Louisville Gas and Electric Company 2022 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") is submitting the fifth and final annual report for the years 2018–2022. The annual report provides the completion of the implementation of LG&E's Action Plan and the number of bolted-style coupling systems removed in 2022 from distribution lines having an operating pressure in excess of 60 psig along with observations of the removed couplings. LG&E has completed all requirements of the order.

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 (>60 psi) 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 was completed in 2022.

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 implemented a new risk analysis software to consider the suggested, among other, risk factors associated with the distribution system. This will allow a better ranking of infrastructure to be utilized by the DIMP team members to initiate improvements.
- Status: Complete

In accordance with the Action Plan Section 3, Part E, a program was implemented for the opportunistic bolted style coupling removal or encapsulation in October 2017. In accordance with the Kentucky Public Service Commission's Order to LG&E on March 16, 2018 for Case No. 2017-00119, LG&E hereby notifies the Commission that the following five mechanical couplings were removed from service from LG&E's high-pressure (>60 psi) gas distribution system in 2022. The five couplings were physically removed from the ground while no 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:

- 800 Cannons Lane Two 12-inch bolted style mechanical couplings installed in 1987 were exposed on 06/29/2022 and removed from the ground on 08/09/2022 for inspection. The lab analysis is attached in Exhibit A and Exhibit B.
- 554 Cannons Lane A 12-inch and a 20-inch bolted style mechanical coupling installed in 1987 were exposed on 07/08/2022 and removed from the ground on 08/09/2022 for inspection. The lab analysis is attached as in Exhibit C and Exhibit D.
- 26th Street and Bank Street A 6-inch bolted style mechanical coupling installed in 1951 was exposed and removed from the ground 11/11/2022. The coupling was inspected. The lab analysis is attached as in Exhibit E.

LG&E plans to continue the opportunistic removal of bolt-style coupling systems and to manage the couplings under its distribution integrity management program.



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

November 29, 2022

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

Attention: Sarah Nicholson

Exhibit A

Report No. 202202293

Metallurgical Evaluation of a 12" Coupling and Associated Hardware

Location: Grandview South - 800 Cannons Ln. Designation: 2022-004

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 12" 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 Grandview South at approximately 800 Cannons Lane on November 23, 1987. 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.

LG&E - Kentucky Utilities

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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.

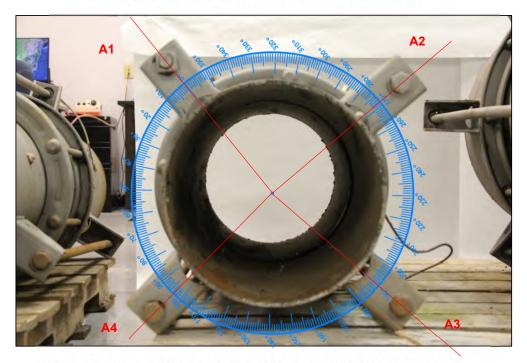
Compound	Angle	Deviation from 90°	Image
Rod A1 / Rod A2	88	- 2	Figure 3
Rod A2 / Rod A3	82	- 8	Figure 3
Rod A3 / Rod A4	87	- 3	Figure 3
Rod A4 / Rod A1	103	13	Figure 3
Rod B1 / Rod B2	85	- 5	Figure 4
Rod B2 / Rod B3	85	- 5	Figure 4
Rod B3 / Rod B4	92	2	Figure 4
Rod B4 / Rod B1	98	8	Figure 4

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling
Pipe A	17 ¼"	1.635"
Pipe B	17 ½"	(Original sample length – 36 3/8")

Exhibit A Page 4 of 28



IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218

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

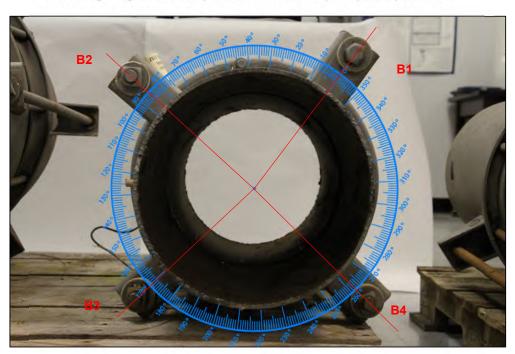


Figure 4. End facing image of the sample at End B with a superimposed protractor.

