Louisville Gas and Electric Company
2021 Annual Report
Case No. 2017-00119

In accordance with the Kentucky Public Service Commission's Order of March 16, 2018 in Case No. 2017-00119, Louisville Gas and Electric Company ("LG&E") submit the fourth annual report for the years 2018– 2022. The annual report provides a status on the implementation of LG&E's Action Plan and the number of bolted-style coupling systems removed in 2021 from distribution lines having an operating pressure in excess of 60 psig along with observations of the removed couplings.

LG&E developed the Action Plan in collaboration with Daniel Ersoy of the Gas Technology Institute ("GTI"). The Action Plan focused on the removal of couplers in the LG&E transmission and high-pressure distribution systems, prohibited use of couplers going forward except in very limited circumstances and only in lower-pressure environments, and to improve the training and communication efforts to minimize the chances of coupler separations. The Action Plan items align with Section 3 of the GTI Report that was submitted in Case No. 2017-00119 as an attachment to Commission Staff's Second Request for Information.

LG&E had completed all action items in the Action Plan submitted in the 2018 annual report with the exception of one item which continues to remain open and in progress

GTI Report Section 3, Part F: Continuous Process Improvement and Leading Indicators

Action 1: Continuous process improvement and leading indicators, including incorporating findings into Distribution Integrity Management Program ("DIMP").

Action Taken: The Gas Distribution and Information Technology teams have launched an initiative to implement a new risk analysis software to consider the suggested, among other, risk factors associated with the distribution system. As risk identification is improved, analysis will allow a better ranking of infrastructure to be utilized by the DIMP team members to initiate improvements.

Status: Phase 1 implementation of new risk model was completed in February 2021. Phase 2 is in progress with a target implementation of March 2022. Phase 2 implementation was dependent on the eGIS system upgrade project that was completed summer of 2021. The new risk model includes asset data on the known joint type of the main.

The couplings retired from LG&E's distribution system include the following listed. In accordance with the Action Plan Section 3, Part E, a program was implemented for the opportunistic bolted style coupling removal or encapsulation (for systems > 3 psig) in October 2017. In accordance with the Kentucky Public Service Commission's Order to the Louisville Gas

and Electric Company on March 16, 2018 for Case No. 2017-00119, the Louisville Gas and Electric Company ("LGE") hereby notifies the Commission that the following two mechanical couplings were removed from service from LG&E's high-pressure gas distribution system in 2021. The two couplings were physically removed from the ground while zero couplings were retired in place by terminating the pipeline in an upstream and / or downstream location. None of the couplings were removed from service due to a failure in the coupling or leak.

Distribution Couplings removed from the ground:

1) 7th Street and Bernheim Lane – A 16-inch bolted style mechanical coupling installed in 1990 was removed from service on 8/25/2021 and removed from the ground on 8/25/2021 for inspection of defects. The lab analysis is attached as in Exhibit A.

2) 7th Street and Bernheim Lane – A 16-inch bolted style mechanical coupling installed in 1990 was removed from service on 8/25/2021 and removed from the ground on 8/25/2021 for inspection of defects. The lab analysis is attached as in Exhibit B.

IMR TEST LABS
A Curtiss-Wright Business Unit
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4510 Robards Lane
Louisville, KY 40218
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LG&E - Kentucky Utilities
6900 Enterprise Drive
Louisville, KY 40214

October 15, 2021

Attention: Sarah Nicholson

Exhibit A

Report No. 202102056

Metallurgical Evaluation of a 16" Coupling and Associated Hardware

Location: 7th St. and Bernheim Ln.
Designation: 2021-20

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 16" pipe with a Dresser Style Insulating Coupling. Four joint harnesses were also affixed to the pipe section. Copies of the installation information for the coupling and harnesses were provided for this investigation. It was reported that the coupling had been installed in the field at the corner of 7th St. and Bernheim Ln. on June 22, 1990. The pipe section was subsequently excavated after substantial service duration without failure. It was requested that the general dimensions, weld quality, corrosion condition and mechanical properties of the coupling components be determined as directed.

RESULTS

The submitted pipe section with the coupling is shown in Figures 1 through 4. Four lugs of the joint harnesses had been fillet welded to both pipe segments. Four rods and associated nuts had been affixed through the welded lugs to apply compression to the coupled joint. The coupling consisted of a steel coupling with an interior nonmetallic gasket / sleeve. Prior to receipt, the ends of the pipe segment were labelled as Ends A and B, as shown in Figures 1 and 2. The top and bottom of the coupling section were also marked. Lugs A1, A2, A3, and A4 were welded to Pipe A, and Lugs B1, B2, B3, and B4 were welded to Pipe B. The rod between Lugs A1 and B1 was identified as Rod 1. The remaining lugs were identified in a corresponding fashion.

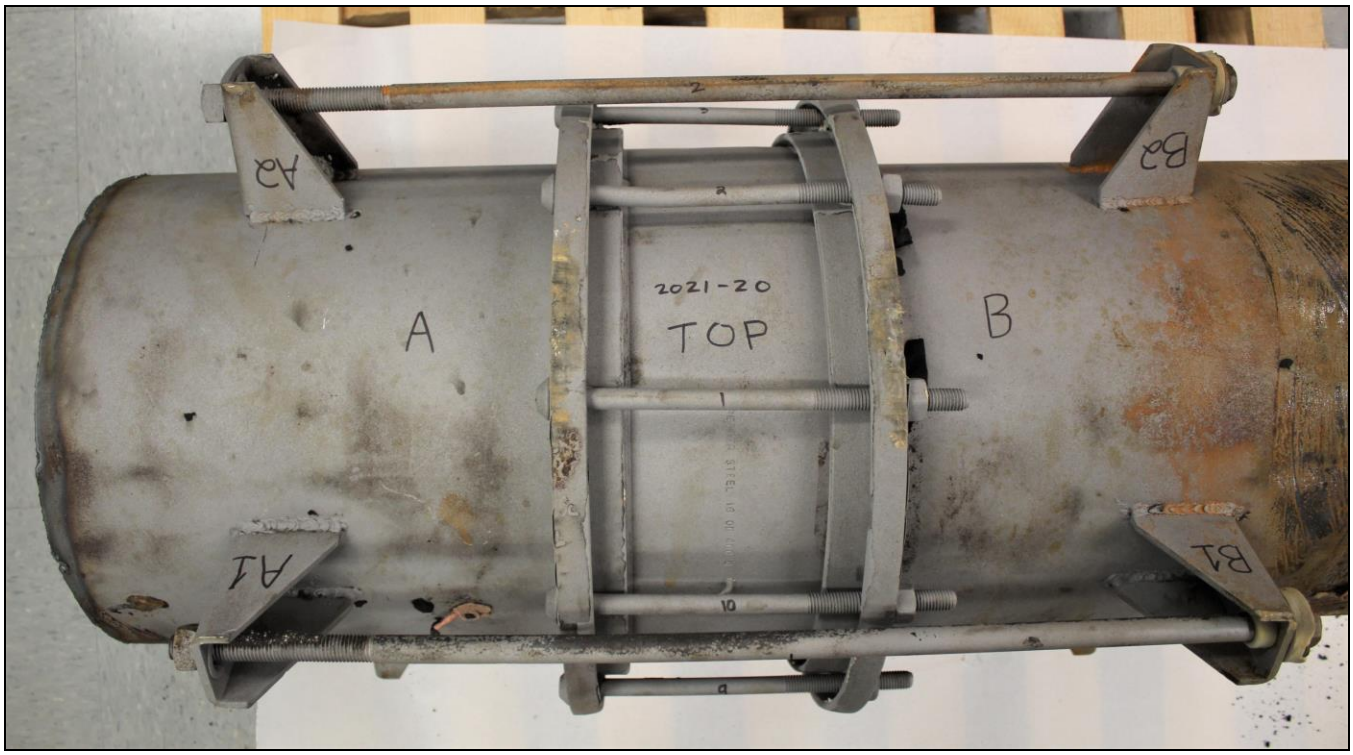


Figure 1. Photograph of the top of the submitted coupling sample.

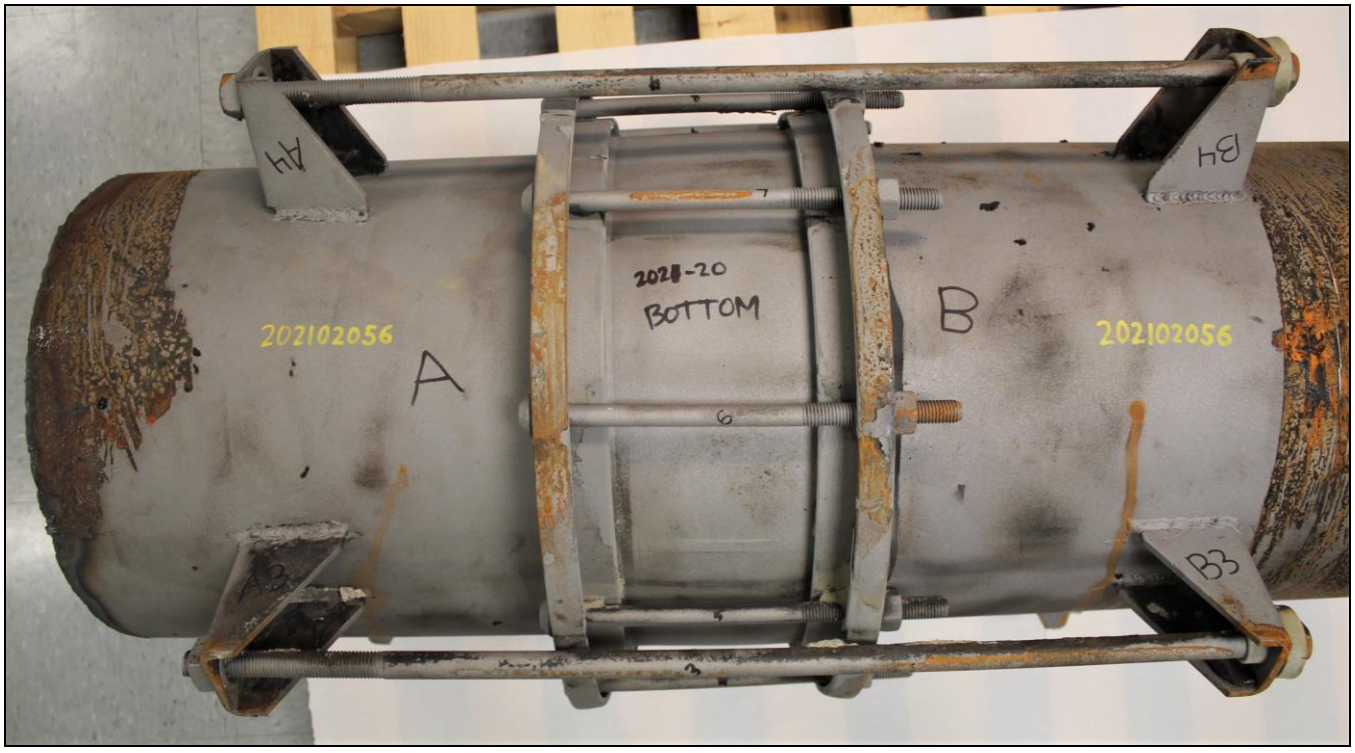


Figure 2. Photograph of the bottom of the submitted sample.

SECTION 1- DIMENSIONAL MEASUREMENT

The four sets of harness lugs were positioned around the pipe. The relative orientations of the harness lugs were measured by photographing the assembly from the ends and applying a protractor overlay for angle measurement. The obtained measurements are shown in Figures 3 and 4 with the data summarized in Table 1. The depth of insertion of the pipe segments into the coupling was also measured and the dimensions are provided in Table 2. No requirements were provided for these characteristics.

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

Compound	Angle	Deviation from 90°	Image
Rod A1 / Rod A2	89	1	Figure 3
Rod A2 / Rod A3	95	5	Figure 3
Rod A3 / Rod A4	88	2	Figure 3
Rod A4 / Rod A1	88	2	Figure 3
Rod B1 / Rod B2	92	2	Figure 4
Rod B2 / Rod B3	85	5	Figure 4
Rod B3 / Rod B4	92	2	Figure 4
Rod B4 / Rod B1	91	1	Figure 4

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling
Pipe A	4.25	1.25 (Original sample length – 48”)
Pipe B	3.5	

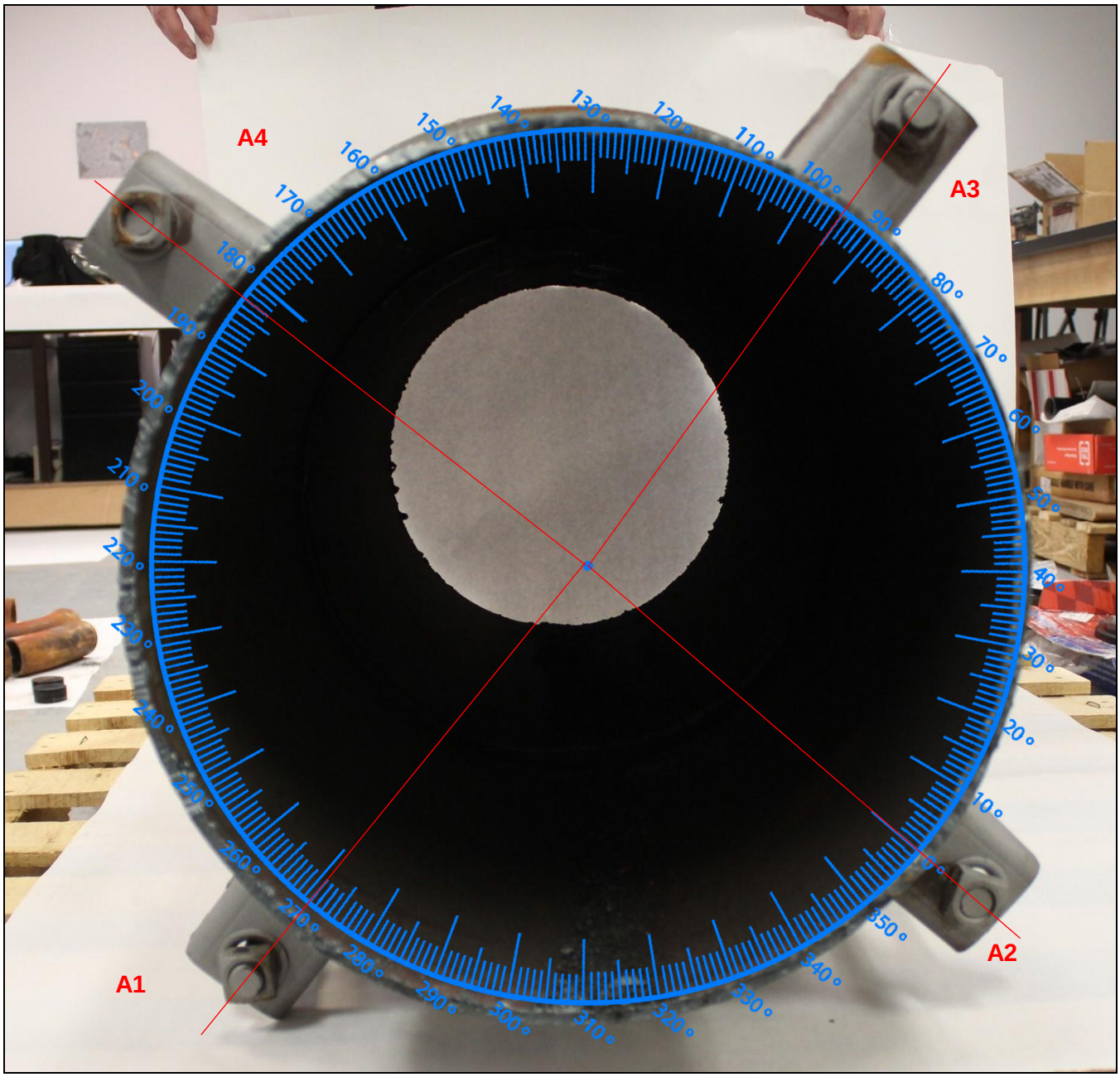


Figure 3. End facing image of the sample at End A with a superimposed protractor.

