                               | > 12-3,                    | /4" OD         |
| MATERIAL       | API 1104 5.4.          | 2.2 Guidelines     | ✓ ≤ 42,000         | O PSI Yield   | > 42,00                         | 00 to < 65,000 PSI Yiel                     | d ≥ 65,000                 | PSI Yield      |
| THICKNESS      | API 1104 6.2           | .2 Guidelines      | ✓ Under 3,         | /16" thick    | 3/16"                           | thru 3/4" thick                             | Over 3/                    | 4" thick       |
| FILLED MASTALS | AWS Electrode Nos      | s: ER70S-3         | AWS Electrode Size | e: 0.035"     | AWS Specification               | n: A5.18                                    | Filler Metal Group:        | 5 <sup>b</sup> |
| FILLER METALS  | Wire Feed Rate (IP     | м) : 200-280       |                    |               |                                 |   |                            |                |
| GAS            | 75/25 Argon/C          | 002                |                    | 40 cfm        |                                 |   |                            |                |
| PREHEAT        | Minimum Preheat        | Temperature (F): 5 | 00                 | Interpass Ten | perature (F): >100 <sup>0</sup> | Other:                                      |                            |                |
|                |                        | WE                 | LD AXIS            |               | TI                              | ECHNIQUE                                    | DIREC                      | TION           |
|                | Flat (1G, 1F, 1FR)     | 4                  | Plate              |               | Backhand                        | 7   | Vertical - Up              |                |
|                | Horizontal (2G, 2F, 2  | 2FR)               | Pipe               | V             | Forehand                        |   | Vertical - Down            | J              |
| POSITION       | Vertical (3G, 3F)      |                    | Rotated            | J             |                                 |   |                            |                |
|                | Overhead (4G, 4F)      |                    | Fixed              |               |                                 |   |                            |                |
|                | Multiple (5G, 5F)      |                    | Inclined (6G, 6F)  |               |                                 |   |                            |                |
|                | Combination            |                    |                    |               |                                 |   |                            |                |
|                |                        | DISPOSITION STY    | LE                 | M             | ETHOD -                         |   | ARC TYPE                   |                |
| TECHNIQUE      | Stringer Beads         | 4                  |                    | Multiple Pass | 1                               | Single Arc                                  |                            | Other:         |
|                | Weave Beads            |                    |                    | Single Pass   | 5                               | Multiple Arc                                |                            | other.         |
| CLEANING       | Base Material:         | Power 🗸            | Hand               |               | Weld: Power                     | √ Ha  | nd                         |                |
|                |                        | вит                | T WELD 4           |               |                                 | FILL  | ET WELD                    |                |
| JOINT DESIGN   |                        | <b>→</b>           | Groove D           | esigns of     | l7"<br>∶Test Cou                | 1/16° ± 1/32°<br>10 45°<br>10 45°<br>10 45° | —≓ <del> </del> →          |                |
|                | Current Type:          | AC                 | DC J               | Polarity:     | Straight/Negative               |   | Reverse/Positive           | 7              |
| ELECTRICAL     | BEAD NO.               | Passes             | ELECTRODE NO. &    | Size          |                                 | RANGE                                       | MAXIMUM TIME LAPSE ALLOWED | SPEED RANGE    |
| CHARACTERIS-   | 470.44                 |                    | TYPE               |               | VOLTS                           | AMPS  | (Min.)                     | (IPM)          |
| TICS &         | Root                   | 1                  | ER70S-3            | 0.035         | 15-19                           |   | 5                          | 12             |
| CECHIENCE OF   |                        |                    |                    |               |                                 |   |                            |                |
| SEQUENCE OF    | Hot Pass               | 1                  | ER70S-3            | 0.035         | 15-19                           |   | 5                          | 12             |
| BEADS          | Hot Pass<br>Fill       | 1                  | ER70S-3            | 0.035         | 15-19                           |   | 5                          | 12             |

|               | Specimen No.                                     | Wid           | dth         | Th        | ickness | Area (in.^2)       | 100000             | ate Total<br>d(Lbs.) | Ultima     | te Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|---------------|--|---------------|-------------|-----------|---------|--------------------|--------------------|----------------------|------------|-------------------------|---------------------------------------|--|
| TENSILE TEST  | 1  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
| TENSILE TEST  | 2  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
|               | 3  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
|               | 4  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
|               | Specimen No.                                     | Root I        | Bend        | Fac       | ce Bend | S de Bend          |                    | Bend                 | Acceptabl  | le                      | Com                                   | ments  |
|               | 5  | 180 De        | egrees      |           |         |                    | Yes                | 1                    | No         |                         |                                       |  |
|               | 6  | 180 De        | egrees      |           |         |                    | Yes                | 1                    | No         |                         |                                       |  |
| GUIDED BEND   | 7  | 180 De        | egrees      |           |         |                    | Yes                |                      | No         |                         |                                       |  |
| TEST          | 8  | 180 De        | egrees      |           |         |                    | Yes                |                      | No         |                         |                                       |  |
| 1631          | 9  |               | = 1         | 180       | Degrees |                    | Yes                |                      | No         |                         |                                       |  |
|               | 10   | +             |             | 180       | Degrees |                    | Yes                |                      | No         | 1 11                    |                                       |  |
|               | 11   |               |             | 180       | Degrees |                    | Yes                |                      | No         |                         |                                       |  |
|               | 12   |               |             | 180       | Degrees |                    | Yes                |                      | No         |                         |                                       |  |
|               | Specimen No.                                     |               | Acceptab    | ole Yes/N | No      |                    |                    |                      | Co         | omments                 |                                       |  |
| NICK BREAK    | 13   | Yes           | <b>V</b>    | No        |         |                    |                    |                      |            |                         |                                       |  |
| TEST          | 14   | Yes           | 1           | No        |         |                    |                    |                      |            |                         |                                       |  |
| 1531          | 15   | Yes           |             | No        |         |                    |                    |                      |            |                         |                                       |  |
|               | 16   | Yes           |             | No        |         |                    |                    |                      |            |                         |                                       |  |
| FILLET WELD   | Satisfactory:                                    | Yes           |             | No        |         |                    | Penetra            | tion into Pa         | rent Meta  | il:                     | Yes                                   | No 🗌   |
| TEST          | Fillet Weld - Fracti                             | ure Test      |             |           |         |                    | Length o           | of Percent o         | f Defect   |                         | in.:                                  | %:   |
| WELDER INFO   | Welder Name Ch                                   |               |             |           |         | License Number 8   | k State <b>J</b> ( | 00-43                | 5-533      | 3                       | Stencil Mark                          |  |
| CERTIFICATION | 1104.<br>Welding Test Cond<br>Visual Examination | ducted By: Ra | alph Pfiste | er        |         |                    |                    |                      | lded, and  | tested in accor         | dance with the requi                  | rements of API                               |
|               | 7.00   |               | 1.7.2       | D V 1     |         | roove Welds by Rad | iograpny):         | NA                   | Laborate   | ory Test No:            |                                       |  |
| -             | Mechanical Test C  Approved By: Wa               |               |             | C. Dumic  | ora     |                    |                    |                      |            | ntion: Terracor         | Consultants                           |  |
|               | APPROVED   |               | na .        | REJECTI   | rn.     |                    |                    |                      | Date: 5/   |                         | Consultants                           | -  |
| -             | APPROVED   | <b>V</b>      |             | KEJECI    | EU      |                    |                    |                      | Date: 3/   | 7/13                    |                                       |  |
| REMARKS       |  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
| CURALTTAL     | By: Walter C. Dun                                | nford         |             |           |         |                    | Title: Ce          | ertified Wel         | ding Inspe | ector                   |                                       |  |
| SUBMITTAL     | Company/Organiz                                  | ation: Terrac | on Consu    | ultants   |         |                    | X-                 |                      | Date: 5/   | 7/15                    |                                       |  |
| V             |  |               |             |           |         |                    |                    |                      |            |                         |                                       |  |
|               | Engineer:  |               |             |           |         |                    |                    |                      | Date:      |                         |                                       |  |
| APPROVAL      | Engineer:<br>Weld Supervisor:                    |               |             |           |         |                    |                    |                      | Date:      |                         |                                       |  |