Page 4 of 15

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 9. 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
	- <i>i i</i>	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A1	la ta si a s	Тор	Obscured – could not be inspected
	Interior	Bottom	Obscured – could not be inspected
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A2	Intorior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A3	Intorior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A4	Interior	Тор	Substantial
		Bottom	Substantial
	Exterior	Тор	Substantial
Lug D1	Exterior	Bottom	Substantial
Lug B1	Interior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug D2	Exterior	Bottom	Substantial
Lug B2	Interior	Тор	Substantial
		Bottom	Substantial
	Exterior	Тор	Substantial
Lug B3	Exterior	Bottom	Substantial
Lug D5	Intorior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B4	EXTEND	Bottom	Substantial
Luy D4	Interior	Тор	Substantial
	Interior	Bottom	Substantial

LG&E - Kentucky Utilities

TABLE 4 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Straight
Rod 2	Straight
Rod 3	Straight, slight corrosion
Rod 4	Bent at Lug A4, slight corrosion
Bolt 1	Straight
Bolt 2	Straight
Bolt 3	Straight
Bolt 4	Straight, slight corrosion
Bolt 5	Straight, slight corrosion
Bolt 6	Straight, slight corrosion
Bolt 7	Straight
Bolt 8	Straight



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

LG&E - Kentucky Utilities

Page 7 of 15

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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



Figure 7. Image of the Lug B1 exterior bottom weld which exhibited substantial fusion except for some undercut and arc strikes.

LG&E - Kentucky Utilities

Page 8 of 15

Exhibit A Page 9 of 28

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 8. Image of the Lug B2 exterior bottom weld which exhibited substantial fusion except for some undercut, spatter, and arc strikes. A portion of the interior weld was obscured.



Figure 9. Image of the Lug B4 exterior top weld which was fractured and exhibited substantial fusion except for some undercut, arc strikes, and spatter.

LG&E - Kentucky Utilities

Page 9 of 15

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 eight coupling bolts and four harness rods exhibited torque values ranging from 40 to 60 ft.-lbs. No requirements were utilized for comparison as the coupler model was not specified.

Component	Breakaway Torque	Observations
Rod 1	40 ftlbs.	
Rod 2	55 ftlbs.	
Rod 3	30 ftIbs.	
Rod 4	40 ftlbs.	
Bolt 1	50 ftlbs.	
Bolt 2	55 ftlbs.	
Bolt 3	45 ftlbs.	
Bolt 4	60 ftlbs.	
Bolt 5	45 ftlbs.	
Bolt 6	55 ftlbs.	
Bolt 7	50 ftlbs.	
Bolt 8	55 ftIbs.	

TABLE 5 – FASTENER TORQUE MEASUREMENT

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the four harness rods and the eight 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.

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %	Reduction in Area, %
Rod 1	108	65.5	25	51
Rod 2	107	66.0	25	50
Rod 3	108	65.0	24	47
Rod 4	108	65.5	25	48
Bolt 1	78.0	49.9	37	73
Bolt 2	83.5	53.5	37	74
Bolt 3	79.0	54.5	37	75
Bolt 4	77.5	49.9	38	75
Bolt 5	82.0	61.0	38	75
Bolt 6	80.5	58.5	36	77
Bolt 7	79.0	59.0	39	76
Bolt 8	80.0	59.5	38	76

TABLE 6 – FASTENER TENSION TEST RESULTS

Specimen Dimensions; Diameter 0.350" with gage length of 1.40"

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	Average of Five Measurements
Lug A1	78
Lug A2	81
Lug A3	76
Lug A4	77
Lug B1	52
Lug B2	76
Lug B3	78
Lug B4	53

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 Appendices A and B. Two representative welds are shown in Figures 10 and 11 with the dye penetrant test media remaining.



Figure 10. Image of the Lug A4 exterior top weld after dye penetrant media had been used during inspection.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 11. Image of the Lug B2 exterior top weld after dye penetrant media had been used during inspection.