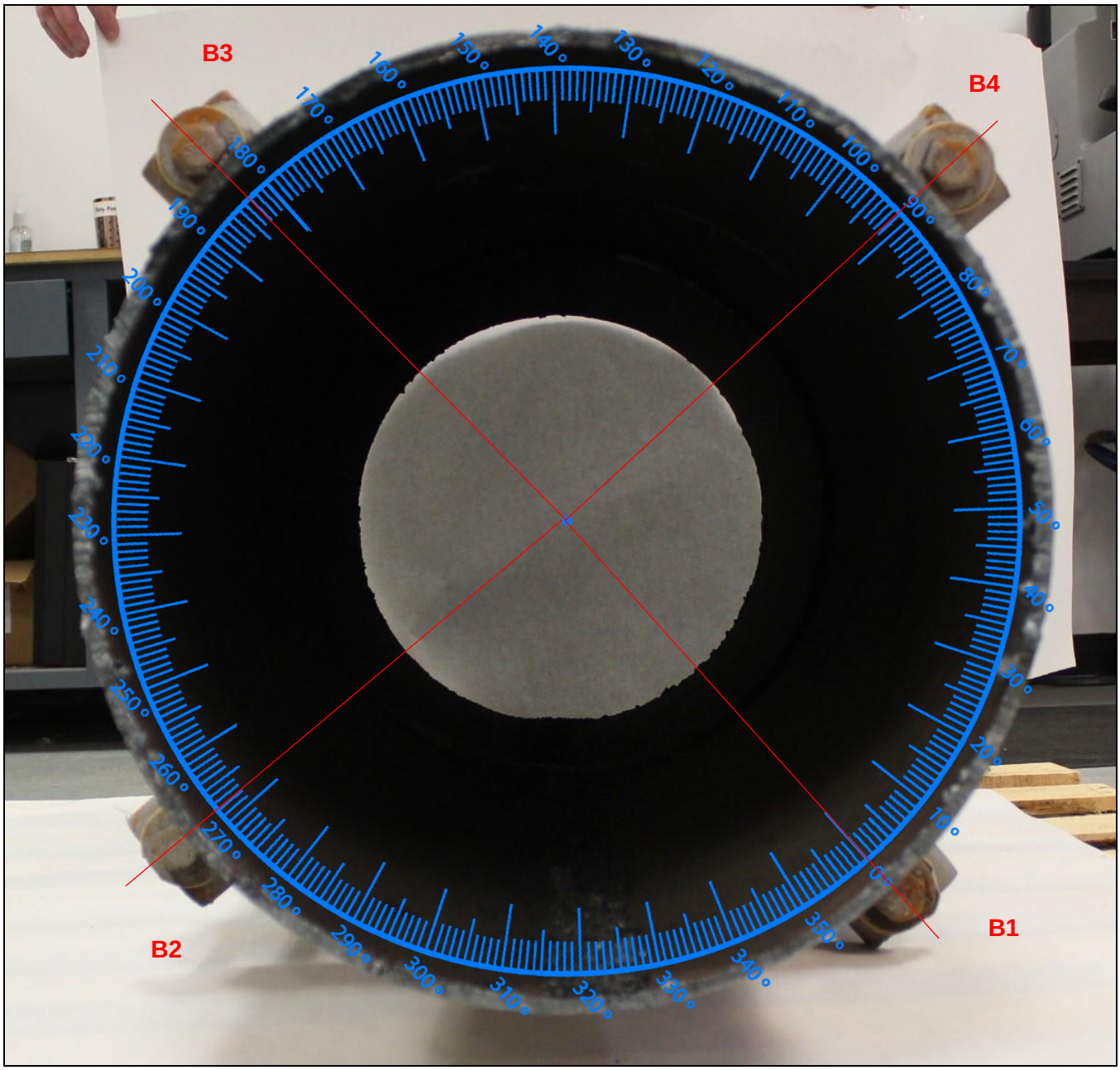


Figure 4. End facing image of the sample at End B with a superimposed protractor.

SECTION 2- VISUAL OBSERVATIONS

The lug attachment welds were regions of interest on the pipe coupling sample. Each lug contained four fillet weld locations; exterior top, exterior bottom, interior top, and interior bottom. Each weld that was present was inspected visually using a flashlight and magnifying lens. It was indicated that welding was performed in accordance with API 1104. General weld inspection was performed initially, followed by visual inspection by an outside NDE company. For comparison purposes, the welds were rated as substantial fusion, partial fusion, and minimal fusion. The summarized weld fusion and corrosion observations are provided in Table 3. Representative weld regions are shown in Figures 5 through 10.

The welds contained localized discontinuities including undercut, arc strikes, porosity, and spatter. No cracking in the welds or base metal heat affected zones (HAZ) was visually identified. No gross corrosion was observed anywhere on the pipe or associated hardware.

The coupling and harness rods were also inspected for damage. The observations for the rods and bolts are provided in Table 4. No corrosion cracking was evident. The rods were not necked down or stretched.

The elastomeric components of the coupling consisted of a pipe separator, insulating sleeve, and two gaskets. Inspection revealed that they appeared to be intact and not degraded.

TABLE 3 – LUG WELD VISUAL EXAMINATION RESULTS

Component	Location	Weld	Observations
Lug A1	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug A2	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Obscured
Lug A3	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug A4	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B1	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion

TABLE 3 – LUG WELD VISUAL EXAMINATION RESULTS – CONTINUED

Component	Location	Weld	Observations
Lug B2	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B3	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B4	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion

TABLE 4 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Bent, no gross corrosion, rotated freely
Rod 2	Not bent or stretched, no gross corrosion, did not rotate freely
Rod 3	Not bent or stretched, no gross corrosion, did not rotate freely
Rod 4	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 1	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 2	Bent, no gross corrosion, did not rotate freely
Bolt 3	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 4	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 5	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 6	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 7	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 8	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 9	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 10	Not bent or stretched, no gross corrosion, did not rotate freely

Figure 5. Image of the Lug A1 exterior bottom weld which exhibited substantial fusion except for some undercut, spatter, and arc strikes.

Figure 6. Image of the Lug A2 exterior top weld which was fractured and exhibited substantial fusion except for some undercut, arc strikes, and spatter.

Figure 7. Image of the Lug A4 exterior bottom weld which exhibited substantial fusion except for some undercut and porosity.

Figure 8. Image of the Lug B1 exterior bottom weld which exhibited substantial fusion except for some undercut, and spatter.

Figure 9. Image of the Lug B1 interior bottom weld which exhibited substantial fusion except for some spatter.

Figure 10. Image of the Lug B4 exterior bottom weld which exhibited substantial fusion except for undercut, and porosity.

SECTION 3- TORQUE TESTING- FOR INFORMATION ONLY

Torque testing was performed on the nuts of the rods and bolts on the pipe coupling sample. A calibrated torque wrench was used to determine breakaway torque on each fastener. The breakaway torque measurements are summarized in Table 5. Rod fasteners did not have a specified torque requirement. The ten coupling bolts and four harness rods exhibited torque values ranging from 15 to 115 ft.-lbs. Rods 1 through 4 rotated when torque was applied to the nuts. No requirements were utilized for comparison as the coupler model was not specified.

TABLE 5 – FASTENER TORQUE MEASUREMENT

Component	Breakaway Torque	Observations
Rod 1	No breakaway	Rotated freely
Rod 2	No breakaway	Rotated under torque
Rod 3	No breakaway	Rotated under torque
Rod 4	No breakaway	Rotated under torque
Bolt 1	15	
Bolt 2	15	
Bolt 3	20	
Bolt 4	70	
Bolt 5	115	
Bolt 6	60	
Bolt 7	80	
Bolt 8	90	
Bolt 9	70	
Bolt 10	60	

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the four harness rods and the ten coupling bolts. The tensile mechanical properties of the fasteners were measured and the results are summarized in Table 6. No mechanical property requirements were provided for the fasteners.

TABLE 6 – FASTENER TENSION TEST RESULTS

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %③	Reduction in Area, %
Rod 1①	120	66.0	20	45
Rod 2①	120	66.5	20	46
Rod 3①	120	65.0	20	43
Rod 4①	122	67.5	20	43
Bolt 1②	78.5	53.5	37	77
Bolt 2②	84.0	57.5	36	77
Bolt 3②	85.0	54.0	37	75
Bolt 4②	82.0	53.0	38	77
Bolt 5②	86.0	57.5	35	75
Bolt 6②	80.0	58.5	36	75
Bolt 7②	84.5	56.5	36	76
Bolt 8②	86.5	52.5	36	72
Bolt 9②	79.5	55.5	37	75
Bolt 10②	85.0	58.0	35	74

① Specimen Dimensions; Diameter 0.50” with gage length of 2.00”
② Specimen Dimensions; Diameter 0.25” with gage length of 1.00”
③ Percent elongation was measured using elongation-after-fracture measurements

SECTION 5- ROCKWELL HARDNESS, ASTM E18-20

Small sections of the eight lugs were excised for hardness testing. Rockwell hardness testing was performed on sectioned segments of the lugs after the removal of surface roughness by sanding. The obtained results are provided in Table 7 and are suggestive of a moderate strength level. No requirements were provided for comparison.

TABLE 7 – LUG HARDNESS TEST RESULTS – ROCKWELL B – HRBW

Results	Average①
Lug A1	85
Lug A2	71
Lug A3	69
Lug A4	77
Lug B1	76
Lug B2	56
Lug B3	56
Lug B4	70

① Reported hardness is an average of four individual readings

SECTION 6- NONDESTRUCTIVE EXAMINATION

The two separated ends of the disassembled coupling were sent to a third party NDE laboratory for inspection. Visual and liquid dye penetrant inspections were performed on the lug attachment welds. Inspection was performed in accordance with the acceptance criteria of API 1104 “Welding of Pipelines and Related Facilities”. The inspection results are provided as Appendix A. Two representative welds are shown in Figures 11 and 12 with the dye penetrant test media remaining.

Figure 11. Image of the Lug A4 exterior top weld after dye penetrant media had been used during inspection.

Figure 12. Image of the Lug B1 exterior top weld after dye penetrant media had been used during inspection.

Respectfully submitted

Brian Kelly
Failure Analyst

Concurrence

Brett A. Miller, P.E. FASM
Technical Director

All procedures were performed in accordance with the IMR Quality Manual, current revision, and related procedures; and the PWA MCL Manual F-23 and related procedures. The information contained in this test report represents only the material tested and may not be reproduced, except in full, without the written approval of IMR Test Labs ("IMR"). IMR maintains a quality system in compliance with the ISO/IEC 17025 and is accredited by A2LA, certificates #1140.03 and #1140.04. IMR will perform all testing in good faith using the proper procedures, trained personnel, and equipment to accomplish the testing required. Conformance will be based on results without measurement uncertainty applied, unless otherwise requested by the customer. IMR's liability to the customer or any third party is limited at all times to the amount charged for the services provided. All test samples will be retained for a minimum of 3 months and may be destroyed thereafter, unless otherwise specified by the customer. The recording of false, fictitious, or fraudulent statements or entries on this document may be punished as a felony under federal statutes. IMR Test Labs is a GEAE S-400 approved lab (Supplier Code T9334).