| T/05 05        | PQR No. M-1-X5          | 2-179              |                   |               | Orig. Issue Date   |                            | Revision Date        |                |
|----------------|-------------------------|--------------------|-------------------|---------------|--------------------|----------------------------|----------------------|----------------|
| TYPE OF        | WPS No. M-BW-           | 1-B-I              | _                 |               | Orig. Issue Date   |                            | Revision Date        |                |
| RECORD         | API 1104 🗸              | Other              |                   |               | *                  |                            |                      |                |
|                | Metal Inert G           | as (MIG)           |                   |               | Type of Proce      | ess: Manual                |                      |                |
| PROCESS        | For: B                  | utt Welding        | / Fillet          | Welding       |                    |                            |                      |                |
| PIPE           | Material Specification  | : 1.315" O.D       | ) X-52 - 0.17     | 9" WT. API 51 |                    |                            |                      |                |
| DIAMETER       | API 1104 6.2.2          | 2 Guidelines       | ✓ Under           | 2-3/8" OD     | 2-3/               | 8" to 12-3/4" OD           | > 12-3               | /4" OD         |
| MATERIAL       | API 1104 5.4.2          | .2 Guidelines      | ≤ 42,0            | 00 PSI Yield  | √ >42              | ,000 to < 65,000 PSI Yield | ≥ 65,000             | PSI Yield      |
| THICKNESS      | API 1104 6.2.2          | 2 Guidelines       | ✓ Under           | 3/16" thick   | 3/1                | 6" thru 3/4" thick         | Over 3,              | 4" thick       |
| FILLER METALS  | AWS Electrode Nos:      | ER70S-3            | AWS Electrode Si  | ze: 0.035"    | AWS Specificat     | ion: A5.18                 | Filler Metal Group:  | 5 <sup>b</sup> |
| FILLER WIETALS | Wire Feed Rate (IPM     | : 170-200          |                   |               |                    |                            | 1                    |                |
| GAS            | 75/25 Argon/CO          | 2                  |                   | 40 cfm        |                    |                            |                      |                |
| PREHEAT        | Minimum Preheat Te      | emperature (F): 50 | 0                 | Interpass Tem | perature (F): >100 | Other:                     |                      | 1              |
|                |                         | WEL                | D AXIS            |               |                    | TECHNIQUE                  | DIRE                 | CTION          |
|                | Flat (1G, 1F, 1FR)      | 1                  | Plate             |               | Backhand           | 4                          | Vertical - Up        |                |
|                | Horizontal (2G, 2F, 2F) | R)                 | Pipe              | 1             | Forehand           |                            | Vertical - Down      | <b>V</b>       |
| POSITION       | Vertical (3G, 3F)       | = = []             | Rotated           | 1             |                    |                            |                      |                |
|                | Overhead (4G, 4F)       |                    | Fixed             |               |                    |                            |                      |                |
|                | Multiple (5G, 5F)       |                    | Inclined (6G, 6F) |               |                    |                            |                      |                |
|                | Combination             |                    |                   | 7             |                    |                            |                      |                |
|                |                         | ISPOSITION STYLE   |                   | М             | ETHOD              |                            | ARC TYPE             |                |
| TECHNIQUE      | Stringer Beads          | /                  |                   | Multiple Pass | <b>√</b>           | Single Arc                 |                      | Other:         |
|                | Weave Beads             |                    |                   | Single Pass   |                    | Multiple Arc               |                      |                |
| CLEANING       | Base Material: P        | ower 🗸             | Hand              |               | Weld: Pow          | er 🗸 Ha                    | nd                   |                |
|                |                         | ВЏТТ               | WELD J            |               |                    | FILL                       | ET WELD              |                |
|                | 371/2° ± 21/2° FC       | OR FITTINGS        |                   |               |                    | 1/.201                     |                      |                |
|                | 30° + 5° 0              |                    |                   |               |                    | 716°± 7                    | 32"                  |                |
| JOINT DESIGN   |                         | 1 1                | <b>/</b> 16"      |               |                    | 1/16" ± 1/32               | "                    |                |
| JOHN DESIGN    |                         | 100                | 11                |               |                    | -                          |                      | (2)            |
|                | 1/32" TO 1/16"          |                    |                   |               |                    | # 1                        |                      |                |
|                | 122 - 110               | <del>- \</del>     | _                 |               |                    |                            | /                    | _/             |
|                | 1/8" ± 1/16             |                    | <u></u>           |               | 1                  | 7" TO 45°                  |                      |                |
|                | 100                     |                    |                   |               |                    |                            |                      |                |
|                |                         |                    | Groove D          | esigns of     | Test Co            | oupons                     |                      |                |
|                | Current Type: A         | с                  | DC 🗸              | Polarity:     | Straight/Negati    | ve                         | Reverse/Positive     | 1              |
| ELECTRICAL     | DEADAIG                 | Dassa              | ELECTRODE NO. 8   | Pin-          |                    | RANGE                      | MAXIMUM TIME         | SPEED RANGE    |
| CHARACTERIS-   | BEAD NO.                | Passes             | TYPE              | Size          | VOLTS              | AMPS                       | LAPSE ALLOWED (Min.) | (IPM)          |
| TICS &         | Root                    | 1                  | ER70S-3           | 0.035         | 15-19              |                            | 5                    | 12             |
| SEQUENCE OF    | Hot Pass                | 1                  | ER70S-3           | 0.035         | 15-19              |                            | 5                    | 12             |
| BEADS          | Fill                    |                    |                   |               |                    |                            |                      |                |
|                | Сар                     | 1                  | ER70S-3           | 0.035         | 15-19              |                            | 5                    | 12             |

|               | Specimen No.   | V           | Vidth     | ŢĬ         | nickness      | Area (in.^2)        | 10.000000000000000000000000000000000000 | ate Total<br>d(Lbs.) | Ultima     | ate Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|---------------|--|-------------|-----------|------------|---------------|---------------------|---|----------------------|------------|--------------------------|---------------------------------------|--|
| TENCH E TECT  | 1  |             | 0.87      |            | 0.22          | 0.19                | 1                                       | 4660                 |            | 76594                    | Ductile                               | Base Metal                                   |
| TENSILE TEST  | 2  |             |           |            |               |                     |   |                      |            |                          |                                       |  |
|               | 3  |             |           |            |               |                     |   |                      |            |                          |                                       |  |
|               | 4  |             |           |            |               |                     |   |                      |            |                          |                                       |  |
| V .           | Specimen No.   | Ro          | ot Bend   | Fa         | ace Bend      | Side Bend           |   | Bend                 | Acceptal   | ole                      | Com                                   | ments  |
|               | 5  | 180         | Degrees   |            |               | 1-1-1-7             | Yes                                     | 1                    | No         |                          |                                       |  |
|               | 6  | 180         | Degrees   |            |               |                     | Yes                                     | 1                    | No         |                          |                                       |  |
| GUIDED BEND   | 7  | 180         | Degrees   |            |               |                     | Yes                                     |                      | No         |                          |                                       |  |
| TEST          | 8  | 180         | Degrees   |            |               |                     | Yes                                     |                      | No         |                          |                                       |  |
| 1631          | 9  |             |           | 180        | 0 Degrees     |                     | Yes                                     |                      | No         |                          |                                       |  |
| 1             | 10   | 11-         |           | 180        | Degrees       |                     | Yes                                     |                      | No         |                          |                                       |  |
|               | 11   |             |           | 180        | Degrees       |                     | Yes                                     |                      | No         |                          |                                       |  |
|               | 12   |             |           | 180        | 0 Degrees     |                     | Yes                                     |                      | No         |                          |                                       |  |
|               | Specimen No.   |             | Accept    | able Yes/I | No            |                     |   |                      | C          | comments                 |                                       |  |
| NICK BREAK    | 13   | Yes         | 1         | No         |               |                     |   |                      |            |                          |                                       |  |
| TEST          | 14   | Yes         | 1         | No         |               |                     |   |                      |            |                          |                                       |  |
| 1631          | 15   | Yes         |           | No         |               |                     |   |                      |            |                          |                                       |  |
|               | 16   | Yes         |           | No         |               |                     |   |                      |            |                          |                                       |  |
| FILLET WELD   | Satisfactory:  | Yes         |           | No         |               |                     | Penetrat                                | tion into Pa         | rent Met   | tal:                     | Yes                                   | No   |
| TEST          | Fillet Weld - Fract  | ure Test    |           |            |               |                     | Length o                                | of Percent o         | f Defect   |                          | in.;                                  | %:   |
| WELDER INFO   | Chris Job  |             | ergy      |            |               | License Number 8    | k State                                 | J00-43               | 35-53      | 3                        | Stencil Mark                          |  |
| CERTIFICATION | We certify that the<br>1104.<br>Welding Test Con-<br>Visual Examinatio | ducted By:  | Ralph Pfi | ster       | e correct and | that the test coupo | ns were pri                             | epared, we           | lded, and  | d tested in accor        | dance with the requi                  | rements of API                               |
|               |  |             |           |            |               | roove Welds by Radi | iography):                              | NA                   |            |                          |                                       |  |
|               | Mechanical Test C  |             |           | er C. Dum  | ford          |                     |   |                      |            | tory Test No:            |                                       |  |
|               | Approved By: Wa  |             | nford     | 1          |               |                     |   |                      |            | ation: Terracor          | Consultants                           |  |
|               | APPROVED   | 1           |           | REJECT     | ED            |                     |   |                      | Date:      | 5/7/15                   |                                       |  |
| REMARKS       |  |             |           |            |               |                     |   |                      |            |                          |                                       |  |
|               | By: Walter C. Dun  | mford       |           |            |               |                     | Title : C                               | ertified We          | elding Ins | pector                   |                                       |  |
| SUBMITTAL     |  |             |           | 7.7.1      |               |                     | 13                                      |                      | 7 999      |                          |                                       |  |
|               | Company/Organiz  | zation: Ter | racon Con | sultants   |               |                     |   |                      | Date:      | 5/7/15                   |                                       |  |
|               | Company/Organiz<br>Engineer:   | zation: Ter | racon Con | sultants   |               |                     |   |                      | Date:      | 5/7/15                   |                                       |  |
| APPROVAL      |  |             | racon Con | sultants   |               |                     |   |                      |            | 5/7/15                   |                                       |  |