Respectfully submitted Brett a. Mile

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

Concurrence Aria Hilly

Brian Kelly Failure Analyst

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 – VISUAL INSPECTION RECORD

								W	ww.mistrasgroup.com
1. Client 2. Work L			ocation Mistras, Louisville			4. Mistras Job No.		5. Date 11/18/2022	7. Page 1 of 1
IMR Test	Labs	3. Client Co	ntact Brett Miller			5. Purchase Order No. 7697FA	8	8. Client Reference No. 202202293	
Code/Specification			10. NI	DT Proc	edure & Revi	sion No.	11. Acceptance	e Criteria	
	PI-1104				100-VT-	004 Rev3		API-1104	
2. Material CS		13. Weld Pr		AW		14. Surface Condition		15. Supplemental L	200 C
6. Technique			SIV	AVV		Lugs brushed cli 17. Visual Aids	CO - NA Same	Yes 18. Light Meter Ser	No No
Direct Visual	Remote Vis	sual 🗆 T	ransluc	ent Vi	sual	🗆 Yes 🖾 No			NA
9. Access within 24" &	30°	20. 1/32" Line/	Simulated	i Imperi	fections Used	21. Dimensional Aids	2	22. Light Meter Cal	. Due
Yes		□ Yes	1	I N	D	🗆 Yes 🗹 No	o l	Flas	shlight
upport lugs A&B ON	202202293								
4. Unit		25. System				26. Component ID	1	27. Drawing	
NA est Results			N	IA	_	NA			NA
28. ID/Weld No.	29. Indicati	on Code(s)	30. Acc.	31. Rej.	32. Commer	nts			
A1	UC, UN	N, WP		x	Poor Workm	anship			
A2	UC, UN			x	Poor Workm				
A3	UC, UN								
A4	UC, UI	N, WP		x	Poor Workm	anship			
B1	UC,UN	N.WP	-	x	Poor Workm	anship			
B2	UC,UN		1	x	Poor Workm				
B3	UC,UN		-	x	Poor Workm				
B4	UC,UN	I,WP		x	Poor Workm	anship			
		_							
_									
			-	-					
						and controlled by Internation time during testing did thes			
dication Codes CR Crack IF Incomplete Fusic PO Porosity UC Undercut	n					ES Excessive Weld Spat WP Weld Profile SF Surface Finish IP Incomplete Penetral		AS Arc Strike GO Gouge PD Physical Dar CO Corrosion OT Other	nage
3. Technician (Print & S	Sign), Level & Da	te	34. Cu	stome	r Signature (if	applicable)	35. Manageme	ent Review (if appli	cable)