APPENDIX A – LIQUID DYE PENETRANT / VISUAL INSPECTION RECORD

MISTRAS

Liquid Penetrant Examination Report

4100 Bishop Lane | Louisville, KY 40218 | P: (502) 966-5558; F: (502) 966-5401 www.mistrasgroup.com

Client:	IMR TEST LABS	Date:	10/1/2021 Page: 2 of 2
Address:	4510 ROBERTS LANE	Job Number:	
	LOUISVILLE, KY 40218	Purchase Order:	PO# 7243FA
Contact:	BRIAN KELLY	Reference Number:	202102056
Location:	MGI SHOP	Part No/Description:	Steel Gas Couplings
			Lug Welds

Code/Specification	Procedure	Acceptance Criteria
ASME SECTION V, ARTICLE 6	100-PT-001 REV 21.2	API 1104

Type and Method

☐ Fluorescent: [Type I] ☐ Water Wash [Method A] ☐ Solvent Removable [Method C] ☐ Post Emulsified: ☐ Hydrophilic [D] ☐ Lipophilic [B]

☒ Red Visible Dye: [Type II] ☐ Water Wash [Method A] ☒ Solvent Removable [Method C] ☐ Post Emulsified [Method B]

Sensitivity Level: ☐ ½ ☐ 1 ☒ 2 ☐ 3 ☐ 4 ☐ N/A ☐ Other:

	Manufacturer	Type	Batch Number(s)	Application Method	Process Time (minutes)	
					Pre-clean Dry Time:	5 MIN
Cleaner:	MAGNAFLUX	SKC-S	18G14K	DAMP CLOTH	Penetrant Dwell Time:	10 MIN
Penetrant:	MAGNAFLUX	SKL-SP2	17L02K	SPRAY	Emulsifier Time:	N/A
Developer:	MAGNAFLUX	SKD-S2	17J04K	SPRAY	Developer Time:	10 MIN
Emulsifier:	N/A	N/A	N/A	N/A	Post Clean Method:	SOLVENT

Developer Form: ☐ a. Dry Powder ☐ b. Water Soluble ☐ c. Water Suspended ☒ d. Nonaqueous Wet ☐ e. Specific Application

Penetrant Removal Method & Dry Time	Black Light (Model and S/N)	White Light Source
SKC-S DAMPENED CLOTH @ 5 MIN	N/A	LED FLASHLIGHT

☒ Original ☐ Repair	Material & Thickness	Test Temperature
	C/S	75° F

Surface Condition

☒ As Welded ☐ As Ground ☐ As Cast ☐ Rough Machined ☐ Final Machined ☒ Meets Code Requirements

Test Results	Quantity Inspected: 8	Quantity Accepted:	Quantity Rejected: 8

RED VISIBLE DYE PENETRANT INSPECTION PERFORMED ON THE FOLLOWING:
Description: (202102055) Couplings - Lug Welds
Weld ID: A1 (REJECTED) -- UNDERCUT, UNDER FILL
Weld ID: A2 (REJECTED) -- UNDER FILL
Weld ID: A3 (REJECTED) -- UNDFER FILL, UNDERCUT, POROSITY
Weld ID: A4 (REJECTED) -- UNDERCUT, UNDER FILL, LACK OF FUSION --- BEAD TIE-IN ON TOP

Weld ID: B1 (REJECTED) -- UNDER FILL, POROSITY, LACK OF FUSION -- BEAD TIE-IN ON TOP
Weld ID: B2 (REJECTED) -- UNDERCUT, UNDER FILL, PORSITY
Weld ID: B3 (REJECTED) -- UNDER FILL, POROSITY
Weld ID: B4 (REJECTED) -- UNDER FILL

Technician Name, Level & Date	Customer (if applicable):	Reviewed By (if applicable):
PAUL HUFFINE, LEVEL II, 10/1/2021		

Certification of Inspection, Liquid Penetrant [Basic Report Form] 100-PTFORM-002 | Rev 1

MISTRAS

Visual Examination Report

4100 Bishop Lane | Louisville, Ky. 40218 | P: (502) 966-5558; F: (502) 966-5401 www.mistrasgroup.com

1. Client	2. Work Location	4. Mistras Job No.	6. Date	7. Page
IMR Test Labs	Mistras, Louisville	202102056	9/30	1 of 1
	3. Client Contact: Brian Kelly	5. Purchase Order No.: 7243FA	8. Client Reference No.: 202102056	

9. Code/Specification	10. NDT Procedure	11. Acceptance Criteria
API 1104	100-VT-004 REV 3	API 1104

12. Material	13. Weld Process	14. Surface Condition	15. Temperature
Carbon Steel	SMAW	Brushed clean	Ambient

16. Technique	17. Visual Aids	18. Supplemental Lighting
☑ Direct Visual ☐ Remote Visual ☐ Translucent Visual	☐ Yes ☑ No	☑ Yes ☐ No

19. Access within 24" & 30°	20. 1/32" Line/Simulated Imperfections Used	21. Dimensional Aids	22. Light Meter Serial No.
☑ Yes ☐ No	☐ Yes ☑ No	☐ Yes ☑ No	Flashlight

23. Additional Information

Informational visual inspection of a temporary I-Beam support. Welds numbered as: For Beams, Left and Right are as facing towards the unit.

(Column or Beam)-(Number for Column or Beam)-(Top, Bottom for columns, Left, Right for beams)-(weld number)

24. Unit	25. System	26. Component ID	27. Drawing
N/A	N/A	N/A	N/A

Test Results

28. ID/Weld No.	29. Indication Code(s)	30. Acc.	31. Rej.	32. Comments
A-1	WP, UC, AS, UN, IF		X	Poor Workmanship
A-2	WP, UC, UN, PO, CL, IF		X	Poor Workmanship
A-3	WP, UC, AS, UN, IF, CL		X	Poor Workmanship
A-4	WP, UC, AS, UN, PO, IF		X	Poor Workmanship
B-1	WP, UC, AS, UN, PO, CL, IF		X	Poor Workmanship
B-2	WP, UC, AS, UN, CL, IL, PO		X	Poor Workmanship
B-3	WP, UC, AS, UN, PO		X	Poor Workmanship
B-4	WP, AS, UN, IF, CL		X	Poor Workmanship

Indication Codes

CR	Crack	CL	Cold Lap	ES	Excessive Weld Spatter	AS	Arc Strike
IF	Incomplete Fusion	UN	Insufficient Fill or Undersize	WP	Weld Profile	GO	Gouge
PO	Porosity	ER	Excessive Reinforcement	SF	Surface Finish	PD	Physical Damage
UC	Undercut	SL	Slag or Flux	IP	Incomplete Penetration	CO	Corrosion
						OT	Other

33. Technician, Level & Date	34. Customer Signature (if applicable)	35. Management Review (if applicable)
Gary Bowman, AWS CWI, 18021381		

Certificate of Inspection, Visual (Welds) 100-VTFORM-001 | Rev 2

Gary W Bowman
CWI 18021381
QC1 EXP. 2/1/2024

Bolt-Style Coupling (pressures > 3 psig)

This form will be completed when LG&E or LG&E contractors expose a bolt-style coupling in a system where **the pressure is > 3 psig (medium and high-pressure distribution and transmission)** and the coupling will be backfilled. The purpose of the form is to provide Operations, Engineering and Gas Regulatory personnel with information about the bolt style coupling installation**.**

Part A- Discovery of Coupling

Precautions:

1. Stop excavation upon discovering the bolt-style coupling in the excavation
2. Set-up a perimeter around the excavation to keep the public away from the excavation

General Information:

1. Contact Employee for the bolt style coupling found: **Tommy Smith**
2. Date of exposure: **08/23/21**
3. Location: **7th St. and Bernheim Ln.**
4. Size of coupling (based on pipe size if not exposed enough to determine): **16”**
5. Type of soil: ☐ Sandy ✖ Clay ☐ Gravel ☐ Topsoil ☐ Other (take picture and describe)
6. Soil Density test: ☐ Type A ✖ Type B ☐ Type C
7. Status: ✖ Removed ☐ Abandoned in place ☐ Backfilled- left in service
8. Discovery Method: ☐ Leak on Coupler ☐ Other Maintenance Excavation ☐ Facility Replacement ☐ Facility Retirement ✖ Other: **Leak Survey**

Pictures:

1. Take at least two pictures of the coupling. The pictures should be from different angles (additional pictures can be taken).
2. Email pictures to supervisor. Ensure pictures are attached to this form:

Sketch: Provide a sketch showing the coupling orientation (vertical/horizontal), nearby branches, pipe, valves and fittings, other utilities or structures, etc.

Leak Survey:

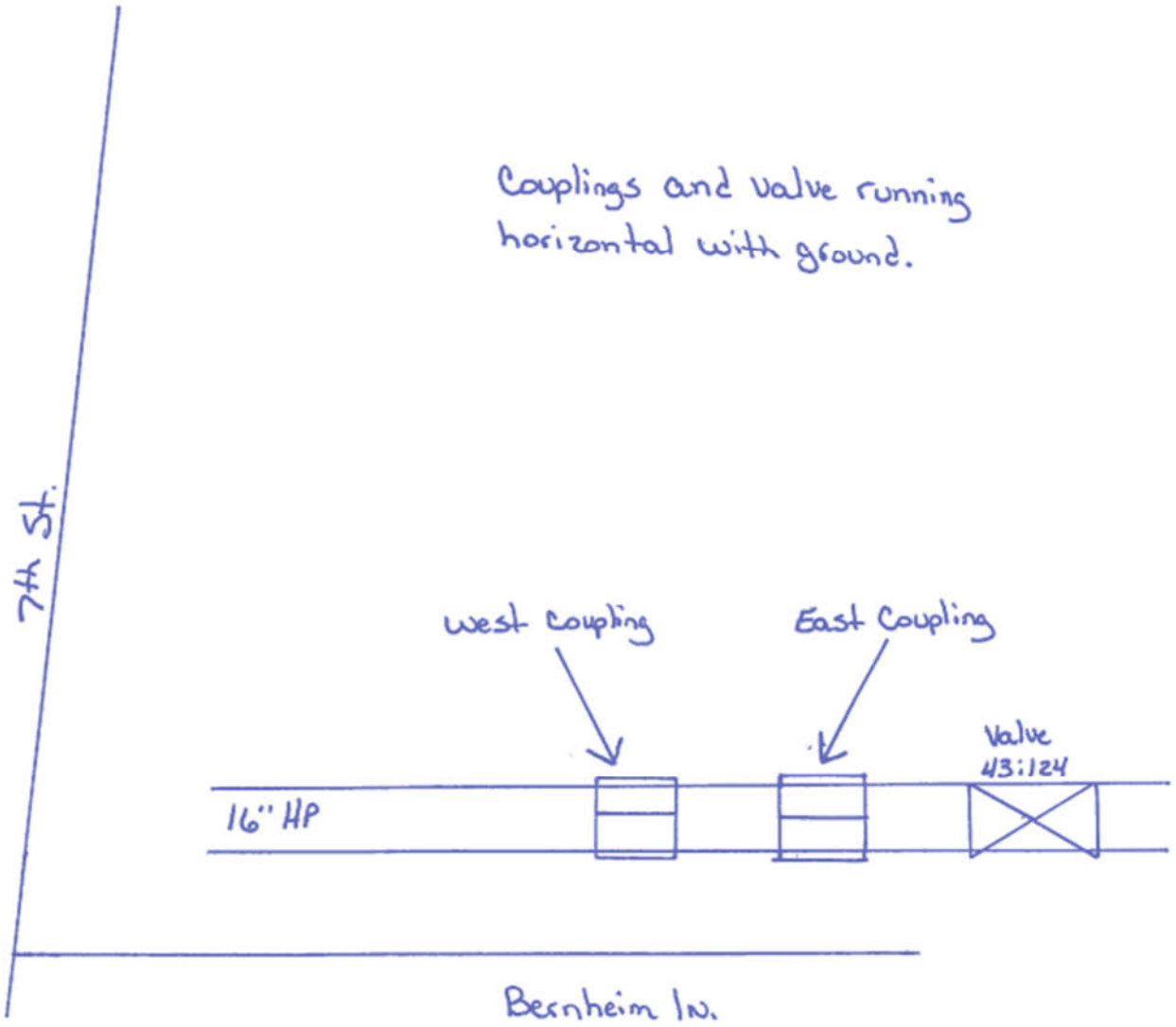
1. Use an instrument designed to detect natural gas to check for the presence of natural gas after backfilling the excavation. Include readings in the above sketch in relation to the coupling. If the contact employee is not leak survey qualified, they should contact:
   a. Their supervisor to call Gas Regulatory to complete the survey after the excavation is backfilled. Call [redacted]
   b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

Leak Survey completed at time of backfill (circle one) yes no not applicable

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at dimp@lge-ku.com .

Field Pictures

Sketch


Couplings and valve running horizontal with ground.
7th St.
West Coupling
East Coupling
Valve 43:124
16" HP
Bernheim Ln.

Safety Briefing

Date: 09-07-21

Employee Name	**Employee ID**
Ethan Hinkson	[redacted]
Rachel Linder	[redacted]
Denis Diemer	[redacted]

Hazards Identified	
X	Sharp edges on cut pipe ends. Wear gloves when handling.
X	Pinch points on couplings. Wear gloves when handling.
X	Some couplings samples are heavy. Use a partner to assist with moving. Use proper lifting techniques. Wear hard toes shoes.
X	Debris may on samples. Wear eye protection.
X	Tripping hazards on floor. Keep area clean and free of tripping hazards

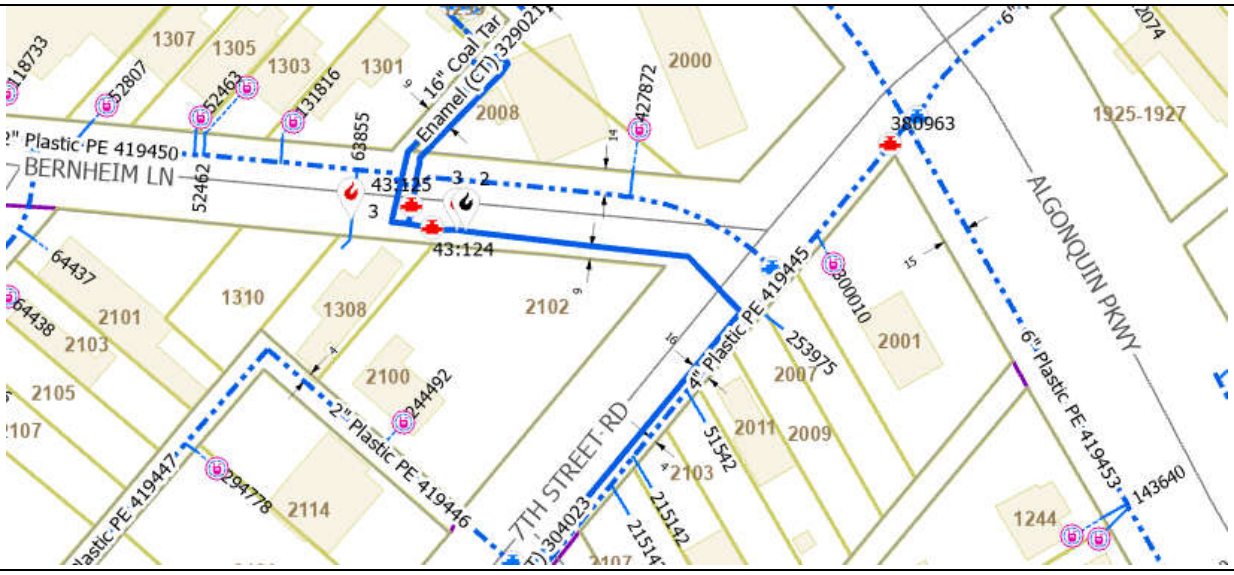
PPE Required	
X	Hard toed shoes
X	Safety glasses
X	Gloves (leather preferred)

Part B- Coupling Information

General Information			Tracking #: 2021-020
PO Number 1094073	Expense Org 004610	Project 158276	Task COUPLER
Address/Location 1301 Bernheim Ln. Louisville, KY 40210 (7th @ Bernheim)			
Size 16”	Material STL	Coating CT	MAOP 99 PSIG
Main/Service Number 329021	Soil Type (from Part A) Clay	Manufacturer DRESSER	Model
Pipe Connection:	Steel to Steel	Steel to Plastic	Plastic to Plastic

Historical Information	
Installation Date 6/22/1990	Document Source Quest – Main Report
Installation Company Local Const	Document Source Quest – Main Report
Foreman Matthews	Document Source Quest – Main Report
Welder Joe Robinson	Document Source Quest – Main Report

GIS Information
Sys Id (of Coupler) 1001513513
Screen Capture



Pictures (Label the following parts before taking pictures.)