| 40.0           |                                  |                     |                         | 1.110         | CLD OILL Q                      | O' ILII IC' III        | OIT ILECOND        | (, \( \),            |
|----------------|----------------------------------|---------------------|-------------------------|---------------|---------------------------------|------------------------|--------------------|----------------------|
| TVDF OF        | PQR No. M-2-X52-1                | 54                  |                         |               | Orig. Issue Date                |                        | Revision Date      |                      |
| TYPE OF        | WPS No. M-BW-2-B                 | I-I                 |                         |               | Orig. Issue Date                |                        | Revision Date      |                      |
| RECORD         | API 1104 🗸 Ot                    | her                 |                         |               | A                               |                        | -                  | Y                    |
| ppocres        | Metal Inert Gas                  | (MIG)               |                         |               | Type of Process                 | : Manual               |                    |                      |
| PROCESS        | For: Butt                        | Welding             | √ Fillet \              | Velding       |                                 |                        |                    |                      |
| PIPE           | Material Specification: 2        | .375" 0.[           | ). X-52-0.154"          | WT. API 5L    |                                 |                        |                    |                      |
| DIAMETER       | API 1104 6.2.2 G                 | uidelines           | Under 2                 | -3/8" OD      | 2-3/8"                          | to 12-3/4" OD          | > 12-3             | 3/4" OD              |
| MATERIAL       | API 1104 5.4.2.2                 | Guidelines          | ≤ 42,00                 | 0 PSI Yield   | > 42,00                         | 00 to < 65,000 PSI Yie | ld                 | PSI Yield            |
| THICKNESS      | API 1104 6.2.2 G                 | uidelines           | ✓ Under 3,              | /16" thick    | 3/16"                           | thru 3/4" thick        | Over 3,            | /4" thick            |
| FILLED MATTALE | AWS Electrode Nos: ER            | 70S-3               | AWS Electrode Size      | e: 0.035"     | AWS Specification               | n: A5.18               | Filler Metal Group | 5 <sup>b</sup>       |
| FILLER METALS  | Wire Feed Rate (IPM) : 2         | 200-280             |                         |               |                                 |                        |                    |                      |
| GAS            | 75/25 Argon/CO2                  |                     |                         | 40 cfm        |                                 |                        | •                  |                      |
| PREHEAT        | Minimum Preheat Temp             | erature (F): 5      | 00                      | Interpass Ten | perature (F): >100 <sup>0</sup> | Other:                 |                    |                      |
|                |                                  | WE                  | LD AXIS                 |               | TE                              | CHNIQUE                | DIRE               | CTION                |
|                | Flat (1G, 1F, 1FR)               | J                   | Plate                   |               | Backhand                        | 4                      | Vertical - Up      |                      |
|                | Horizontal (2G, 2F, 2FR)         |                     | Pipe                    | 1             | Forehand                        |                        | Vertical - Down    | \ \ \                |
| POSITION       | Vertical (3G, 3F)                |                     | Rotated                 | 4             |                                 |                        |                    |                      |
|                | Overhead (4G, 4F)                |                     | Fixed                   |               |                                 |                        |                    | 191                  |
|                | Multiple (5G, 5F)                |                     | Inclined (6G, 6F)       |               |                                 |                        |                    |                      |
|                | Combination                      |                     |                         |               |                                 |                        |                    |                      |
|                | DISP                             | OSITION STYL        | E                       | М             | ETHOD                           |                        | ARC TYPE           |                      |
| TECHNIQUE      | Stringer Beads J                 |                     |                         | Multiple Pass | ✓                               | Single Arc             |                    | Other:               |
|                | Weave Beads                      |                     |                         | Single Pass   |                                 | Multiple Arc           |                    | , <u>u</u>           |
| CLEANING       | Base Material: Pov               | ver 🗸               | Hand                    |               | Weld: Power                     | √ Ha                   | and 🔲              |                      |
|                |                                  | BUT                 | T WELD 🗸                |               |                                 | FIL                    | LET WELD           |                      |
| JOINT DESIGN   | 37½°± 2½°F0R<br>30° + 5° 0 F0    | FITTINGS<br>OR PIPE | <b>4 1=</b> 1/16"       |               |                                 | 1/16" ± 1/32           | <b></b>            |                      |
| JOINT BESIGN   | 1/32" TO 1/16" 1<br>1/8" ± 1/16" | N.                  |                         |               | 17"                             | TO 45°                 |                    |                      |
|                | Current Type: AC                 |                     |                         |               | Test Cou                        | ipons                  | Reverse/Positive   |                      |
| ELECTRICAL     | Current Type: AC                 |                     | DC 🗸                    | Polarity:     | 4                               | RANGE                  | MAXIMUM TIME       | ✓                    |
| CHARACTERIS-   | BEAD NO.                         | Passes              | ELECTRODE NO. &<br>TYPE | Size          | VOLTS                           | AMPS                   | LAPSE ALLOWED      | SPEED RANGE<br>(IPM) |
| TICS &         | Root                             | 1                   | ER70S-3                 | 0.035         | 15 - 19                         | AIVIPS                 | (Min.)<br>5        | 12                   |
| SEQUENCE OF    | Hot Pass                         | 1                   | ER70S-3                 | 0.035         | 15 - 19                         | -                      | 5                  | 12                   |
| BEADS          | Fill                             | 1                   | 203                     | 5.033         | 10.10                           | 1                      |                    |                      |
| DEADS          | Сар                              | 1                   | ER70S-3                 | 0.035         | 15 - 19                         |                        | 5                  | 12                   |
|                | 1                                | -                   |                         |               | 1                               | . 4                    |                    |                      |

Duke Energy NGBU Procedure Qualification Records Page 178 of 187 Location of Failure Ultimate Total **Ultimate Unit Stress** Type of Failure Specimen No. Width Thickness Area (in.^2) Base Metal or Load(Lbs.) Ductile or Brittle (psi) Weld 1.05 0.18 0.19 13527 71571 Ductile Base Metal **TENSILE TEST** 2 3 Specimen No. Root Bend Face Bend Side Bend Bend Acceptable Comments 180 Degrees Yes 6 180 Degrees Yes No 7 180 Degrees Yes No **GUIDED BEND** 8 180 Degrees Yes No TEST 9 180 Degrees Yes No 10 180 Degrees Yes No 11 180 Degrees Yes No 12 180 Degrees Ves No Specimen No. Acceptable Yes/No Comments **NICK BREAK** 13 1 No Yes TEST 14 Yes No 15 Yes No 16 Yes No Penetration into Parent Metal: Satisfactory: No No **FILLET WELD** Macro Results (Fusion): TEST Fillet Weld - Fracture Test Length of Percent of Defect 96: in.: Fillet Leg Size: inches x inches Concavity/Convexity in.: Stencil Mark License Number & State J00-435-533 Welder Name Chris Jobert **WELDER INFO** Contractor Duke Energy We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of API Visual Examination Results: Satisfactory CERTIFICATION Radiographic Test Results (For Alternative Qualification of Groove Welds by Radiography): NA Mechanical Test Conducted By: Walter C. Dumford Laboratory Test No: Approved By: Walter C. Dumford Organization: Terracon Consultants APPROVED REJECTED Date: 5/7/15 REMARKS By: Walter C. Dumford Title: Certified Welding Inspector SUBMITTAL Date: 5/7/15 Company/Organization: Terracon Consultants Engineer: Date: **APPROVAL** Weld Supervisor: Date: Director of Gas Engineering: Date:

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| 40.0             | A-1-2-1                            |                    |                         | 1110          | CLD OILL Q                      | O' (EII TO' (TT         | OIT ILLCOIND        | (1 41.)              |
|------------------|------------------------------------|--------------------|-------------------------|---------------|---------------------------------|-------------------------|---------------------|----------------------|
| TYPE OF          | PQR No. M-4-X52-1                  | 88                 |                         |               | Orig. Issue Date                |                         | Revision Date       |                      |
| TYPE OF          | WPS No. M-BW-2-B                   | -II                |                         |               | Orig. Issue Date                |                         | Revision Date       |                      |
| RECORD           | API 1104 🗸 Oth                     | er                 |                         |               | A                               |                         |                     | Y                    |
|                  | Metal Inert Gas                    | (MIG)              |                         |               | Type of Process                 | Manual                  |                     |                      |
| PROCESS          | For: Butt V                        | Velding [          | √ Fillet \              | Welding       |                                 |                         |                     |                      |
| PIPE             | Material Specification: 4          | .5"O.D             | X-52 - 0.188" \         | NT. API 5L    |                                 |                         |                     |                      |
| DIAMETER         | API 1104 6.2.2 Gu                  | idelines           | Under 2                 | 2-3/8" OD     | 2-3/8"                          | to 12-3/4" OD           | > 12-3              | 3/4" OD              |
| MATERIAL         | API 1104 5.4.2.2 G                 | uidelines          | ≤ 42,00                 | 0 PSI Yield   | > 42,00                         | 00 to < 65,000 PSI Yiel | d ≥ 65,000          | PSI Yield            |
| THICKNESS        | API 1104 6.2.2 Gu                  | uidelines          | Under 3                 | /16" thick    | √ 3/16"                         | thru 3/4" thick         | Over 3              | /4" thick            |
| FULFDAAFTALC     | AWS Electrode Nos: ER              | 70S-3              | AWS Electrode Size      | e: 0.035"     | AWS Specification               | n: A5.18                | Filler Metal Group: | 5 <sup>b</sup>       |
| FILLER METALS    | Wire Feed Rate (IPM) : 2           | 00-280             |                         |               |                                 |                         |                     |                      |
| GAS              | 75/25 Argon/CO2                    |                    |                         | 40 cfm        | •                               |                         |                     |                      |
| PREHEAT          | Minimum Preheat Tempe              | erature (F): 5     | 50°                     | Interpass Ten | perature (F): >100 <sup>0</sup> | Other:                  |                     |                      |
|                  |                                    | WE                 | LD AXIS                 |               | TE                              | CHNIQUE                 | DIRE                | CTION                |
|                  | Flat (1G, 1F, 1FR)                 | 1                  | Plate                   |               | Backhand                        | <b>V</b>                | Vertical - Up       |                      |
|                  | Horizontal (2G, 2F, 2FR)           |                    | Pipe                    | 1             | Forehand                        |                         | Vertical - Down     |                      |
| POSITION         | Vertical (3G, 3F)                  |                    | Rotated                 | 4             |                                 |                         |                     |                      |
|                  | Overhead (4G, 4F)                  |                    | Fixed                   |               |                                 |                         |                     |                      |
|                  | Multiple (5G, 5F)                  |                    | Inclined (6G, 6F)       | 1             |                                 |                         |                     |                      |
|                  | Combination                        |                    |                         |               |                                 |                         |                     |                      |
|                  | DISPO                              | OSITION STY        | LE                      | M             | ETHOD                           |                         | ARC TYPE            |                      |
| TECHNIQUE        | Stringer Beads                     |                    |                         | Multiple Pass | ✓                               | Single Arc ~            |                     | Other:               |
|                  | Weave Beads                        |                    |                         | Single Pass   |                                 | Multiple Arc            | ]                   | other.               |
| CLEANING         | Base Material: Pow                 | er 🗸               | Hand                    |               | Weld: Power                     | √ Ha                    | and 🔲               |                      |
|                  |                                    | BUT                | T WELD 🗸                |               |                                 | FILL                    | ET WELD             |                      |
| Sign on a second | 37½°± 2½°FOR 1<br>30° + 5° 0 FO    | FITTINGS<br>R PIPE |                         |               |                                 | 1/16" ± 1/32            | <b></b>             |                      |
| JOINT DESIGN     | 1/32" TO 1/16" 1<br>1/8" ± 1/16" - |                    | 1 V16"                  |               | 17"                             | TO 45°                  |                     |                      |
|                  | Current Tune: AC                   |                    |                         |               | Test Cou                        | ipons                   | Reverse/Positive    | [7]                  |
| ELECTRICAL       | Current Type: AC                   |                    | DC ✓                    | Polarity:     | -                               | RANGE                   | MAXIMUM TIME        | <b>V</b>             |
| CHARACTERIS-     | BEAD NO.                           | Passes             | ELECTRODE NO. &<br>TYPE | Size          | VOLTS                           | AMPS                    | LAPSE ALLOWED       | SPEED RANGE<br>(IPM) |
| TICS &           | Root                               | 1                  | ER70S-3                 | 0.035         | 15 - 19                         | AIVIPS                  | (Min.)<br>5         | 12                   |
| SEQUENCE OF      | Hot Pass                           | 1                  | ER70S-3                 | 0.035         | 15 - 19                         |                         | 5                   | 12                   |
| BEADS            | Fill                               | 1                  | EN7U3°3                 | U.V.33        | 13:13                           |                         | 15 10 00 00         | 12                   |
| DLADS            | Сар                                | 1                  | ER70S-3                 | 0.035         | 15 - 19                         |                         | 5                   | 12                   |
|                  | Cap                                | 1                  | EN/03-3                 | 0.033         | 13-19                           |                         | 3                   | 12                   |

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|                      | Specimen No.  | W           | Vidth        | Th           | ickness     | Area (in.^2)           | 1/20/20/20  | ate Total<br>d(Lbs.) | Ultima      | te Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|----------------------|---|-------------|--------------|--------------|-------------|------------------------|-------------|----------------------|-------------|-------------------------|---------------------------------------|--|
| TENCH E TECT         | ì   | (           | 0.73         |              | 0.2         | 0.15                   | 9           | 9077                 |             | 62171                   | Ductile                               | Base Metal                                   |
| TENSILE TEST         | 2   |             |              |              |             |                        |             |                      |             |                         |                                       |  |
| (                    | 3   |             |              |              |             |                        |             |                      |             |                         |                                       |  |
|                      | .4  |             |              |              |             |                        |             |                      |             |                         |                                       |  |
|                      | Specimen No.  | Roc         | ot Bend      | Fac          | e Bend      | Side Bend              |             | Bend                 | Acceptab    | le                      | Com                                   | ments  |
|                      | 5   | 180         | Degrees      |              |             |                        | Yes         | 1                    | No          |                         |                                       |  |
|                      | 6   | 180         | Degrees      |              |             |                        | Yes         | 4                    | No          |                         |                                       |  |
| GUIDED BEND          | 7   | 180         | Degrees      |              |             |                        | Yes         |                      | No          |                         |                                       |  |
|                      | 8   | 180         | Degrees      |              |             |                        | Yes         |                      | No          |                         |                                       |  |
| TEST                 | 9   |             |              | 180          | Degrees     |                        | Yes         |                      | No          |                         |                                       |  |
|                      | 10  |             |              | 180          | Degrees     |                        | Yes         |                      | No          |                         |                                       |  |
|                      | 11  |             |              | 180          | Degrees     |                        | Yes         |                      | No          |                         |                                       |  |
|                      | 12  |             |              | 180          | Degrees     |                        | Yes         |                      | No          |                         |                                       |  |
|                      | Specimen No.  |             | Accept       | able Yes/N   | lo          |                        |             |                      | C           | omments                 |                                       |  |
| NICK BREAK           | 13  | Yes         | 1            | No           |             |                        |             |                      |             |                         |                                       |  |
| TEST                 | 14  | Yes         | 1            | No           |             |                        |             |                      |             |                         |                                       |  |
|                      | 15  | Yes         |              | No           |             |                        |             |                      |             |                         |                                       |  |
|                      | 16  | Yes         |              | No           |             |                        |             |                      |             |                         |                                       |  |
| FILLET WELD          | Satisfactory:   | Yes         |              | No           |             |                        | Penetrat    | tion into Pa         | rent Meta   | al:                     | Yes                                   | No   |
| TEST                 | Fillet Weld - Fractu  | ire Test    |              |              |             |                        | Length o    | of Percent c         | of Defect   |                         | in.:                                  | %:   |
|                      | Welder Name Ch  | nris Jo     | bert         |              |             | License Number &       | State J     | 00-43                | 5-53        | 3                       | Stencil Mark                          |  |
| WELDER INFO          | Contractor Duk  | ce En       | ergy         |              |             |                        |             |                      |             |                         |                                       | - 7  |
|                      | We certify that the 1104.   | statemen    | ts in this r | ecord are    | correct and | d that the test coupor | ns were pro | epared, we           | lded, and   | tested in accord        | dance with the requi                  | rements of API                               |
|                      | Welding Test Cond   | lucted By:  | Ralph Pfi    | ster         |             |                        |             |                      |             |                         |                                       |  |
|                      | Visual Examination  | Results:    | Satisfacto   | ry           |             |                        |             |                      |             |                         |                                       |  |
| CERTIFICATION        | Radiographic Test F   | Results (Fo | or Alternat  | tive Qualifi | cation of G | iroove Welds by Radi   | ography):   | NA                   |             |                         |                                       |  |
|                      | Mechanical Test Co  | onducted (  | By: Walte    | r C. Dumfo   | ord         |                        |             |                      | Laborate    | ory Test No:            |                                       |  |
|                      | Approved By: Walt   | ter C. Dum  | nford        |              |             |                        |             |                      | Organiza    | ation: Terracon         | Consultants                           |  |
|                      | APPROVED  | 1           |              | REJECTE      | ED          |                        |             |                      | Date: 5     | /7/15                   |                                       | -  |
|                      |   |             |              |              |             | 3                      |             |                      |             |                         |                                       |  |
| REMARKS              |   |             |              |              |             |                        |             |                      |             |                         |                                       |  |
|                      | By: Walter C, Dum   |             |              |              |             |                        | Title: Ce   | ertified Wel         | ding Inspe  | ector                   |                                       |  |
| REMARKS<br>SUBMITTAL | By: Walter C. Dum<br>Company/Organiza   | nford       | acon Con:    | sultants     |             |                        | Title: Ce   | ertified Wel         | Iding Inspo | 1071                    |                                       |  |
|                      | A 141 A | nford       | acon Con:    | sultants     |             |                        | Title: Ce   | ertified Wel         |             | 1077                    |                                       |  |
|                      | Company/Organiza  | nford       | acon Con:    | sultants     |             |                        | Title: Ce   | ertified Wel         | Date: 5     | 1077                    |                                       |  |