APPENDIX B – LIQUID DYE PENETRANT INSPECTION RECORD

100 Bishop Lar	ne Louisville, KY 402	18 P: (502)	966-5558; F:	(502) 966-5401			www.r	nistrasgroup.co		
lient: IMF	3			Date:	Date: 11-19-2022			Page: 1 of 1		
ddress: 451		Job Numbe	r:		11 19 2022 1011 1001					
LOUISVILLE,KY 40218					rder:	7697FA				
Contact: BRE	TT MILLER			Reference	Reference Number: 202202293 Part No/Description: STEEL GAS CC					
ocation: MG	I SHOP			Part No/De						
						LIFTING LUG	5			
Code/Specific AM:	ation SE SEC.V ARTICLE 6		Procedure	2 100-PT-001 REV 2	2	Accepta	ance Criteria API 1104			
ype and Metho Fluorescent [Type I] Sensitivity Leve	t: 🗌 Water Wash	ovable (Meth ed: 🗌 Hydr	ophilic [D]] Lipophilic [B]	Red [Type II]		☐ Water Wash [Me ☐ Solvent Removab ☐ Post Emulsified [i	e [Method C]		
				1	-					
	Manufacturer	1	Гуре	Batch Number(s)	Applic	ation Method	Process Time (r			
Cleaner:	MAGNAFLUX		KC-S	20L01K	DA	MD CLOTU	Pre-clean Dry Time:	5MIN		
Penetrant:	MAGNAFLUX		L-SP2	18LO4K		MP CLOTH BRUSH	Penetrant Dwell Time Emulsifier Time:			
Developer:	MAGNAFLUX		KD-S2	21J046	-	SPRAY	Developer Time:	N/A 10 MIN		
Emulsifier:	N/A		N/A	N/A			Post Clean Method:	N/A		
	DAMP CLOTH @ 5N	Material &	Thickness	N/A			L.E.D. FLASHLIGH			
Urface Conditio	nal 🗌 Repair			C/S		_	67 F			
As Welded		As Cast	Rough Mach	ined 🗌 Final Machi	ned 🛛 N	leets Code Requ	uirements			
Test Results		Quan	tity Inspected	1:8 Quar	ntity Accept	ted:	Quantity Rejected:	8		
DESCRIPTION WELD I.D.: A WELD I.D.: A WELD I.D.: A WELD I.D.: B WELD I.D.: B WELD I.D.: B WELD I.D.: B	VETRANT INSPECT N: (202202293) CC (1(REJECTED)UN (2(REJECTED)UN (3(REJECTED)UN (4(REJECTED)UN (1(REJECTED)UN (2(REJECTED)UN (3(REJECTED)UN (4(REJECTED)UN) (4(REJECTED)UN)	DUPLINGS DERCUT DERCUT,P DERCUT,L DERCUT,P DERCUT,L DERCUT,P DERCUT,P	- LUG WELI OROSITY ACK OF FUS OROSITY ACK OF FUS OROSITY OROSITY,L/	SION SION ACK OF FUSION						
Discard by shredding. /	sument may be defense article/s At no time during testing did the: ne, Level & Date	ervice related as d se parts or materia	l come into contact	iled by International Traffic In An with mercury. if applicable):	ns Regulations (1		Distribute only to entities meeting d By (if applicable):	ITAR requirements.		

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: James McGough
- 2. Date of exposure: 06/29/2022
- 3. Location: Grandview Valve Nest (Approximate Address: 800 Cannons Ln. Louisville, KY 40207)
- 4. Size of coupling (based on pipe size if not exposed enough to determine): 12"
- 5. Type of soil:

 Sandy
 Clay
 Gravel
 Topsoil
 Other (take picture and describe)
- 6. Soil Density test: □ Type A X Type B □Type C
- 7. Status: X Removed □Abandoned in place □Backfilled- left in service

 8. Discovery Method: □ Leak on Coupler
 □Other Maintenance Excavation
 X Facility Replacement

 □Facility Retirement
 □Other:

9. Pressure Class: □ Medium Pressure (MP) X High Pressure (HP) □ Transmission

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
 - b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

yes

Leak Survey completed at time of backfill (circle one)

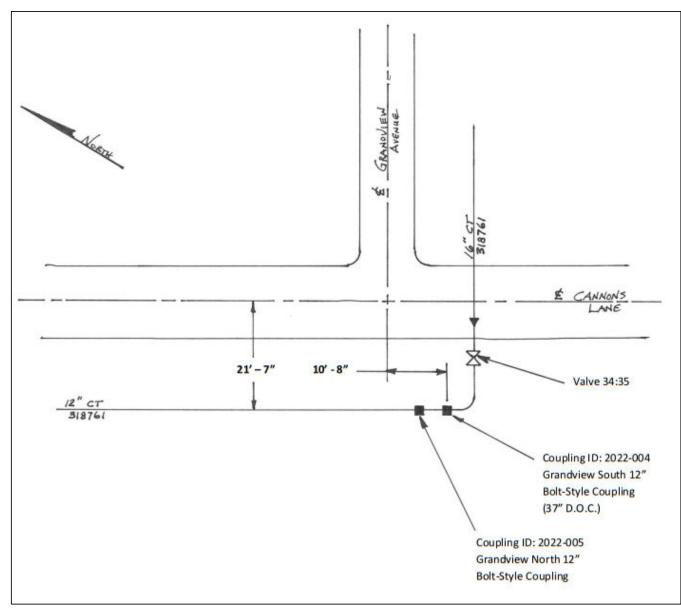
no (not applicable)

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at the second seco

Field Pictures







version 7.0 (10/27/2020)