Figure 1 Coupler Top View

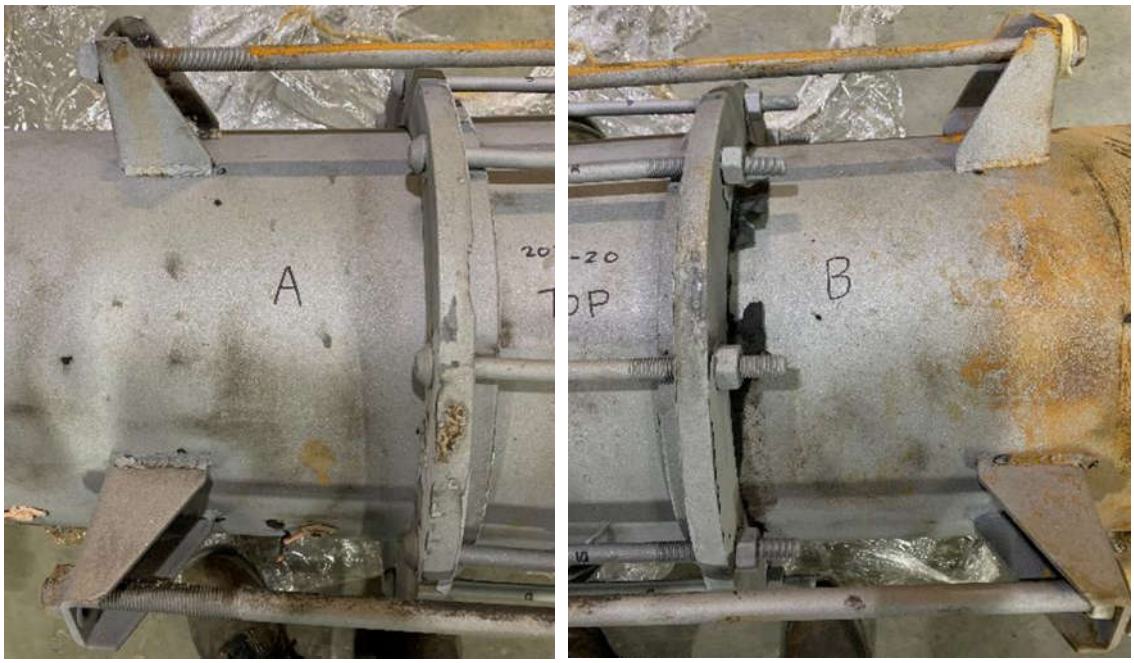


Figure 2 Pipe Sides A and B

Figure 3 Coupler Bottom View

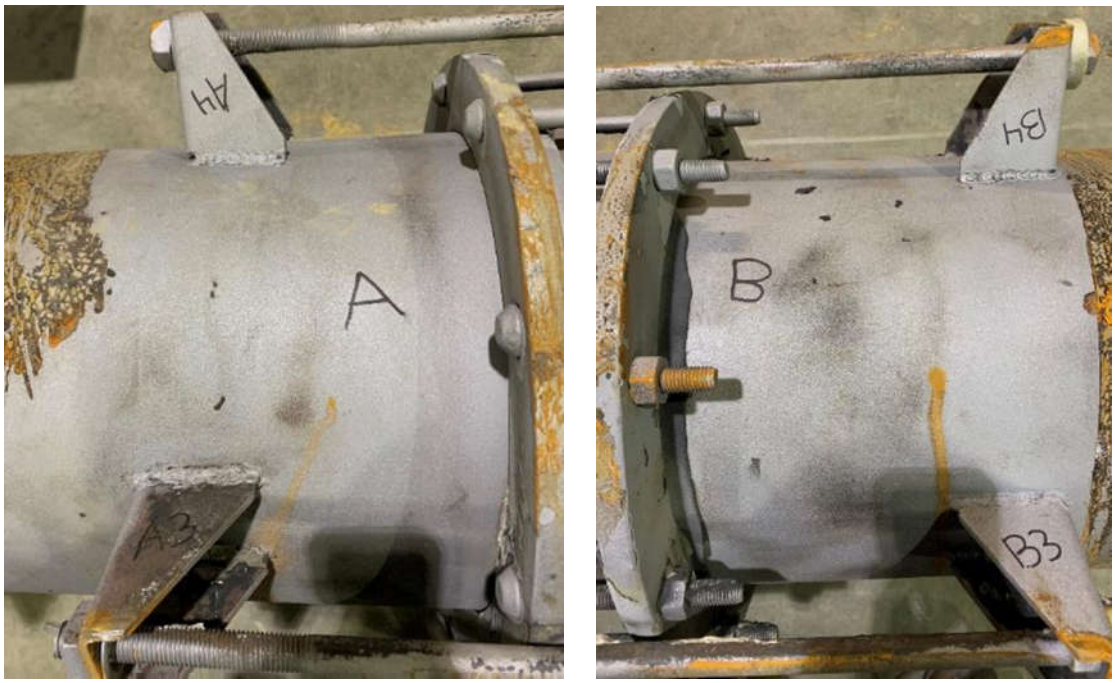


Figure 4 Pipe Sides A and B (bottom)

Figure 5 Lugs A1 and A2

Figure 6 Lugs A3 and A4

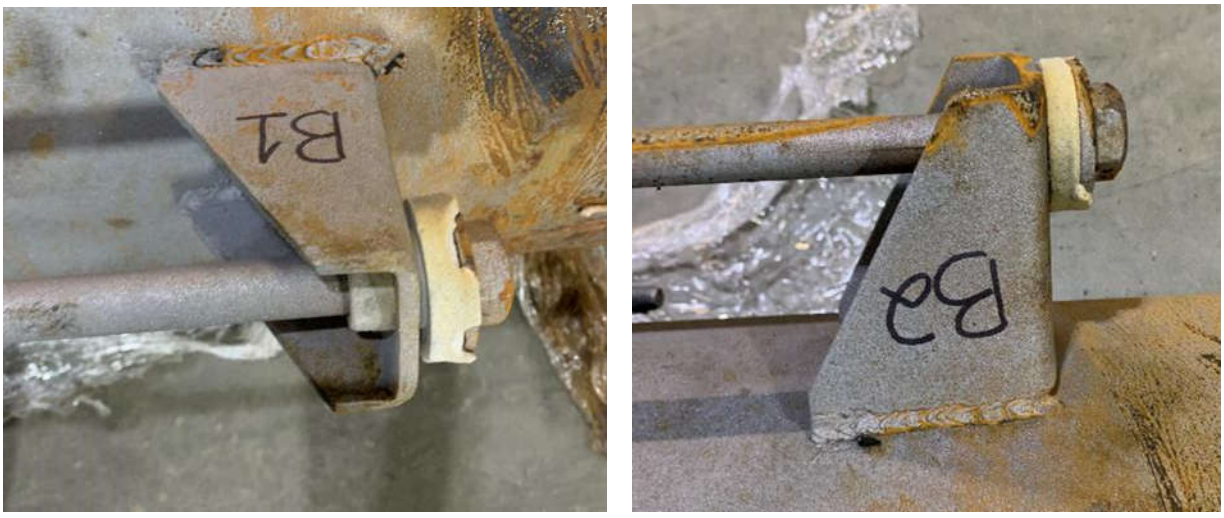


Figure 7 Lugs B1 and B2

Figure 8 Lugs B3 and B4

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson [redacted] Date: 09-07-21

Rachel Linder [redacted]

Denis Diemer [redacted]

Table 1- Component Quantities

Number of Bolts on Coupler Body	10
Number of Reinforcement Rods	4
Number of Lugs	8

Table 2- Corrosion

	Pipe A	Pipe B	Coupler Body	Bolts	Rods	Lugs	Nuts
General External Corrosion?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Localized External Corrosion?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pits Present?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Internal Corrosion?	n/a	n/a					

* If Pits are present take maximum depth measurements and put in the Additional Comments section.

Table 3- Coupler Body

Bolt	Washer Present	Nut present?
1	No	Yes
2	No	Yes
3	No	Yes
4	No	Yes
5	No	Yes
6	No	Yes
7	No	Yes
8	No	Yes
9	No	Yes
10	No	Yes

Table 4- Reinforcement Rods

Rod	Length (in.)	Diameter (in.)	Washer present at head of bolt?	Washer present at end of bolt?	Nut Present? Type?	Type of rod?
1	30.75	0.75	Yes	No	Yes, square	Standard hex head
2	30.75	0.75	Yes	No	Yes, square	Standard hex head
3	30.75	0.76	Yes	No	Yes, square	Standard hex head
4	30.75	0.75	Yes	No	Yes, square	Standard hex head

Type of Lug

(Please indicate the shape of the lug by circling one below. If the lug shape is different than any preset shape below, sketch the shape.)

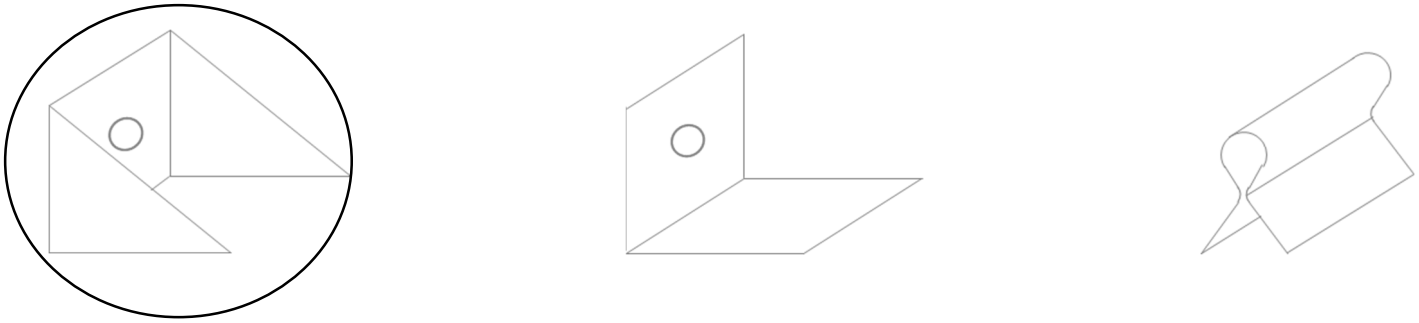


Table 5- Lugs (Measurements)

Pipe Side	Lug Number	Thickness (in.)	Circumference (in)	
			Distance to next lug, clockwise	Distance to next lug, counter-clockwise
A	1	0.25	9.75	9.5
A	2	0.26	9.5	10
A	3	0.266	10	10.5
A	4	0.255	9.8	9.75
B	1	0.260	9.75	9.25
B	2	0.273	9.25	9.75
B	3	0.269	9.5	9.75
B	4	0.255	9.75	9.8

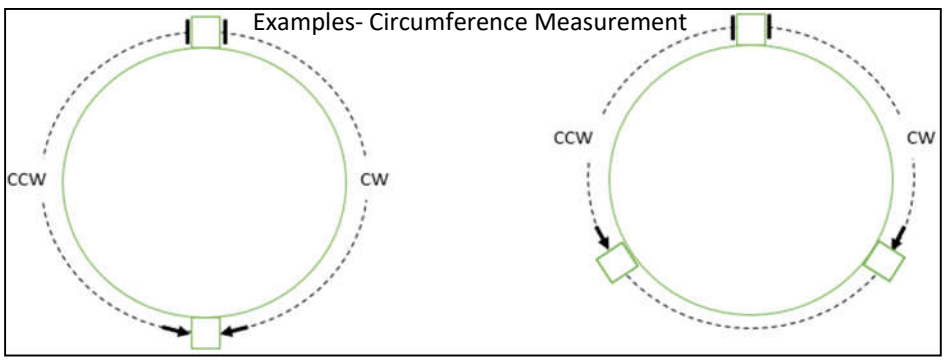


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	No	Yes, slightly bowed	n/a
A2	B2	Yes	No	n/a
A3	B3	No	No	n/a
A4	B4	Yes	No	n/a

Table 7- Lugs (Weld Quality)

Pipe Side	Lug Number	Any failed welds causing detachment?	Welded on all sides of exterior? If no, describe	Are welds on exterior continuous? If no, describe
A	1	No	Yes, where possible	Yes
A	2	No	Yes, where possible	Yes
A	3	No	Yes, where possible	Yes
A	4	No	Yes, where possible	Yes
B	1	No	Yes, where possible	Yes
B	2	No	Yes, where possible	Yes
B	3	No	Yes, where possible	Yes
B	4	No	Yes, where possible	Yes

Pipe Side	Lug Number	Welded on all sides of interior? If no, describe	Are welds on interior continuous? If no, describe
A	1	Yes	Yes
A	2	Yes	No
A	3	No	No, one only goes halfway
A	4	Yes	Yes
B	1	Yes	Yes
B	2	Yes	Yes
B	3	Yes	Yes
B	4	Yes	Yes

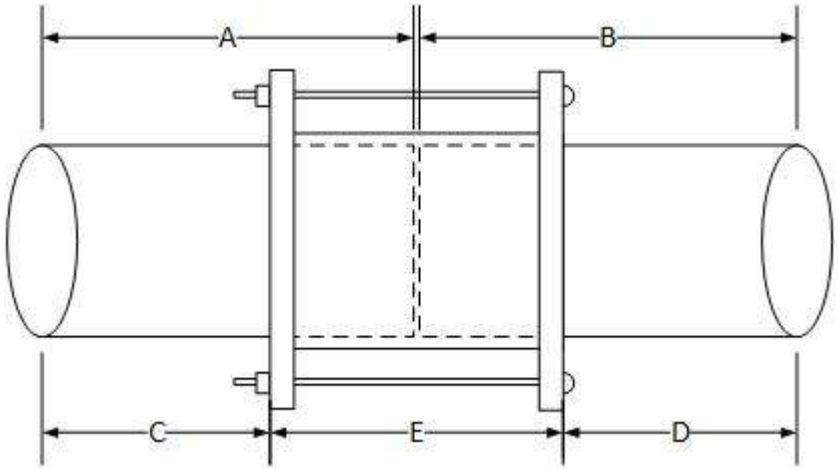


Table 8- Stab Depth

	A	B	C	D	**Stab Depth** (A-C) or (B-D)
Pipe Side A	19.25		14.75		4.5
Pipe Side B		28		23.5	4.5
	Sum of stab depths (should be closely equal to measurement E)				9
	Coupler Length (E)				9
	Difference				0

Additional Comments - General Observations, Pit Depths, etc.