|               |                         |  |                      | 41.4.4        |                                  | ELICIDED A PERCENT -    |                               |                |
|---------------|-------------------------|--|----------------------|---------------|----------------------------------|-------------------------|-------------------------------|----------------|
| 7/05 05       | PQR No. M-F-2-          | X42-154                                      |                      |               | Orig. Issue Date                 |                         | Revision Date                 |                |
| TYPE OF       | WPS No. M-FW-           | A-I  |                      |               | Orig. Issue Date                 |                         | Revision Date                 |                |
| RECORD        | API 1104 🗸              | Other  |                      |               | A                                |                         | *                             |                |
|               | Metal Inert G           | as (MIG)                                     |                      |               | Type of Process:                 | Manual                  |                               |                |
| PROCESS       | For: Be                 | utt Welding                                  | Fillet               | Velding 🗸     |                                  |                         |                               |                |
| PIPE          | Material Specification: | 2.375" O.                                    | <br>D X-42 - 0.154   | " WT. API 51  |                                  |                         |                               |                |
| DIAMETER      | API 1104 6.2.2          | Guidelines                                   | Under 2              | 3/8" OD       | 2-3/8"                           | to 12-3/4" OD           | > 12.3                        | /4" OD         |
| MATERIAL      | API 1104 5.4.2.         | 2 Guidelines                                 | √ ≤42,00             | 0 PSI Yield   | > 42,000                         | 0 to < 65,000 PSI Yield | ≥ 65,000                      | PSI Yield      |
| THICKNESS     | API 1104 6.2.2          | Guidelines                                   | ✓ Under 3            | /16" thick    | 3/16" ti                         | hru 3/4" thick          | Over 3/                       | 4" thick       |
|               | AWS Electrode Nos:      | ER70S-3                                      | AWS Electrode Size   | e: 0.035"     | AWS Specification                | A5.18                   | Filler Metal Group:           | 5 <sup>b</sup> |
| FILLER METALS | Wire Feed Rate (IPM)    | AT AT A                                      | 111/10 21501/035 512 |               | Thirt specification              | 1,151,55                | Titlet Wetar Group.           |                |
| GAS           | 75/25 Argon/CO2         | _  |                      | 40 cfm        |                                  |                         |                               |                |
| PREHEAT       | Minimum Preheat Te      |  | E00                  |               | pperature (F): >100 <sup>0</sup> | Other:                  |                               |                |
| PREMEAT       | Wilnimum Preneat le     |  |                      | interpass rem |                                  |                         | T puns                        | TION           |
|               | St. (45. 45. 450)       |  | LD AXIS              |               |                                  | CHNIQUE                 | DIREC                         | TION           |
|               | Flat (1G, 1F, 1FR)      | <u> </u>                                     | Plate                | - E           | Backhand                         | <u> </u>                | Vertical - Up                 |                |
| DOCUTION      | Horizontal (2G, 2F, 2FF | <u>,                                    </u> | Pipe                 | /             | Forehand                         |                         | Vertical - Down               |                |
| POSITION      | Vertical (3G, 3F)       |  | Rotated              | <b>✓</b>      |                                  |                         |                               |                |
|               | Overhead (4G, 4F)       |  | Fixed                |               |                                  |                         |                               |                |
|               | Multiple (5G, 5F)       |  | Inclined (6G, 6F)    |               | 4                                |                         |                               |                |
|               | Combination             |  |                      | 20            | e FA                             | 1                       | 1185.735                      |                |
|               |                         | ISPOSITION STY                               | LE                   |               | ETHOD                            |                         | ARC TYPE                      |                |
| TECHNIQUE     | Stringer Beads          | 4  |                      |               | ✓ <u> </u>                       | Single Arc              |                               | Other:         |
|               | Weave Beads             |  |                      | Single Pass   |                                  | Multiple Arc            |                               |                |
| CLEANING      | Base Material: P        | ower 🗸                                       | Hand                 |               | Weld: Power                      | ✓ Har                   | nd 📗                          |                |
|               |                         | вит  | T WELD               |               |                                  | FILLE                   | T WELD ~                      |                |
|               | 371/2° ± 21/2° FO       | O FITTINGS                                   |                      |               |                                  | VV                      |                               |                |
|               | 30° + 5° - 0            |  |                      |               |                                  | 116 ± 1/3               | 52"                           |                |
|               |                         | . 1  |                      |               |                                  | 1/16" ± 1/32"           | 7                             |                |
| JOINT DESIGN  |                         | المام  | ► 1/16"              |               |                                  |                         | پر اا                         | \              |
|               | 0.75500                 | 1  | 7                    |               |                                  |                         |                               | 1              |
|               | 1/32" TO 1/16"          | $\perp \perp \mid \perp \mid$                | _                    |               |                                  | 1                       |                               |                |
|               | 1/8" ± 1/16"            |  |                      |               |                                  | /                       |                               | - 0            |
|               | 78 - 716                | 77   | 34                   |               | 17"                              | TO 45°                  |                               |                |
|               |                         |  | Cennus D             | arione of     | : Test Cou                       | 0000                    |                               |                |
|               |                         |  | OLOOVA D             | esigns or     | 1621 000                         | ронъ                    |                               |                |
| NICON P       | Current Type: A         | ۵ 🔲  | DC 🗸                 | Polarity:     | Straight/Negative                |                         | Reverse/Positive              | 4              |
| ELECTRICAL    | BEAD NO.                | Passes                                       | ELECTRODE NO. &      | Size          |                                  | RANGE                   | MAXIMUM TIME<br>LAPSE ALLOWED | SPEED RANGE    |
| CHARACTERIS-  | BLAD NO.                | 1 03562                                      | TYPE                 | 3126          | VOLTS                            | AMPS                    | (Min.)                        | (IPM)          |
| TICS &        | Root                    | 1  | ER70S-3              | 0.035         | 15 - 19                          |                         | 5                             | 12             |
| SEQUENCE OF   | Hot Pass                | 1  | ER70S-3              | 0.035         | 15 - 19                          |                         | 5                             | 12             |
| BEADS         | Fill                    |  |                      |               |                                  |                         |                               |                |
|               | Сар                     | 1  | ER70S-3              | 0.035         | 15 - 19                          |                         | 5                             | 12             |

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|               | Specimen No.              | Width                   | Thickness            | Area (in.^2)         | 10.750.5    | ate Total<br>d(Lbs.) | A. A. S. A. A. A. A. A. | e Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|---------------|---------------------------|-------------------------|----------------------|----------------------|-------------|----------------------|-------------------------|------------------------|---------------------------------------|--|
| TENSILE TEST  | 1                         |                         |                      |                      |             |                      |                         |                        |                                       |  |
| TENSILE TEST  | 2                         |                         |                      |                      |             |                      |                         |                        |                                       |  |
|               | 3                         | 2                       |                      |                      |             |                      |                         |                        |                                       |  |
|               | 4                         |                         |                      |                      |             |                      |                         |                        |                                       |  |
|               | Specimen No.              | Root Bend               | Face Bend            | Side Bend            |             | Bend                 | Acceptable              | 4                      | Com                                   | ments  |
| 11 13         | 5                         | 180 Degrees             |                      |                      | Yes         |                      | No                      |                        |                                       |  |
|               | 6                         | 180 Degrees             |                      |                      | Yes         |                      | No                      |                        |                                       |  |
| GUIDED BEND   | 7                         | 180 Degrees             |                      |                      | Yes         |                      | No                      | (H)+1                  |                                       |  |
|               | 8                         | 180 Degrees             |                      |                      | Yes         |                      | No                      |                        |                                       |  |
| TEST          | 9                         |                         | 180 Degrees          |                      | Yes         |                      | No                      |                        |                                       |  |
|               | 10                        |                         | 180 Degrees          |                      | Yes         |                      | No                      |                        |                                       |  |
|               | 11                        |                         | 180 Degrees          |                      | Yes         |                      | No                      |                        |                                       |  |
|               | 12                        |                         | 180 Degrees          |                      | Yes         |                      | No                      |                        |                                       |  |
|               | Specimen No.              | Acceptal                | ale Yes/No           |                      |             |                      | Co                      | mments                 |                                       |  |
| NICK BREAK    | 13                        | Yes                     | No                   |                      |             |                      |                         |                        |                                       |  |
| TEST          | 14                        | Yes 🗸                   | No                   |                      |             |                      |                         |                        |                                       |  |
|               | 15                        | Yes 🗸                   | No                   |                      |             |                      |                         |                        |                                       |  |
|               | 16                        | Yes 🗸                   | No                   |                      |             |                      |                         |                        |                                       |  |
| FILLET WELD   | Satisfactory:             | Yes 🗸                   | No                   |                      | Penetrat    | ion into Pa          | rent Meta               | l:                     | Yes 🗸                                 | No   |
| TEST          | Fillet Weld - Fractu      | re Test. Acceptable     |                      |                      | Length o    | f Percent o          | f Defect:               | None                   | in.:                                  | %:   |
|               | Welder Name C             | nris Jobert             |                      | License Number &     | State JC    | 00-43                | 5-533                   |                        | Stencil Mark                          |  |
| WELDER INFO   | Contractor Dul            | ke Energy               |                      |                      |             |                      |                         |                        |                                       |  |
|               | We certify that the 1104. | statements in this re   | cord are correct and | that the test coupon | ns were pre | epared, we           | ded, and t              | ested in accor         | dance with the requi                  | rements of API                               |
| +             | Welding Test Cond         | ucted By: Ralph Pfist   | er                   |                      |             |                      |                         |                        |                                       |  |
| CERTIFICATION | Visual Examination        | Results: Satisfactory   |                      |                      |             |                      |                         |                        |                                       |  |
| CENTIFICATION | Radiographic Test F       | Results (For Alternativ | e Qualification of G | roove Welds by Radi  | ography):   | NA                   |                         |                        |                                       |  |
|               | Mechanical Test Co        | onducted By: Walter     | C. Dumford           |                      |             |                      | Laborato                | ry Test No:            |                                       |  |
|               | Approved By: Walt         | ter C. Dumford          |                      |                      |             |                      | Organiza                | tion: Terracon         | Consultants                           |  |
|               | APPROVED                  | ✓                       | REJECTED             |                      |             |                      | Date: 5/                | 7/15                   |                                       |  |
| REMARKS       |                           |                         |                      |                      |             |                      |                         |                        |                                       |  |
| CURACITA I    | By: Walter C. Dum         | ford                    |                      |                      | Title: Ce   | rtified Wel          | ding Inspe              | ctor                   |                                       |  |
| SUBMITTAL     | Company/Organiza          | tion: Terracon Consu    | ıltants              |                      | V           |                      | Date: 5/                | 7/15                   |                                       |  |
|               | Engineer:                 |                         |                      |                      |             |                      | Date:                   |                        |                                       |  |
| APPROVAL      | Weld Supervisor:          |                         |                      |                      |             |                      | Date:                   |                        |                                       |  |
|               | Director of Gas Eng       | ineering:               |                      |                      |             |                      | Date:                   |                        |                                       |  |