Sketch

Safety Briefing

Date: October 3, 2022

Employee Name	Employee ID
Sarah Nicholson	
Ethan Hinkson	

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

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

Part B- Coupling Information

General Informa	ation		Tracking #: 2022-004		
PO Number Expense Org		Project	Task		
1121185	121185 004610		COUPLER		
Address/Location					
Grandview South @ 800 Cannons Ln. Louisville, KY 40207					
Size	Material	Coating	МАОР		
12"	STL	СТ	200 PSIG		
Main/Service Number Soil Type (from Part A)		Manufacturer	Model		
318761	Clay (Type B)	Dresser	Style 38		
Pipe Connection: Steel to Steel		Steel to Plastic	Plastic to Plastic		

Historical Information	
Installation Date	Document Source
11/23/1987	Quest
Installation Company	Document Source
Southern Pipeline	Quest
Foreman	Document Source
Campbell	Quest
Welder	Document Source
Paul Howard & Don Gousha	Quest

GIS Information	
Sys Id (of Coupler)	
73388283	
Screen Capture	
	Control (1)

Pictures (Label the following parts before taking pictures.)



Figure 1 – Coupler Top View



Figure 2 – Pipe Side A (Top)



Figure 3 – Pipe Side B (Top)



Figure 4 – Coupler Bottom View



Figure 5 – Lug A1



Figure 6 – Lug A2



Figure 7 – Lug A3

Figure 8 – Lug A4



Figure 9 – Lug B1



Figure 10 – Lug B2



Figure 11 – Lug B3



Figure 12 – Lug B4

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson & Sarah Nicholson

Date: 10/3/2022

Table 1- Component Quantities

Number of Bolts on Coupler Body	8
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?	Yes	No	No	No	No	No	No
Localized External Corrosion?	No	No	No	No	No	No	No
Pits Present?	No	No	No	No	No	No	No
Internal Corrosion?	No	No					

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

Table 3- Coupler Body

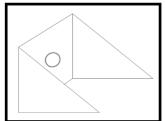
Bolt	Washer Present	Nut present?
1	No	Yes
2	No	Yes
3	No	Yes
4	No	Yes
5	No	Yes
6	No	Yes
7	No	Yes
8	No	Yes

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 ¾"	3⁄4″	Yes	Yes	Square	Standard
2	30 ¾"	3/4"	Yes	Yes	Square	Standard
3	30 ¾"	3/4"	Yes	Yes	Square	Standard
4	30 ¾″	3/4"	Yes	Yes	Square	Standard

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.)



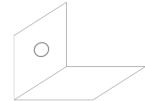




Table 5- Lugs (Measurements)

	Lug		Circumfe	rence (in)
Pipe Side	Pipe Side Number	Thickness (in.)	Distance to next lug, clockwise	Distance to next lug, counter- clockwise
А	1	0.23"	6 ¼"	6 ½"
А	2	0.23"	8″	6 ¼"
A	3	0.24"	7″	8″
A	4	0.23″	6 ½"	7″
В	1	0.23″	6 ¾"	7″
В	2	0.23″	7 ¼"	6 ¾″
В	3	0.22″	7 ½"	7 ¼"
В	4	0.23"	7"	7 ½"

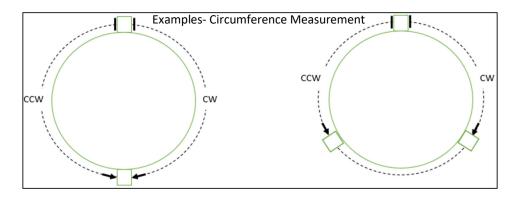


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	Yes	No	No
A2	B2	Yes	No	No
A3	В3	Yes	No	No
A4	B4	Yes	No	No

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
А	1	No	Yes	Yes
А	2	No	Yes	Yes
А	3	No	Yes	Yes
А	4	No	Yes	Yes
В	1	No	Yes	Yes
В	2	No	Yes	Yes
В	3	No	Yes	Yes
В	4	No	Yes	Yes