Revision Log

7.0 – Modified table 7 to clarify “detachment” wording, changed formatting, expanded tables, added example figures. CSM

8.0 – Inserted Lab Analysis template into form to make IMR template. EKH

IMR TEST LABS
A Curtiss-Wright Business Unit
www.imrlouisville.com

4510 Robards Lane
Louisville, KY 40218
T: 1.502.810.9007 | **F**: 1.502.810.0380

LG&E - Kentucky Utilities
6900 Enterprise Drive
Louisville, KY 40214

October 15, 2021

Attention: Sarah Nicholson

Exhibit B
Report No. 202102055

Metallurgical Evaluation of a 16" Coupling and Associated Hardware

Location: 7th St. and Bernheim Ln.
Designation: 2021-21

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 16" pipe with a Dresser Style Insulating Coupling. Four joint harnesses were also affixed to the pipe section. Copies of the installation information for the coupling and harnesses were provided for this investigation. It was reported that the coupling had been installed in the field at the corner of 7th St. and Bernheim Ln.on June 22, 1990. The pipe section was subsequently excavated after substantial service duration without failure. It was requested that the general dimensions, weld quality, corrosion condition and mechanical properties of the coupling components be determined as directed.

RESULTS

The submitted pipe section with the coupling is shown in Figures 1 through 4. Four lugs of the joint harnesses had been fillet welded to both pipe segments. Four rods and associated nuts had been affixed through the welded lugs to apply compression to the coupled joint. The coupling consisted of a steel coupling with an interior nonmetallic gasket / sleeve. Prior to receipt, the ends of the pipe segment were labelled as Ends A and B, as shown in Figures 1 and 2. The top and bottom of the coupling section were also marked. Lugs A1, A2, A3, and A4 were welded to Pipe A, and Lugs B1, B2, B3, and B4 were welded to Pipe B. The rod between Lugs A1 and B1 was identified as Rod 1. The remaining lugs were identified in a corresponding fashion.

Figure 1. Photograph of the top of the submitted coupling sample.

Figure 2. Photograph of the bottom of the submitted sample.

SECTION 1- DIMENSIONAL MEASUREMENT

The four sets of harness lugs were positioned around the pipe. The relative orientations of the harness lugs were measured by photographing the assembly from the ends and applying a protractor overlay for angle measurement. The obtained measurements are shown in Figures 3 and 4 with the data summarized in Table 1. The depth of insertion of the pipe segments into the coupling was also measured and the dimensions are provided in Table 2. No requirements were provided for these characteristics.

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

Compound	Angle	Deviation from 90°	Image
Rod A1 / Rod A2	88	2	Figure 3
Rod A2 / Rod A3	91	1	Figure 3
Rod A3 / Rod A4	95	5	Figure 3
Rod A4 / Rod A1	86	4	Figure 3
Rod B1 / Rod B2	88	2	Figure 4
Rod B2 / Rod B3	97	7	Figure 4
Rod B3 / Rod B4	82	8	Figure 4
Rod B4 / Rod B1	93	3	Figure 4

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling
Pipe A	5”	0.25” (Original sample length – 46”)
Pipe B	2.75”	

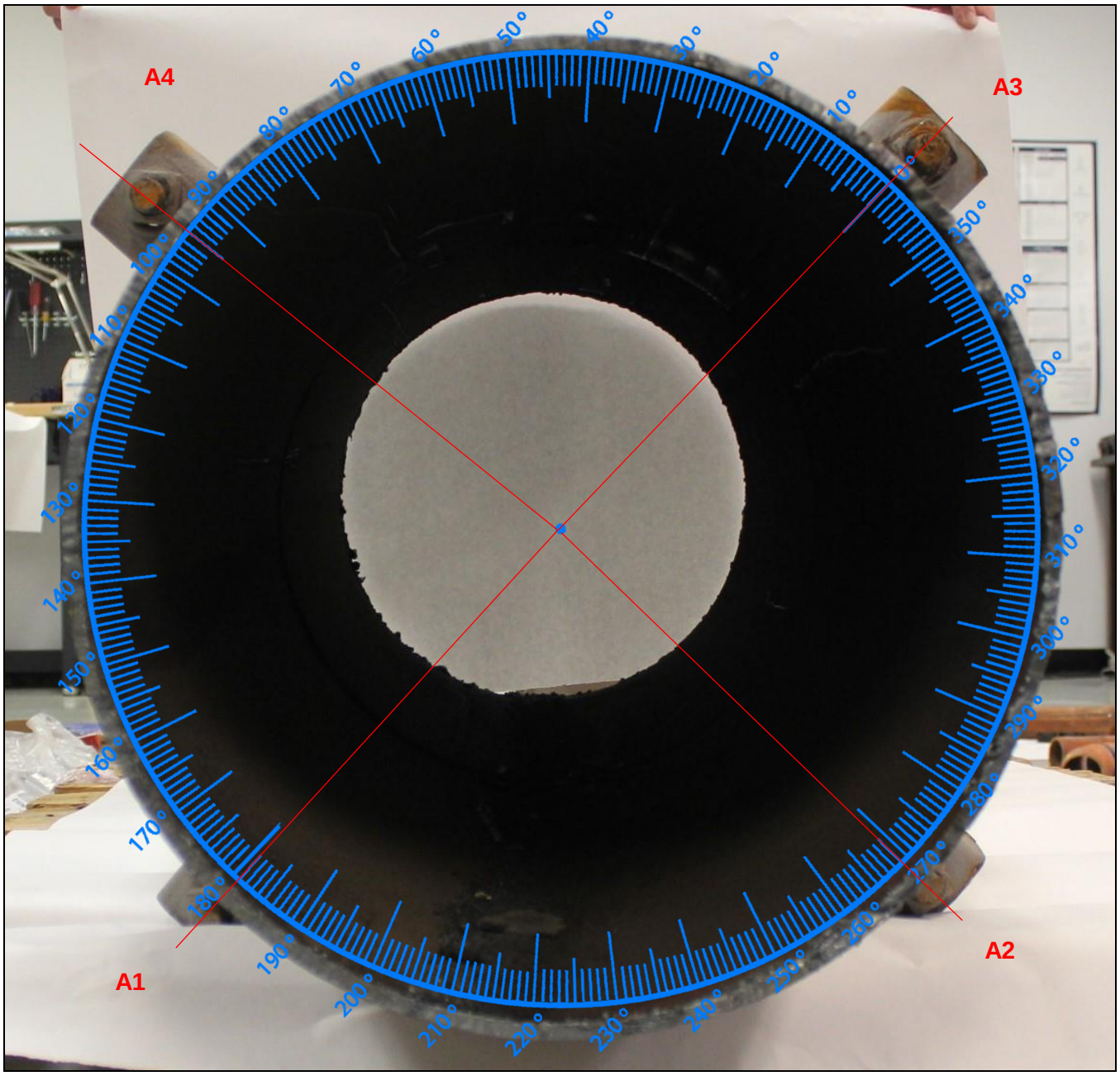


Figure 3. End facing image of the sample at End A with a superimposed protractor.

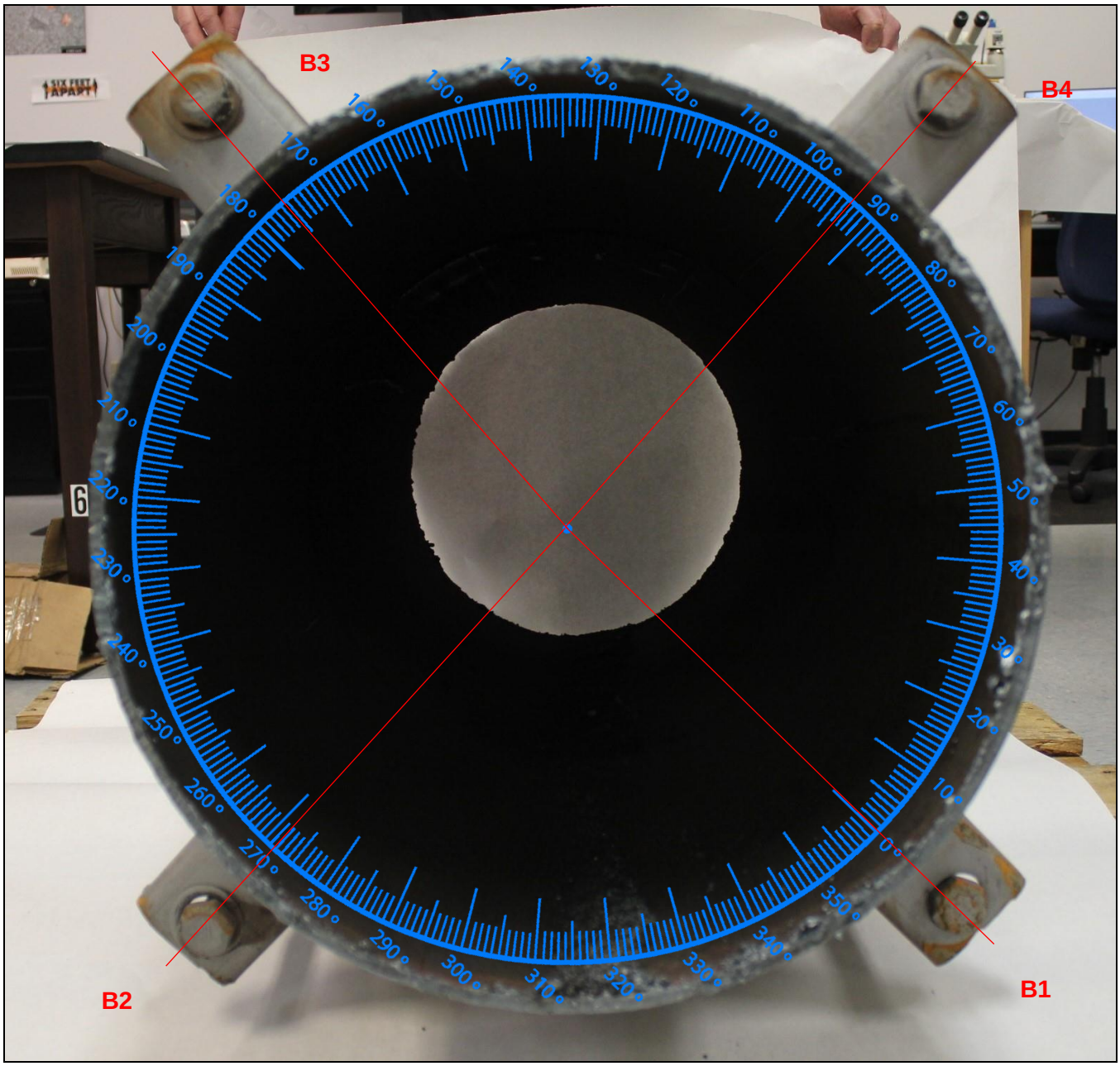


Figure 4. End facing image of the sample at End B with a superimposed protractor.

SECTION 2- VISUAL OBSERVATIONS

The lug attachment welds were regions of interest on the pipe coupling sample. Each lug contained four fillet weld locations; exterior top, exterior bottom, interior top, and interior bottom. Each weld that was present was inspected visually using a flashlight and magnifying lens. It was indicated that welding was performed in accordance with API 1104. General weld inspection was performed initially, followed by visual inspection by an outside NDE company. For comparison purposes, the welds were rated as substantial fusion, partial fusion, and minimal fusion. The summarized weld fusion and corrosion observations are provided in Table 3. Representative weld regions are shown in Figures 5 through 12.

The welds contained localized discontinuities including undercut, arc strikes, porosity, and spatter. No cracking in most of the welds or base metal heat affected zones (HAZ) was visually identified. No gross corrosion was observed anywhere on the pipe or associated hardware. Welds on Lug A2 were cracked.

The coupling and harness rods were also inspected for damage. The observations for the rods and bolts are provided in Table 4. No corrosion cracking was evident. The rods were not necked down or stretched.

The elastomeric components of the coupling consisted of a pipe separator, insulating sleeve, and two gaskets. Inspection revealed that they appeared to be intact and not degraded.

TABLE 3 – LUG WELD VISUAL EXAMINATION RESULTS

Component	Location	Weld	Observations
Lug A1	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug A2	Exterior	Top	Substantial Fusion (cracked)
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion (cracked)
		Bottom	Substantial Fusion
Lug A3	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug A4	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B1	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Obscured
		Bottom	Substantial Fusion

TABLE 3 – LUG WELD VISUAL EXAMINATION RESULTS – CONTINUED

Component	Location	Weld	Observations
Lug B2	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B3	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion
Lug B4	Exterior	Top	Substantial Fusion
		Bottom	Substantial Fusion
	Interior	Top	Substantial Fusion
		Bottom	Substantial Fusion

TABLE 4 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Bent, no gross corrosion, did not rotate freely
Rod 2	Bent, no gross corrosion, rotated freely
Rod 3	Not bent or stretched, no gross corrosion, did not rotate freely
Rod 4	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 1	Broken, no gross corrosion, did not rotate freely
Bolt 2	Bent, no gross corrosion, did not rotate freely
Bolt 3	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 4	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 5	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 6	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 7	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 8	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 9	Not bent or stretched, no gross corrosion, did not rotate freely
Bolt 10	Bent, no gross corrosion, did not rotate freely

Figure 5. Image of the Lug A1 exterior bottom weld which exhibited substantial fusion except for some undercut, porosity, and arc strikes.

Figure 6. Image of the Lug A2 exterior top weld which was fractured and exhibited substantial fusion except for some undercut and porosity.

Figure 7. Image of the Lug A4 exterior top weld which exhibited substantial fusion except for some undercut and spatter.

Figure 8. Image of the Lug B2 exterior bottom weld which exhibited substantial fusion except for some undercut.