|               |                           |  |                         | 1 110         | CLD OILL Q                       | C' ILII IC' III         | OIT ILCOID           | (, \( \)             |
|---------------|---------------------------|--|-------------------------|---------------|----------------------------------|-------------------------|----------------------|----------------------|
| T/05 05       | PQR No. M-F-2-X52         | 2-154  |                         |               | Orig. Issue Date                 |                         | Revision Date        |                      |
| TYPE OF       | WPS No. M-FW-B-           | 1  |                         |               | Orig. Issue Date                 |                         | Revision Date        |                      |
| RECORD        | API 1104 🗸 01             | ther   |                         |               | N.                               |                         |                      | Y                    |
|               | Metal Inert Gas           | (MIG)  |                         |               | Type of Process                  | : Manual                |                      |                      |
| PROCESS       | For: Butt                 | Welding [  | Fillet \                | Welding 🗸     |                                  |                         |                      |                      |
| PIPE          | Material Specification: 2 | .375" O.   | D. X-52-0.154"          | WT. API 5L    |                                  |                         |                      |                      |
| DIAMETER      | API 1104 6.2.2 G          | uidelines  | Under 2                 | 3/8" OD       | 2-3/8                            | to 12-3/4" OD           | > 12.3               | 1/4" OD              |
| MATERIAL      | API 1104 5.4.2.2          | Guidelines   | ≤ 42,00                 | 0 PSI Yield   | √ > 42,0                         | 00 to < 65,000 PSI Yiel | d ≥ 65,000           | PSI Yield            |
| THICKNESS     | API 1104 6.2.2 G          | iuidelines   | ✓ Under 3               | /16" thick    | 3/16"                            | thru 3/4" thick         | Over 3,              | /4" thick            |
|               | AWS Electrode Nos: Ef     | R70S-3   | AWS Electrode Size      | e: 0.035"     | AWS Specificatio                 | n: A5.18                | Filler Metal Group   | 5 <sup>b</sup>       |
| FILLER METALS | Wire Feed Rate (IPM) :    |  |                         |               |                                  | ADDOS.                  |                      |                      |
| GAS           | 75/25 Argon/CO2           |  |                         | 40 cfm        |                                  | Τ                       |                      |                      |
| PREHEAT       | Minimum Preheat Temp      | perature (F):  | 50°                     | Interpass Ten | nperature (F): >100 <sup>0</sup> | Other:                  |                      |                      |
| . HEHEAT      | 3                         |  | LD AXIS                 | 35.635.130    |                                  | ECHNIQUE                | DIRE                 | CTION                |
|               | Flat (1G, 1F, 1FR)        | <b>V</b>   | Plate                   |               | Backhand                         | 7                       | Vertical - Up        |                      |
|               | Horizontal (2G, 2F, 2FR)  |  | Pipe                    |               | Forehand                         |                         | Vertical - Down      |                      |
| POSITION      | Vertical (3G, 3F)         | 一百   | Rotated                 | 7             |                                  |                         |                      |                      |
| , 65,116,1    | Overhead (4G, 4F)         |  | Fixed                   |               |                                  |                         |                      |                      |
|               | Multiple (5G, 5F)         |  | Inclined (6G, 6F)       |               |                                  |                         |                      |                      |
|               | Combination               |  | 1                       |               | A.                               |                         |                      |                      |
| -             | DISF                      | POSITION STY   | LE                      |               | ETHOD                            | 1                       | ARC TYPE             |                      |
| TECHNIQUE     | Stringer Beads J          |  |                         |               | 7                                | Single Arc              |                      | - Ca                 |
| TEGINIQUE     | Weave Beads               |  |                         | Single Pass   |                                  | Multiple Arc            | ī                    | Other:               |
| CLEANING      | Base Material: Pov        | wer 🗸  | Hand                    |               | Weld: Power                      |                         | and                  |                      |
| CLLAINING     | buse material 1 of        |  | TT WELD                 |               | Weldt Tollie                     |                         | ET WELD              |                      |
|               |                           | ВО   | I WELD                  |               |                                  | FILL                    | El WELD              |                      |
|               | 371/2" ± 21/2" FOR        | FITTINGS   |                         |               |                                  | V 1                     | 4-9-11               | ĺ                    |
|               | 30° + 5° 0 F              | OR PIPE  |                         |               |                                  | 1/16' ± 1               | <b>——</b>            |                      |
| JOINT DESIGN  |                           | 1.   | <b>⋈  -</b> 1/16"       |               |                                  | 1/16" ± 1/32            | "                    |                      |
| JOINT DESIGN  | 4                         | 100  | 1 1                     |               |                                  |                         |                      |                      |
|               | 1/32" TO 1/16"            | $\supset$ $\Box$   |                         |               |                                  | 1                       | - C-1213             | × /                  |
|               | 732 10 716 1              | $\rightarrow \!$ | _                       |               |                                  |                         | <i>/</i>             | _/                   |
|               | 1/8" ± 1/16"              |  | -                       |               | 17'                              | " TO 45°                |                      |                      |
|               |                           | 4.4  |                         |               |                                  | 10 12                   |                      |                      |
|               |                           |  | Groove D                | esigns of     | f Test Cou                       | upons                   |                      |                      |
|               | Current Type: AC          |  | DC 🗸                    | Polarity:     | Straight/Negative                |                         | Reverse/Positive     | 4                    |
| ELECTRICAL    | -and the Ac               |  |                         | . 5.8.0.7.    |                                  | RANGE                   | MAXIMUM TIME         | 1                    |
| CHARACTERIS-  | BEAD NO.                  | Passes   | ELECTRODE NO. &<br>TYPE | Size          | VOLTS                            | AMPS                    | LAPSE ALLOWED (Min.) | SPEED RANGE<br>(IPM) |
| TICS &        | Root                      | 1  | ER70S-3                 | 0.035         | 15 - 19                          | CHAIL 3                 | (Min.)               | 12                   |
| SEQUENCE OF   | Hot Pass                  | 1  | ER70S-3                 | 0.035         | 15 - 19                          | 1                       | 5                    | 12                   |
| BEADS         | Fill                      | 1  |                         | 0.000         | 15.35                            | +                       |                      | -                    |
| DEADS         | Сар                       | 1  | ER70S-3                 | 0.035         | 15 - 19                          |                         | 5                    | 12                   |
|               | Cup                       | 1  | LI1703-3                | 0.033         | 13-13                            |                         | -                    | 1,0                  |