Pipe Side	Lug Number	Welded on all sides of interior? If no, describe	Are welds on interior continuous? If no, describe
A	1	N/A (Obscured)	N/A (Obscured)
A	2	Yes	Yes
A	3	Yes	N/A (Obscured)
A	4	Yes	N/A (Obscured)
В	1	Yes	N/A (Obscured)
В	2	Yes	Yes
В	3	Yes	Yes
В	4	Yes	Yes

Exhibit A Page 27 of 28

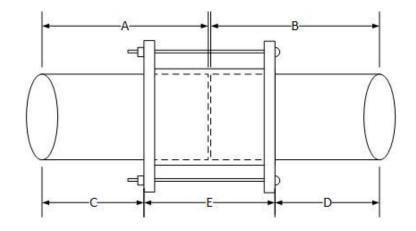


Table 8- Stab Depth

	Α	В	С	D	Stab Depth (A-C) or (B-D)
Pipe Side A	16 ¼"		14 ¼"		2″
Pipe Side B		18"		13 ½"	4 1⁄2"
	รเ	6 ½"			
	Coupler Length (E)				8 ½"
		2″			

Additional Comments - General Observations, Pit Depths, etc.



Figure 13 – General Corrosion on Pipe Side A



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

November 29, 2022

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

Attention: Sarah Nicholson

Exhibit B

Report No. 202202294

Metallurgical Evaluation of a 12" Coupling and Associated Hardware

Location: Grandview North @ 800 Cannons Ln. Designation: 2002-005

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 12" 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 Grandview North, at approximately 800 Cannons Lane on November 23, 1987. 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.

LG&E - Kentucky Utilities

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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, DEGREES Image: Comparison of the second s

Compound	Angle	Deviation from 90°	Image
Rod A1 / Rod A2	95	5	Figure 3
Rod A2 / Rod A3	101	11	Figure 3
Rod A3 / Rod A4	82	- 8	Figure 3
Rod A4 / Rod A1	82	- 8	Figure 3
Rod B1 / Rod B2	103	13	Figure 4
Rod B2 / Rod B3	86	- 4	Figure 4
Rod B3 / Rod B4	90	0	Figure 4
Rod B4 / Rod B1	81	- 9	Figure 4

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling	
Pipe A	18.375"	1.875"	
Pipe B	19.750"	(Original sample length – 40.0")	

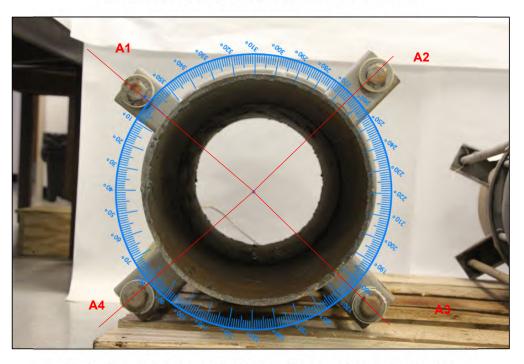


Figure 3. End facing image of the sample at End A with a superimposed protractor.

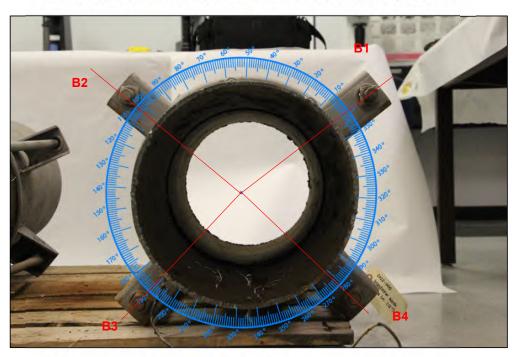


Figure 4. End facing image of the sample at End B with a superimposed protractor.