Figure 9. Image of the Lug B2 interior bottom weld which exhibited substantial fusion.

Figure 10. Image of the Lug B4 exterior top weld which exhibited substantial fusion except for arc strikes, undercut, and spatter.

Figure 11. Image of the broken end of Bolt 1.

Figure 12. Image of the bent end of Bolt 2.

SECTION 3- TORQUE TESTING- FOR INFORMATION ONLY

Torque testing was performed on the nuts of the rods and bolts on the pipe coupling sample. A calibrated torque wrench was used to determine breakaway torque on each fastener. The breakaway torque measurements are summarized in Table 5. Rod fasteners did not have a specified torque requirement. The ten coupling bolts and four harness rods exhibited torque values ranging from 10 to 115 ft.-lbs. Rods 1 through 4 rotated when torque was applied to the nuts. No requirements were utilized for comparison as the coupler model was not specified.

TABLE 5 – FASTENER TORQUE MEASUREMENT

Component	Breakaway Torque	Observations
Rod 1	No breakaway	Rotated under torque
Rod 2	No breakaway	Rotated freely
Rod 3	No breakaway	Rotated under torque
Rod 4	No breakaway	Rotated under torque
Bolt 1	80	
Bolt 2	115	
Bolt 3	100	
Bolt 4	60	
Bolt 5	65	
Bolt 6	25	
Bolt 7	10	
Bolt 8	20	
Bolt 9	55	
Bolt 10	75	

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the four harness rods and the ten coupling bolts. The tensile mechanical properties of the fasteners were measured and the results are summarized in Table 6. No mechanical property requirements were provided for the fasteners.

TABLE 6 – FASTENER TENSION TEST RESULTS

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %③	Reduction in Area, %
Rod 1①	119	66.0	22	49
Rod 2①	119	65.0	21	47
Rod 3①④	118	66.5	20	48
Rod 4①	121	67.0	20	44
Bolt 1②	71.0	51.0	38	72
Bolt 2②	67.5	47.6	39	73
Bolt 3②	71.5	50.5	39	72
Bolt 4②	67.0	46.9	39	73
Bolt 5②	69.5	50.5	40	74
Bolt 6②	71.0	52.0	39	74
Bolt 7②	72.0	53.0	39	73
Bolt 8②	66.5	46.9	40	74
Bolt 9②	72.0	53.5	39	72
Bolt 10②	72.0	49.3	38	73

① Specimen Dimensions; Diameter 0.50” with gage length of 2.00”
② Specimen Dimensions; Diameter 0.25” with gage length of 1.00”
③ Percent elongation was measured using elongation-after-fracture measurements
④ Specimen fractured outside the middle half of the marked gage

SECTION 5- ROCKWELL HARDNESS, ASTM E18-20

Small sections of the eight lugs were excised for hardness testing. Rockwell hardness testing was performed on sectioned segments of the lugs after the removal of surface roughness by sanding. The obtained results are provided in Table 7 and are suggestive of a moderate strength level. No requirements were provided for comparison.

TABLE 7 – LUG HARDNESS TEST RESULTS – ROCKWELL B – HRBW

Results	Average①
Lug A1	73
Lug A2	72
Lug A3	69
Lug A4	72
Lug B1	88
Lug B2	77
Lug B3	72
Lug B4	71

① Reported hardness is an average of four individual readings

SECTION 6- NONDESTRUCTIVE EXAMINATION

The two separated ends of the disassembled coupling were sent to a third party NDE laboratory for inspection. Visual and liquid dye penetrant inspections were performed on the lug attachment welds. Inspection was performed in accordance with the acceptance criteria of API 1104 “Welding of Pipelines and Related Facilities”. The inspection results are provided as Appendix A. Two representative welds are shown in Figures 13 and 14 with the dye penetrant test media remaining.

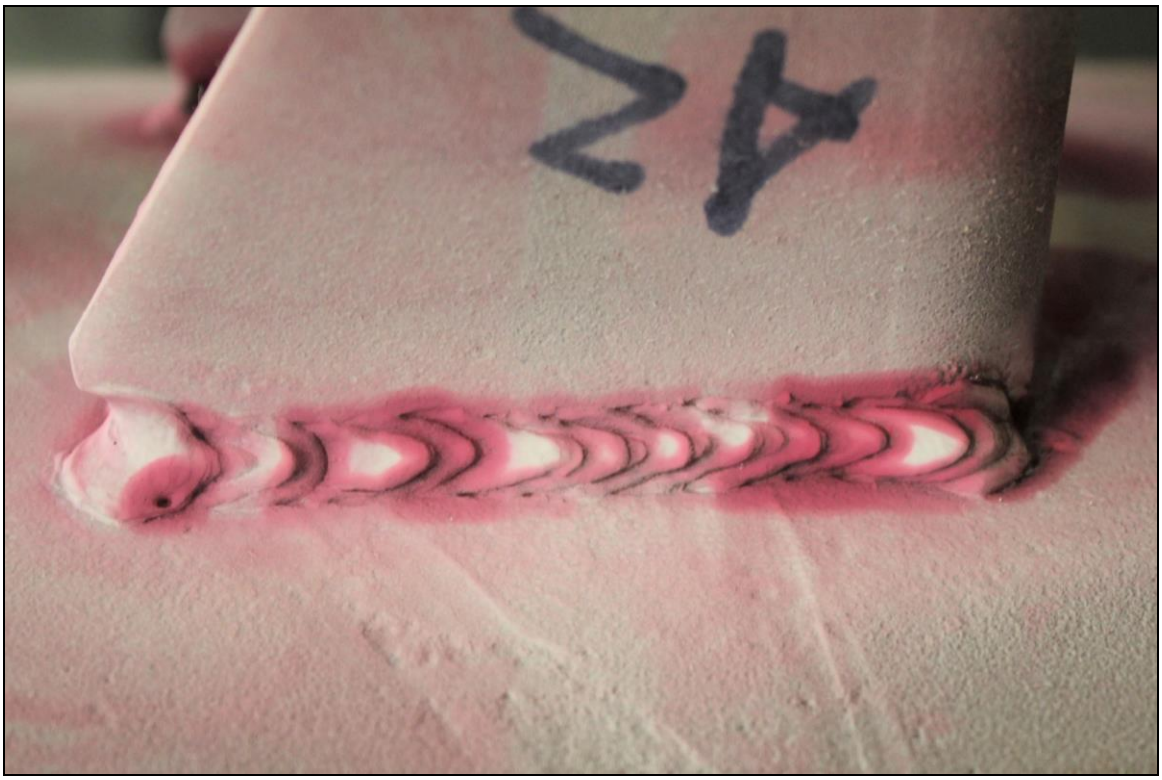


Figure 13. Image of the Lug A4 exterior top weld after dye penetrant media had been used during inspection.

Figure 14. Image of the Lug B1 exterior top weld after dye penetrant media had been used during inspection.

Respectfully submitted

Brian Kelly
Failure Analyst

Concurrence

Brett A. Miller, P.E. FASM
Technical Director

All procedures were performed in accordance with the IMR Quality Manual, current revision, and related procedures; and the PWA MCL Manual F-23 and related procedures. The information contained in this test report represents only the material tested and may not be reproduced, except in full, without the written approval of IMR Test Labs ("IMR"). IMR maintains a quality system in compliance with the ISO/IEC 17025 and is accredited by A2LA, certificates #1140.03 and #1140.04. IMR will perform all testing in good faith using the proper procedures, trained personnel, and equipment to accomplish the testing required. Conformance will be based on results without measurement uncertainty applied, unless otherwise requested by the customer. IMR's liability to the customer or any third party is limited at all times to the amount charged for the services provided. All test samples will be retained for a minimum of 3 months and may be destroyed thereafter, unless otherwise specified by the customer. The recording of false, fictitious, or fraudulent statements or entries on this document may be punished as a felony under federal statutes. IMR Test Labs is a GEAE S-400 approved lab (Supplier Code T9334).

APPENDIX A – LIQUID DYE PENETRANT / VISUAL INSPECTION RECORD

MISTRAS

Liquid Penetrant Examination Report

4100 Bishop Lane | Louisville, KY 40218 | P: (502) 966-5558; F: (502) 966-5401 www.mistrasgroup.com

Client:	IMR TEST LABS	Date:	10/1/2021 Page: 1 of 2
Address:	4510 ROBERTS LANE	Job Number:	
	LOUISVILLE, KY 40218	Purchase Order:	PO# 7243FA
Contact:	BRIAN KELLY	Reference Number:	202102055
Location:	MGI SHOP	Part No/Description:	Steel Gas Couplings
			Lug Welds

Code/Specification	Procedure	Acceptance Criteria
ASME SECTION V, ARTICLE 6	100-PT-001 REV 21.2	API 1104

Type and Method

☐ Fluorescent: [Type I] ☐ Water Wash [Method A] ☐ Solvent Removable [Method C] ☐ Post Emulsified: ☐ Hydrophilic [D] ☐ Lipophilic [B]

☒ Red Visible Dye: [Type II] ☐ Water Wash [Method A] ☒ Solvent Removable [Method C] ☐ Post Emulsified [Method B]

Sensitivity Level: ☐ ½ ☐ 1 ☒ 2 ☐ 3 ☐ 4 ☐ N/A ☐ Other:

	Manufacturer	Type	Batch Number(s)	Application Method	Process Time (minutes)	
					Pre-clean Dry Time:	5 MIN
Cleaner:	MAGNAFLUX	SKC-S	18G14K	DAMP CLOTH	Penetrant Dwell Time:	10 MIN
Penetrant:	MAGNAFLUX	SKL-SP2	17L02K	SPRAY	Emulsifier Time:	N/A
Developer:	MAGNAFLUX	SKD-S2	17J04K	SPRAY	Developer Time:	10 MIN
Emulsifier:	N/A	N/A	N/A	N/A	Post Clean Method:	SOLVENT

Developer Form: ☐ a. Dry Powder ☐ b. Water Soluble ☐ c. Water Suspended ☒ d. Nonaqueous Wet ☐ e. Specific Application

Penetrant Removal Method & Dry Time	Black Light (Model and S/N)	White Light Source
SKC-S DAMPENED CLOTH @ 5 MIN	N/A	LED FLASHLIGHT

☒ Original ☐ Repair	Material & Thickness	Test Temperature
	C/S	75° F

Surface Condition

☒ As Welded ☐ As Ground ☐ As Cast ☐ Rough Machined ☐ Final Machined ☒ Meets Code Requirements

Test Results	Quantity Inspected: 8	Quantity Accepted:	Quantity Rejected: 8

RED VISIBLE DYE PENETRANT INSPECTION PERFORMED ON THE FOLLOWING:
Description: (202102055) Couplings - Lug Welds
Weld ID: A1 (REJECTED)-- POROSITY, UNDERCUT, UNDER FILL
Weld ID: A2 (REJECTED)-- WELD FAILURE -- SPLIT/CRACKED
Weld ID: A3 (REJECTED) -- POROSITY, UNDER FILL
Weld ID: A4 (REJECTED) -- UNDER FILL, UNDERCUT, POROSITY

Weld ID: B1 (REJECTED) -- UNDER FILL, UNDERCUT, POROSITY
Weld ID: B2 (REJECTED) -- UNDER FILL, LACK OF FUSION --- BEAD TIE-IN AT TOP
Weld ID: B3 (REJECTED) -- UNDERCUT, UNDER FILL, LACK OF FUSION --- BEAD TIE-IN AT TOP
Weld ID: B4 (REJECTED) -- UNDER FILL

Technician Name, Level & Date	Customer (if applicable):	Reviewed By (if applicable):
Paul Huffine PAUL HUFFINE, LVL II, 10/1/2021		

Certification of Inspection, Liquid Penetrant [Basic Report Form] 100-PTFORM-002 | Rev 1

MISTRAS

Visual Examination Report

4100 Bishop Lane | Louisville, Ky. 40218 | P: (502) 966-5558; F: (502) 966-5401 www.mistrasgroup.com

1. Client	2. Work Location	4. Mistras Job No.	5. Date	7. Page
IMR Test Labs	Mistras, Louisville	202102055	9/30	1 of 1
	3. Client Contact: Brian Kelly	5. Purchase Order No.: 7243FA	8. Client Reference No.: 202102055	

9. Code/Specification	10. NDT Procedure	11. Acceptance Criteria
API 1104	100-VT-004 REV 3	API 1104

12. Material	13. Weld Process	14. Surface Condition	15. Temperature
Carbon Steel	SMAW	Brushed clean	Ambient

16. Technique	17. Visual Aids	18. Supplemental Lighting
[✓] Direct Visual [ ] Remote Visual [ ] Translucent Visual	[ ] Yes [✓] No	[✓] Yes [ ] No

19. Access within 24" & 30°	20. 1/32" Line/Simulated Imperfections Used	21. Dimensional Aids	22. Light Meter Serial No.
[✓] Yes [ ] No	[ ] Yes [✓] No	[ ] Yes [✓] No	Flashlight

23. Additional Information

Informational visual inspection of a temporary I-Beam support. Welds numbered as: For Beams, Left and Right are as facing towards the unit. (Column or Beam)-(Number for Column or Beam)-(Top, Bottom for columns, Left, Right for beams)-(weld number)

24. Unit	25. System	26. Component ID	27. Drawing
N/A	N/A	N/A	N/A

Test Results

28. ID/Weld No.	29. Indication Code(s)	30. Acc.	31. Rej.	32. Comments
A-1	WP, UC, AS, UN, PO		X	Poor Workmanship
A-2	CR, WP, UC, UN, PO		X	Poor Workmanship
A-3	WP, UC, AS, UN, PO		X	Poor Workmanship
A-4	WP, UC, AS, UN, PO		X	Poor Workmanship
B-1	WP, UC, AS, UN, PO, CL		X	Poor Workmanship
B-2	WP, UC, AS, UN, CL, IL		X	Poor Workmanship
B-3	WP, UC, AS, UN		X	Poor Workmanship
B-4	WP, AS, UN, CL		X	Poor Workmanship

Indication Codes

CR	Crack	CL	Cold Lap	ES	Excessive Weld Spatter	AS	Arc Strike
IF	Incomplete Fusion	UN	Insufficient Fill or Undersize	WP	Weld Profile	GO	Gouge
PO	Porosity	ER	Excessive Reinforcement	SF	Surface Finish	PD	Physical Damage
UC	Undercut	SL	Slag or Flux	IP	Incomplete Penetration	CO	Corrosion
						OT	Other

33. Technician, Level & Date	34. Customer Signature (if applicable)	35. Management Review (if applicable)
Gary Bowman, AWS CWI, 18021381		

Certificate of Inspection, Visual (Welds) 100-VTFORM-001 | Rev 2

Gary W Bowman
CWI 18021381
QC1 EXP. 2/1/2024

Bolt-Style Coupling (pressures > 3 psig)

This form will be completed when LG&E or LG&E contractors expose a bolt-style coupling in a system where **the pressure is > 3 psig (medium and high-pressure distribution and transmission)** and the coupling will be backfilled. The purpose of the form is to provide Operations, Engineering and Gas Regulatory personnel with information about the bolt style coupling installation**.**

Part A- Discovery of Coupling

Precautions:

1. Stop excavation upon discovering the bolt-style coupling in the excavation
2. Set-up a perimeter around the excavation to keep the public away from the excavation

General Information:

1. Contact Employee for the bolt style coupling found: **Tommy Smith**
2. Date of exposure: **08/23/21**
3. Location: **7th St. and Bernheim Ln.**
4. Size of coupling (based on pipe size if not exposed enough to determine): **16"**
5. Type of soil: ☐ Sandy ✖ Clay ☐ Gravel ☐ Topsoil ☐ Other (take picture and describe)
6. Soil Density test: ☐ Type A ✖ Type B ☐ Type C
7. Status: ✖ Removed ☐ Abandoned in place ☐ Backfilled- left in service
8. Discovery Method: ☐ Leak on Coupler ☐ Other Maintenance Excavation ☐ Facility Replacement ☐ Facility Retirement ✖ Other: **Leak Survey**

Pictures:

1. Take at least two pictures of the coupling. The pictures should be from different angles (additional pictures can be taken).
2. Email pictures to supervisor. Ensure pictures are attached to this form:

Sketch: Provide a sketch showing the coupling orientation (vertical/horizontal), nearby branches, pipe, valves and fittings, other utilities or structures, etc.