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|                                     | Specimen No.   | Width  | Thickness  | Area (in.^2)          | 10.750.5         | ate Total<br>d(Lbs.) | Ultima   | te Unit Stress<br>(psi)  | Type of Fallure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |
|-------------------------------------|--|--|--|-----------------------|------------------|----------------------|--|--|---------------------------------------|--|
| TENCH E TECT                        | 1  |  |  |                       |                  |                      |  |  |                                       |  |
| TENSILE TEST                        | 2  |  |  |                       |                  |                      |  |  |                                       |  |
|                                     | 3  |  |  |                       |                  |                      |  |  |                                       |  |
|                                     | 4  |  | 1 1 1  |                       |                  |                      |  |  |                                       |  |
|                                     | Specimen No.   | Root Bend  | Face Bend  | 5 de Bend             |                  | Bend                 | Acceptabl                                      | e  | Com                                   | ments  |
|                                     | 5  | 180 Degrees  |  |                       | Yes              |                      | No   |  |                                       |  |
|                                     | 6  | 180 Degrees  |  |                       | Yes              |                      | No   |  |                                       |  |
| GUIDED BEND                         | 7  | 180 Degrees  |  |                       | Yes              |                      | No   | (H);=1   |                                       |  |
|                                     | 8  | 180 Degrees  |  |                       | Yes              |                      | No   |  |                                       |  |
| TEST                                | 9  |  | 180 Degrees  |                       | Yes              |                      | No   |  |                                       |  |
|                                     | 10   |  | 180 Degrees  |                       | Yes              | 1 1                  | No   |  |                                       |  |
|                                     | 11   |  | 180 Degrees  |                       | Yes              |                      | No   |  |                                       |  |
|                                     | 12   |  | 180 Degrees  |                       | Yes              |                      | No   |  |                                       |  |
|                                     | Specimen No.   | Accep  | table Yes/No   |                       |                  |                      | Co   | omments.   |                                       |  |
| NICK BREAK                          | 13   | Yes 🗸  | No   |                       |                  |                      |  |  |                                       |  |
| TEST                                | 14   | Yes 🗸  | No   |                       |                  |                      |  |  |                                       |  |
|                                     | 15   | Yes 🗸  | No   |                       |                  |                      |  |  |                                       |  |
|                                     | 16   | Yes  | No   |                       |                  |                      |  |  |                                       |  |
| FILLET WELD                         | Satisfactory:  | Yes ✓  | No   |                       | Penetrat         | ion into Pa          | rent Meta                                      | l:   | Yes 🗸                                 | No   |
| 2222                                | L. T. LOTO P. S. T. S. L. L. S.  |  |  |                       |                  |                      |  |  |                                       |  |
| TEST                                | Fillet Weld - Fractu   | re Test. Satisfacto  | ry   |                       | Length o         | f Percent o          | f Defect.                                      | None   | in.:                                  | %:   |
| TEST                                | Fillet Weld - Fractur Welder Name Ch   |  |  | License Number 8      |                  |                      | 2000   |  | in.:<br>Stencil Mark                  | %:   |
|                                     | Welder Name Ch   | nris Jober   |  | License Number 8      |                  |                      | 2000   |  |                                       | %:   |
| WELDER INFO                         |  | nris Jober   |  | License Number 8      |                  |                      | 2000   |  |                                       | %:   |
|                                     | Welder Name Ch   | nris Jober<br>se Energy  |  |                       | State <b>J</b> ( | 00-43                | 5-533  | 3  | Stencil Mark                          |  |
|                                     | Welder Name Ch<br>Contractor Duk<br>We certify that the<br>1104.   | nris Jober<br>se Energy  | t<br>record are correct an   |                       | State <b>J</b> ( | 00-43                | 5-533  | 3  | Stencil Mark                          |  |
|                                     | Welder Name Ch<br>Contractor Duk<br>We certify that the<br>1104.<br>Welding Test Condi   | nris Jober<br>ce Energy<br>statements in this  | record are correct and   |                       | State <b>J</b> ( | 00-43                | 5-533  | 3  | Stencil Mark                          |  |
|                                     | Welder Name Ch<br>Contractor Duk<br>We certify that the<br>1104.<br>Welding Test Condu<br>Visual Examination   | ris Jober E Energy statements in this ucted By: Ralph P Results: Satisfactor   | record are correct and<br>fister   | d that the test coupo | State J(         | 00-43.               | 5-533  | 3  | Stencil Mark                          |  |
| WELDER INFO                         | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Condu Visual Examination Radiographic Test F  | ce Energy statements in this ucted By: Ralph P Results: Satisfactor  | record are correct and<br>lister<br>bry<br>tive Qualification of G               | d that the test coupo | State J(         | 00-43.               | 5-533  | tested in accord   | Stencil Mark                          |  |
| WELDER INFO                         | Welder Name Ch  Contractor Duk  We certify that the 1104.  Welding Test Condu  Visual Examination  Radiographic Test Fo  | ce Energy statements in this ucted By: Ralph P Results: Satisfactor Results (For Alterna                                 | record are correct and<br>lister<br>bry<br>tive Qualification of G               | d that the test coupo | State J(         | 00-43.               | 5-533  | tested in accord   | Stencil Mark  dance with the requi    |  |
| WELDER INFO                         | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Conde Visual Examination Radiographic Test F Mechanical Test Co   | statements in this ucted By: Ralph P Results: Satisfactor Results (For Alterna and ucted By: Walts (For Dumford          | record are correct and<br>iister<br>ory<br>tive Qualification of C               | d that the test coupo | State J(         | 00-43.               | 5-533  Ided, and  Laborato  Organiza           | tested in according to the second sec | Stencil Mark  dance with the requi    |  |
| WELDER INFO                         | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Conde Visual Examination Radiographic Test F Mechanical Test Co   | ce Energy statements in this ucted By: Ralph P Results: Satisfactor Results (For Alterna                                 | record are correct and<br>lister<br>bry<br>tive Qualification of G               | d that the test coupo | State J(         | 00-43.               | 5-533  | tested in according to the second sec | Stencil Mark  dance with the requi    |  |
| WELDER INFO                         | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Conde Visual Examination Radiographic Test F Mechanical Test Co   | statements in this ucted By: Ralph P Results: Satisfactor Results (For Alterna and ucted By: Walts (For Dumford          | record are correct and<br>iister<br>ory<br>tive Qualification of C               | d that the test coupo | State J(         | 00-43.               | 5-533  Ided, and  Laborato  Organiza           | tested in according to the second sec | Stencil Mark  dance with the requi    |  |
| WELDER INFO  CERTIFICATION  REMARKS | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Conde Visual Examination Radiographic Test F Mechanical Test Co   | statements in this ucted By: Ralph P. Results: Satisfactor Results (For Alternational Conducted By: Walth ter C. Dumford | record are correct and<br>iister<br>ory<br>tive Qualification of C               | d that the test coupo | ns were pre      | 00-43.               | 5-533  Ided, and  Laborato Organiza Date: 5/   | tested in accordance of the second se | Stencil Mark  dance with the requi    |  |
| WELDER INFO  CERTIFICATION          | Welder Name Ch Contractor Duk We certify that the 1104. Welding Test Condu Visual Examination Radiographic Test F Mechanical Test Co Approved By: Walt   | statements in this ucted By: Ralph P. Results: Satisfactor Results (For Alternational Conducted By: Walter C. Dumford    | record are correct and isster bry tive Qualification of Ger C. Dumford  REJECTED | d that the test coupo | ns were pre      | epared, wel          | 5-533  Ided, and  Laborato Organiza Date: 5/   | tested in according Test No: tion: Terracon 7/15   | Stencil Mark  dance with the requi    |  |
| WELDER INFO  CERTIFICATION  REMARKS | Welder Name Ch  Contractor Duk  We certify that the 1104.  Welding Test Conduction  Radiographic Test R  Mechanical Test Co  Approved By: Walt  APPROVED  By: Walter C, Dumin                              | statements in this ucted By: Ralph P. Results: Satisfactor Results (For Alternational Conducted By: Walter C. Dumford    | record are correct and isster bry tive Qualification of Ger C. Dumford  REJECTED | d that the test coupo | ns were pre      | epared, wel          | 5-533  Ided, and  Laborato  Organiza  Date: 5/ | tested in according Test No: tion: Terracon 7/15   | Stencil Mark  dance with the requi    |  |
| WELDER INFO  CERTIFICATION  REMARKS | Welder Name Ch  Contractor Duk  We certify that the 1104.  Welding Test Conde Visual Examination Radiographic Test R  Mechanical Test Co  Approved By: Walt  APPROVED  By: Walter C, Dumi Company/Organiza | statements in this ucted By: Ralph P. Results: Satisfactor Results (For Alternational Conducted By: Walter C. Dumford    | record are correct and isster bry tive Qualification of Ger C. Dumford  REJECTED | d that the test coupo | ns were pre      | epared, wel          | 5-533  Ided, and  Laborate Organiza Date: 5/   | tested in according Test No: tion: Terracon 7/15   | Stencil Mark  dance with the requi    |  |