Leak Survey:

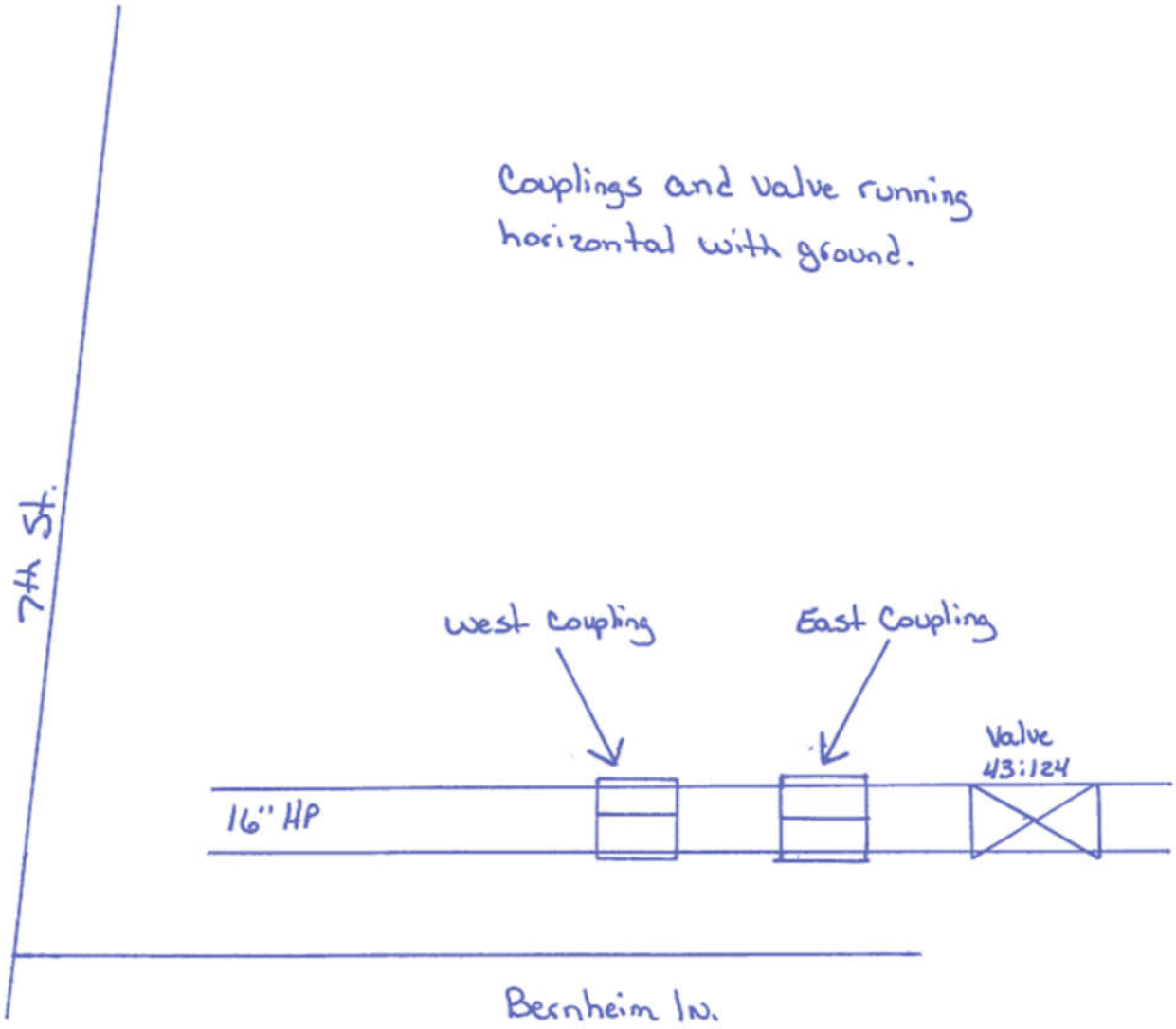
1. Use an instrument designed to detect natural gas to check for the presence of natural gas after backfilling the excavation. Include readings in the above sketch in relation to the coupling. If the contact employee is not leak survey qualified, they should contact:
   a. Their supervisor to call Gas Regulatory to complete the survey after the excavation is backfilled. Call [redacted]
   b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

Leak Survey completed at time of backfill (circle one) yes no not applicable

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at dimp@lge-ku.com .

Field Pictures

Sketch


Couplings and valve running horizontal with ground.
7th St.
West Coupling
East Coupling
Valve 43:124
16" HP
Bernheim In.

Safety Briefing

Date: 09-07-21

Employee Name	**Employee ID**
Ethan Hinkson	[redacted]
Rachel Linder	[redacted]
Denis Diemer	[redacted]

Hazards Identified	
X	Sharp edges on cut pipe ends. Wear gloves when handling.
X	Pinch points on couplings. Wear gloves when handling.
X	Some couplings samples are heavy. Use a partner to assist with moving. Use proper lifting techniques. Wear hard toes shoes.
X	Debris may on samples. Wear eye protection.
X	Tripping hazards on floor. Keep area clean and free of tripping hazards

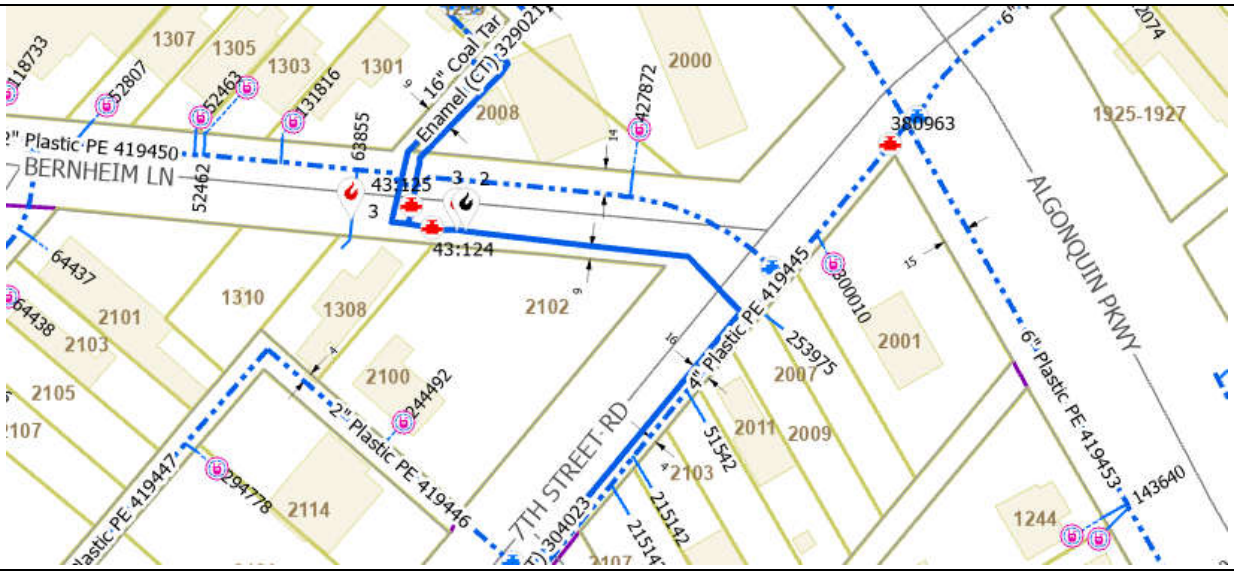
PPE Required	
X	Hard toed shoes
X	Safety glasses
X	Gloves (leather preferred)

Part B- Coupling Information

General Information			Tracking #: 2021-021
PO Number 1094073	Expense Org 004610	Project 158276	Task COUPLER
Address/Location 1301 Bernheim Lane, Louisville, KY 40210 (7th @ Bernheim)			
Size 16”	Material STL	Coating CT	MAOP 99 PSIG
Main/Service Number 329021	Soil Type (from Part A) Clay	Manufacturer N/A	Model
Pipe Connection:	Steel to Steel	Steel to Plastic	Plastic to Plastic

Historical Information	
Installation Date 6/22/1990	Document Source Quest – Main Report
Installation Company Local Const	Document Source Quest – Main Report
Foreman Matthews	Document Source Quest – Main Report
Welder Joe Robinson	Document Source Quest – Main Report

GIS Information
Sys Id (of Coupler)
Screen Capture



Pictures (Label the following parts before taking pictures.)

Figure 1: Top View

Figure 2: Coupler Body (Top View)

Figure 3: Pipe A (Top View)

Figure 4: Pipe B (Top View)

Figure 5: Coupler Body (Bottom View)

Figure 6: Pipe A (Bottom View)

Figure 7: Pipe B (Bottom View)