|               |  |                    |   | 4.3.3         | E-SUELIN-PIE                    | TANK TO THE TANK T |                               |                |  |  |
|---------------|--|--------------------|---|---------------|---------------------------------|--|-------------------------------|----------------|--|--|
| TVDF OF       | PQR No. M-F-4-   | X52-188            | Orig. Issue Date Revision Date Orig. Issue Date Revision Date |               |                                 |  |                               |                |  |  |
| TYPE OF       | WPS No. M-FW-  | -B-II              |   |               | Orig. Issue Date                |  | Revision Date                 |                |  |  |
| RECORD        | API 1104 🗸 Other   |                    |   |               |                                 |  |                               |                |  |  |
|               | Metal Inert  | Gas (MIG)          |   |               | Type of Process:                | Manual   |                               |                |  |  |
| PROCESS       | For:   | Butt Welding       | Fillet V  | Velding 🗸     |                                 |  |                               |                |  |  |
| PIPE          | Material Specification   | on: 4.5"O.D        | X-52 - 0.188" \   | WT. API 5L    |                                 |  |                               |                |  |  |
| DIAMETER      | API 1104 6.2   | .2 Guidelines      | Under 2   | 3/8" OD       | 2-3/8"                          | to 12-3/4" OD  | > 12-3                        | /4" OD         |  |  |
| MATERIAL      | API 1104 5.4.  | 2.2 Guidelines     | ≤ 42,00   | 0 PSI Yield   | > 42,000                        | 0 to < 65,000 PSI Yield  | ≥ 65,000                      | PSI Yield      |  |  |
| THICKNESS     | API 1104 6.2   | .2 Guidelines      | Under 3   | /16" thick    | √ 3/16" t                       | hru 3/4" thick   | Over 3/                       | 4" thick       |  |  |
| FULED METALS  | AWS Electrode Nos  | s: ER70S-3         | AWS Electrode Size  | e: 0.035"     | AWS Specification               | : A5.18  | Filler Metal Group:           | 5 <sup>b</sup> |  |  |
| FILLER METALS | Wire Feed Rate (IP   | м) : 200-280       |   |               |                                 |  |                               |                |  |  |
| GAS           | 75/25 Argon/C  | .02                |   | 40 cfm        |                                 |  |                               |                |  |  |
| PREHEAT       | Minimum Preheat  | Temperature (F): 5 | 00  | Interpass Tem | perature (F): >100 <sup>0</sup> | Other:   |                               |                |  |  |
|               |  | WEI                | LD AXIS   |               | TEC                             | CHNIQUE  | DIREC                         | CTION          |  |  |
|               | Flat (1G, 1F, 1FR)   | 1                  | Plate   |               | Backhand                        | <b>V</b>   | Vertical - Up                 |                |  |  |
|               | Horizontal (2G, 2F, 2  | 2FR)               | Pipe  | 1             | Forehand                        |  | Vertical - Down               |                |  |  |
| POSITION      | Vertical (3G, 3F)  |                    | Rotated   | 1             |                                 |  |                               |                |  |  |
|               | Overhead (4G, 4F)  |                    | Fixed   |               |                                 |  |                               |                |  |  |
|               | Multiple (5G, 5F)  |                    | Inclined (6G, 6F)   |               |                                 |  |                               |                |  |  |
|               | Combination  |                    |   |               |                                 |  |                               |                |  |  |
|               | 1  | DISPOSITION STYL   | E   | М             | ETHOD                           |  | ARC TYPE                      |                |  |  |
| TECHNIQUE     | Stringer Beads   |                    |   | Multiple Pass |                                 | Single Arc 🗸   |                               | Other:         |  |  |
|               | Weave Beads  |                    |   | Single Pass   |                                 | Multiple Arc   |                               |                |  |  |
| CLEANING      | Base Material:   | Power 🗸            | Hand  |               | Weld: Power                     | √ Har  | nd                            |                |  |  |
|               | BUTT WELD FILLET WELD  |                    |   |               |                                 |  |                               |                |  |  |
| JOINT DESIGN  | 371/2° ± 21/2° FOR FITTINGS<br>30° + 5° - 0 FOR PIPE  1/16" ± 1/32"  1/16" ± 1/32" |                    |   |               |                                 |  |                               |                |  |  |
|               | 17" TO 45°  Groove Designs of Test Coupons   |                    |   |               |                                 |  |                               |                |  |  |
|               | Current Type:  | AC                 | DC 🗸  | Polarity:     | Straight/Negative               |  | Reverse/Positive              | 4              |  |  |
| ELECTRICAL    | BEAD NO. Passes  |                    | ELECTRODE NO. &   | Cinc          |                                 | RANGE  | MAXIMUM TIME<br>LAPSE ALLOWED | SPEED RANGE    |  |  |
| CHARACTERIS-  | BEAD NO.   | Passes             | TYPE  | Size          | VOLTS                           | AMPS   | (Min.)                        | (IPM)          |  |  |
| TICS &        | Root   | 1                  | ER70S-3   | 0.035         | 15 - 19                         |  | 5                             | 12             |  |  |
| SEQUENCE OF   | Hot Pass   | 1                  | ER70S-3   | 0.035         | 15 - 19                         |  | 5                             | 12             |  |  |
| BEADS         | Fill   |                    | 1   |               |                                 |  |                               |                |  |  |
|               | Сар  | 1                  | ER70S-3   | 0.035         | 15 - 19                         |  | 5                             | 12             |  |  |

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|                     | Specimen No.   | Width                 | Thickness   | Area (in.^2)       | 10.750.55 | ate Total<br>d(Lbs.)                                   | Ultimat           | e Unit Stress<br>(psi) | Type of Failure<br>Ductile or Brittle | Location of Failure<br>Base Metal or<br>Weld |  |
|---------------------|--|-----------------------|-------------|--------------------|-----------|--|-------------------|------------------------|---------------------------------------|--|--|
| TENCHE TECT         | 1  |                       |             |                    |           |  |                   |                        |                                       |  |  |
| TENSILE TEST        | 2  |                       |             |                    |           |  |                   |                        |                                       |  |  |
|                     | 3  |                       |             |                    |           |  |                   |                        |                                       |  |  |
|                     | 4  |                       | 1 1         |                    |           |  |                   |                        |                                       |  |  |
| GUIDED BEND<br>TEST | Specimen No.   | Root Bend             | Face Bend   | 5 de Bend          | Bend Bend |  | Acceptable        |                        | Comments                              |  |  |
|                     | 5  | 180 Degrees           |             |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 6  | 180 Degrees           |             |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 7  | 180 Degrees           |             |                    | Yés       | (H).   | No                | ( 44) + 1              |                                       |  |  |
|                     | 8  | 180 Degrees           |             |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 9  |                       | 180 Degrees |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 10   |                       | 180 Degrees |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 11   |                       | 180 Degrees |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | 12   |                       | 180 Degrees |                    | Yes       |  | No                |                        |                                       |  |  |
|                     | Specimen No.   | Acceptal              | ble Yes/No  |                    |           |  | Co                | mments                 |                                       |  |  |
| NICK BREAK          | 13   | Yes J                 | No          |                    |           |  |                   |                        |                                       |  |  |
| TEST                | 14   | Yes J                 | No          |                    |           |  |                   |                        |                                       |  |  |
| ,                   | 15   | Yes 🗸                 | No          |                    |           |  |                   |                        |                                       |  |  |
|                     | 16   | Yes 🗸                 | No          |                    |           |  |                   |                        |                                       |  |  |
| FILLET WELD         | Satisfactory:  | Yes 🗸                 | No          |                    | Penetrat  | ion into Pa  | rent Meta         | l:                     | Yes 🗸                                 | No   |  |
| TEST                | Fillet Weld - Fractu   | re Test. Satisfactory |             |                    | Length o  | f Percent o  | f Defect. I       | None                   | in.:                                  | %:   |  |
|                     | Welder Name C  | hris Jobert           |             | License Number 8   | State JC  | 0-435  | 5-533             |                        | Stencil Mark                          |  |  |
| WELDER INCO         |  | 7.7.2.2.3             |             |                    |           |  |                   |                        |                                       |  |  |
| WELDER INFO         | Contractor Du  | ke Energy             |             |                    |           |  |                   |                        |                                       |  |  |
|                     | We certify that the statements in this record are correct and that the test coupons were prepared, welded, and tested in accordance with the requirements of API 1104. |                       |             |                    |           |  |                   |                        |                                       |  |  |
|                     |  |                       |             |                    |           |  |                   |                        |                                       |  |  |
|                     | Welding Test Conducted By: Ralph Pfister   |                       |             |                    |           |  |                   |                        |                                       |  |  |
| CERTIFICATION       | Visual Examination Results: Satisfactory  Radiographic Test Results (For Alternative Qualification of Groove Welds by Radiography): NA                                 |                       |             |                    |           |  |                   |                        |                                       |  |  |
|                     |  | onducted By: Walter   |             | TOOVE WEIGS BY NAU | ography). | 19/5   | Laborato          | ry Test No:            |                                       |  |  |
|                     | Approved By: Walter C. Dumford   |                       |             |                    |           | Laboratory Test No: Organization: Terracon Consultants |                   |                        |                                       |  |  |
|                     | APPROVED REJECTED  |                       |             |                    |           |  | Date: 5/7/15      |                        |                                       |  |  |
|                     | AFFROVED   | Ψ.                    | KELETED     |                    |           |  | Date. 3           | 77715                  |                                       |  |  |
| REMARKS             |  |                       |             |                    |           |  |                   |                        |                                       |  |  |
| 0.000               | By: Walter C. Dumford Title: Certified   |                       |             |                    |           | rtified Wel  | Velding Inspector |                        |                                       |  |  |
| SUBMITTAL           | Company/Organization: Terracon Consultants   |                       |             |                    |           |  | Date: 5/7/15      |                        |                                       |  |  |
|                     | Engineer:  | Engineer:             |             |                    |           |  | Date:             |                        |                                       |  |  |
| APPROVAL            | Weld Supervisor:   |                       |             |                    |           |  | Date:             |                        |                                       |  |  |
|                     | Director of Gas Engineering:   |                       |             |                    |           | Date:  |                   |                        |                                       |  |  |

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### **Welding Procedure**

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### 1. Signature

Reviewed and approved by: Members of the Work Process Integration Team



### **Welding Procedure**

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#### 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 Effective<br>Date |           | <ul> <li>Initial Issue</li> <li>Legacy Documents incorporated into this procedure:</li> <li>Contributing Legacy Piedmont Documents         <ul> <li>CM-PL-4000 – PNG Welding Manual Attachment 2 – Piedmont Natural Gas Procedure Qualification Records</li> </ul> </li> <li>Contributing Legacy Duke Documents         <ul> <li>PQR documents</li> </ul> </li> <li>Contributing JIP PQRs that correspond to WPS' (old #) 14 – 27</li> </ul> | Members of<br>Work Process<br>Integration Team |  |
| 1.0                 | 5-19-2019 | Revised the "WHO" section, added Gas   |  |  |