Figure 8: Lug A1

Figure 9: Lug A2

Figure 10: Lug A3

Figure 11: Lug A4

Figure 12: Lug B1

Figure 13: Lug B2

Figure 14: Lug B3

Figure 15: Lug B4

Figure 16: Reinforcement Rod 1

Figure 17: Reinforcement Rod 2

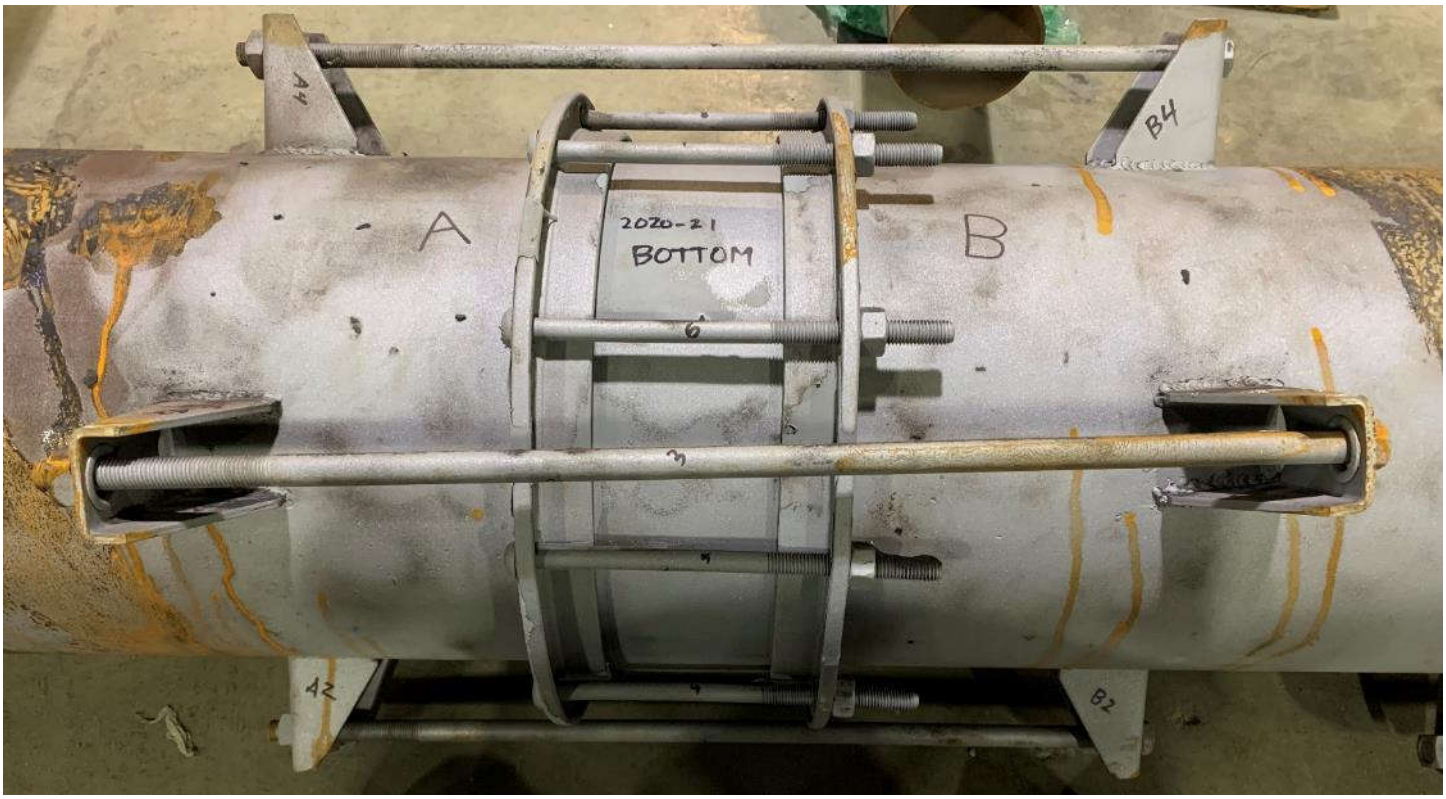


Figure 18: Reinforcement Rod 3

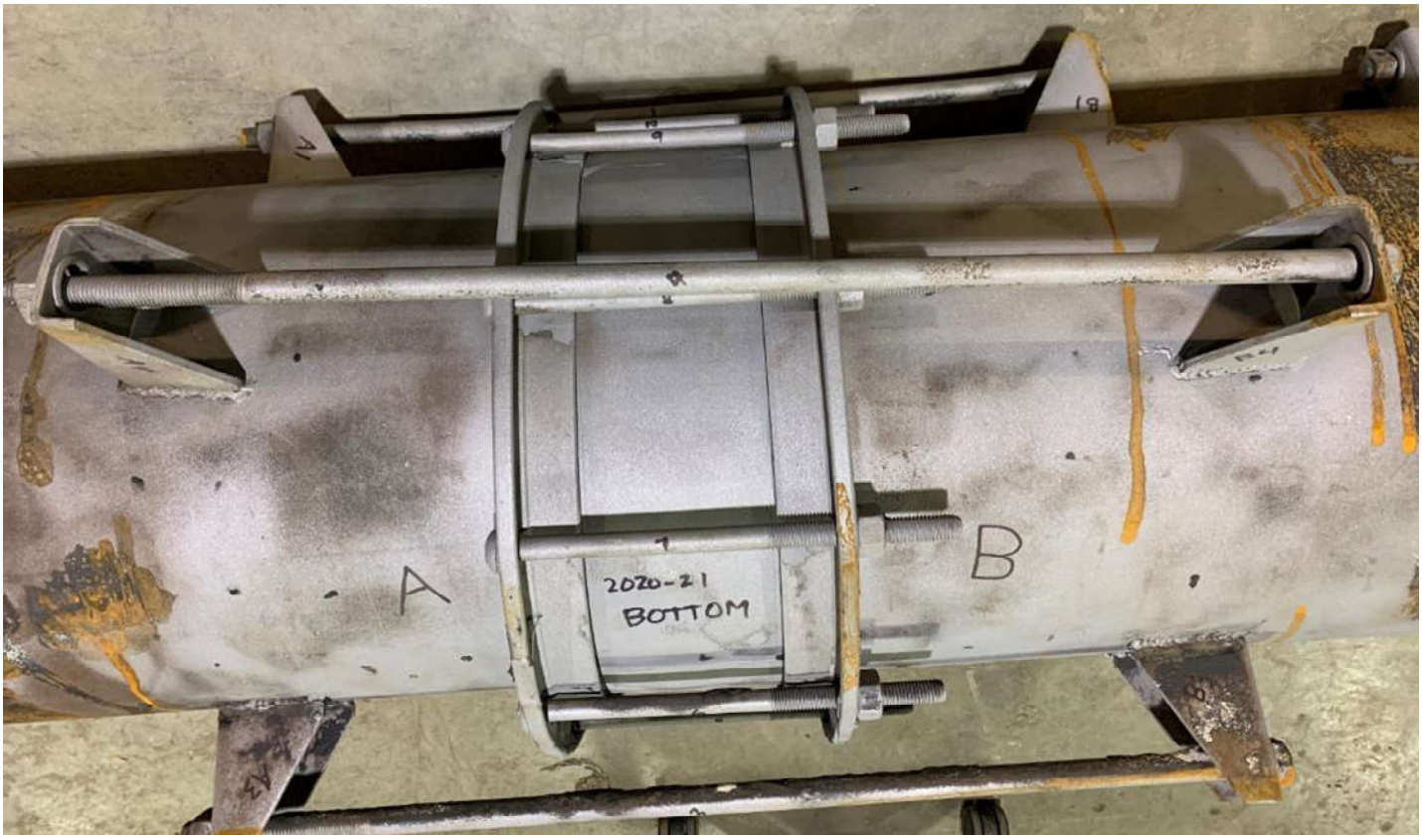


Figure 19: Reinforcement Rod 4

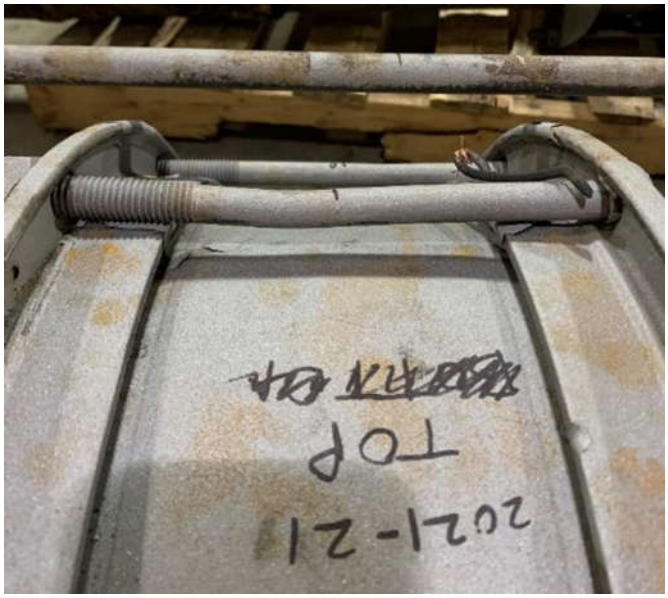


Figure 20: Coupler Bolt 1

Figure 21: Coupler Bolt 2

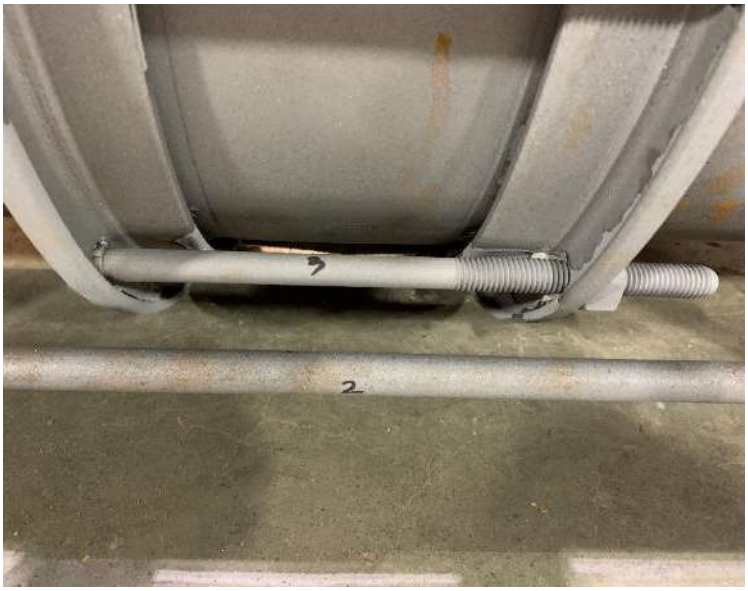


Figure 22: Coupler Bolt 3

Figure 23: Coupler Bolt 4

Figure 24: Coupler Bolt 5

Figure 25: Coupler Bolt 6

Figure 26: Coupler Bolt 7

Figure 27: Coupler Bolt 8

Figure 28: Coupler Bolt 10

Figure 29: Coupler Bolt 10

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson [redacted] Date: 09-07-21

Rachel Linder [redacted]

Denis Diemer [redacted]

Table 1- Component Quantities

Number of Bolts on Coupler Body	10
Number of Reinforcement Rods	4
Number of Lugs	8

Table 2- Corrosion

	Pipe A	Pipe B	Coupler Body	Bolts	Rods	Lugs	Nuts
General External Corrosion?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Localized External Corrosion?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Pits Present?	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Internal Corrosion?	n/a	n/a					

* If Pits are present take maximum depth measurements and put in the Additional Comments section.

Table 3- Coupler Body

Bolt	Washer Present	Nut present?
1	No	Yes
2	No	Yes
3	No	Yes
4	No	Yes
5	No	Yes
6	No	Yes
7	No	Yes
8	No	Yes
9	No	Yes
10	No	Yes

Table 4- Reinforcement Rods

Rod	Length (in.)	Diameter (in.)	Washer present at head of bolt?	Washer present at end of bolt?	Nut Present? Type?	Type of rod?
1	30.5	0.75	No	No	Yes, square	Standard hex head
2	30.75	0.75	No	No	Yes, square	Standard hex head
3	30.5	0.75	No	No	Yes, square	Standard hex head
4	30.5	0.75	No	No	Yes, square	Standard hex head

Type of Lug

(Please indicate the shape of the lug by circling one below. If the lug shape is different than any preset shape below, sketch the shape.)

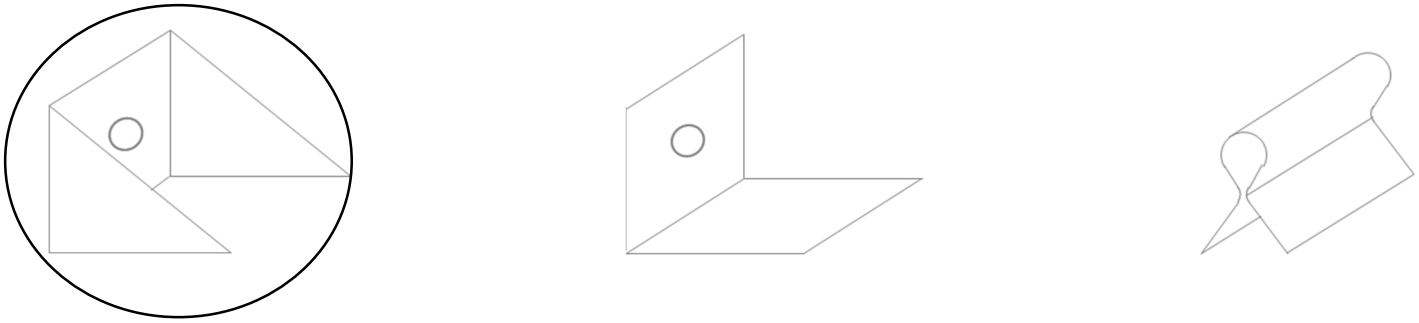


Table 5- Lugs (Measurements)

Pipe Side	Lug Number	Thickness (in.)	Circumference (in)	
			Distance to next lug, clockwise	Distance to next lug, counter-clockwise
A	1	0.26	9.25	8.5
A	2	0.283	8.5	10
A	3	0.282	10	10.5
A	4	0.265	10.5	9.25
B	1	0.252	10.25	9.25
B	2	0.256	9.25	10.5
B	3	0.263	10.5	9
B	4	0.274	9	10.25

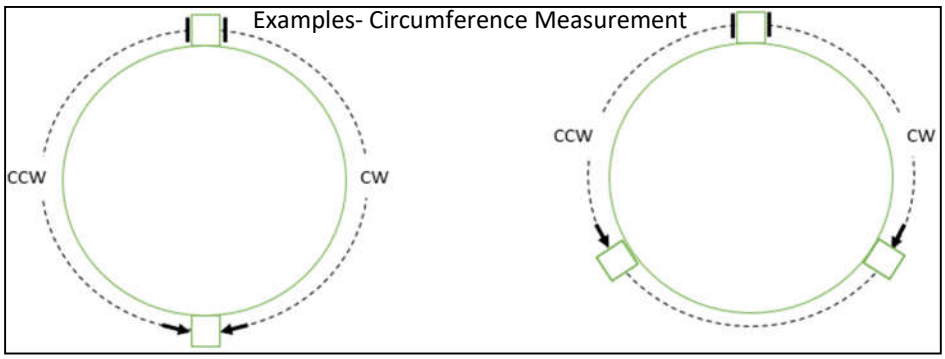


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	No	Yes, slightly bowed	n/a
A2	B2	Yes	No	n/a
A3	B3	No	No	n/a
A4	B4	No	No	n/a

Table 7- Lugs (Weld Quality)

Pipe Side	Lug Number	Any failed welds causing detachment?	Welded on all sides of exterior? If no, describe	Are welds on exterior continuous? If no, describe
A	1	No	Yes, where possible	Yes
A	2	Yes	Yes, where possible	Yes, but one is broken
A	3	No	Yes, where possible	Yes
A	4	No	Yes, where possible	Yes
B	1	No	Yes, where possible	Yes
B	2	No	Yes, where possible	Yes
B	3	No	Yes, where possible	Yes
B	4	No	Yes, where possible	Yes

Pipe Side	Lug Number	Welded on all sides of interior? If no, describe	Are welds on interior continuous? If no, describe
A	1	Yes	Yes
A	2	Yes	Yes, but one is broken
A	3	Yes	No, one only goes halfway
B	4	Yes	No, stops short
B	1	Yes	Yes
B	2	n/a; one side covered with rock	n/a
B	3	Yes	Yes, but one side looks poorly done
B	4	Yes	No, stops a little short

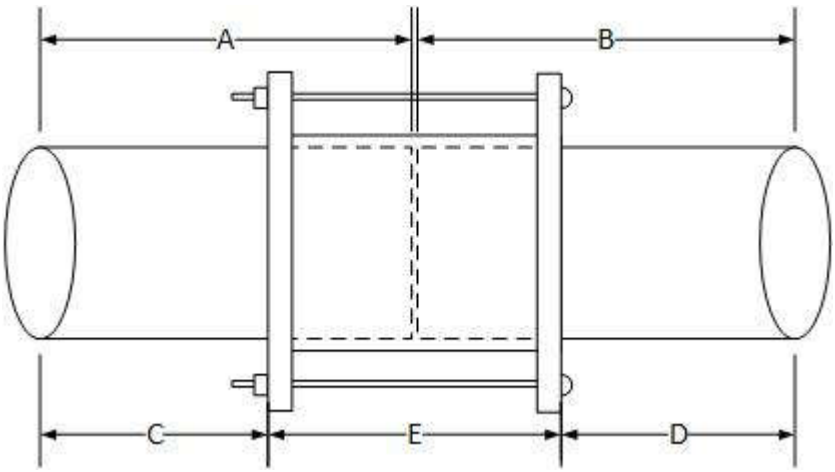


Table 8- Stab Depth

	A	B	C	D	**Stab Depth** (A-C) or (B-D)
Pipe Side A	25.25		21.25		4
Pipe Side B		20.5		16	4.5
	Sum of stab depths (should be closely equal to measurement E)				8.5
	Coupler Length (E)				9
	Difference				0.5

Additional Comments - General Observations, Pit Depths, etc.

Revision Log

7.0 – Modified table 7 to clarify “detachment” wording, changed formatting, expanded tables, added example figures. CSM

8.0 – Inserted Lab Analysis template into form to make IMR template. EKH