Page 4 of 16

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 9. 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	Тор	Substantial
	Exterior	Bottom	Substantial
	Interior	Тор	Substantial
		Bottom	Substantial
Lug A2	Exterior	Тор	Substantial
		Bottom	Substantial
	Interior	Тор	Minimal
		Bottom	Minimal
	Exterior	Тор	Substantial
Lug A3		Bottom	Substantial
	Interior	Тор	Substantial
		Bottom	Obscured by deposits
	Exterior	Тор	Substantial
		Bottom	Substantial
Lug A4	Interior	Тор	Obscured by deposits
		Bottom	Substantial
	Exterior	Тор	Substantial
Lue D4		Bottom	Substantial
Lug B1	Interior	Тор	Substantial
		Bottom	Substantial
Lug B2	Exterior	Тор	Substantial
		Bottom	Substantial
	Interior	Тор	Substantial
		Bottom	Substantial
Lug B3	Exterior	Тор	Substantial
		Bottom	Substantial
	Interior	Тор	Substantial
		Bottom	Substantial
Lug B4	Exterior	Тор	Substantial
		Bottom	Substantial
	Interior	Тор	Substantial
		Bottom	Substantial

LG&E - Kentucky Utilities

TABLE 4 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Bent – Slight Rust
Rod 2	Bent – Slight Rust
Rod 3	Straight – Slight Rust
Rod 4	Straight – Slight Rust
Bolt 1	Straight - Superficial Rust
Bolt 2	Straight - Superficial Rust
Bolt 3	Straight - Superficial Rust
Bolt 4	Straight - Superficial Rust
Bolt 5	Straight - Superficial Rust
Bolt 6	Straight - Superficial Rust
Bolt 7	Straight - Superficial Rust
Bolt 8	Straight - Superficial Rust



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

LG&E - Kentucky Utilities

Page 7 of 16

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 6. Image of the Lug A3 exterior and interior welds which exhibited overlap, undercut, spatter, and arc strikes.



Figure 7. Image of the Lug A4 exterior and interior welds which exhibited general fusions along with undercut, spatter, and overlap.

LG&E - Kentucky Utilities

Page 8 of 16

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218

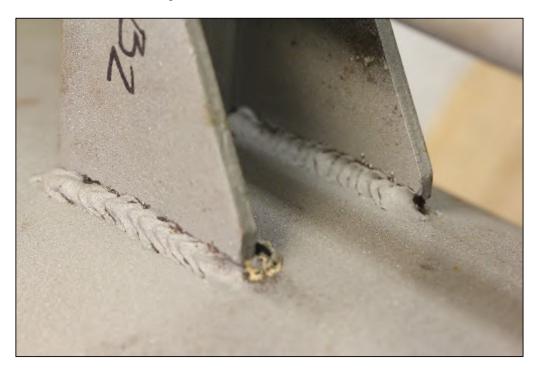


Figure 8. Image of the Lug B2 exterior weld which exhibited substantial fusion except for some undercut, and overlap.



Figure 9. Image of the Lug B4 exterior weld which exhibited substantial fusion except for undercut and arc strikes.

LG&E - Kentucky Utilities

Page 9 of 16

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 eight coupling bolts and four harness rods exhibited torque values ranging from 20 to 80 ft.-lbs. Rods 1 and 2 rotated when torque was applied to the nuts. No requirements were utilized for comparison as the coupler model was not specified.

Component	Breakaway Torque	Observations
Rod 1	80 ftIbs.	Loose rod
Rod 2	40 ftlbs.	Loose rod
Rod 3	20 ftlbs.	
Rod 4	60 ftlbs.	
Bolt 1	20 ftlbs.	
Bolt 2	25 ftlbs.	
Bolt 3	40 ftlbs.	
Bolt 4	45 ftlbs.	
Bolt 5	50 ftlbs.	
Bolt 6	35 ftlbs.	
Bolt 7	50 ftlbs.	
Bolt 12	40 ftIbs.	

TABLE 5 – FASTENER TORQUE MEASUREMENT

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the four harness rods and the eight 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.

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %③	Reduction in Area, %
Rod 1 ①	106	65.0	25	50
Rod 2 ①	108	65.0	25	48
Rod 3 ①	108	64.5	25	49
Rod 4 ①	107	65.5	25	49
Bolt 1 ① ②	95.5	85.5	5	55
Bolt 2 1 2	102	91.5	5	54
Bolt 3 ①	103	95.5	16	54
Bolt 4 ①	98.0	90.0	19	58
Bolt 5 1 4	111	101	15	56
Bolt 6 ①	101	94.5	17	54
Bolt 7 ①	96.5	90.5	19	59
Bolt 8	103	98.5	3	57

TABLE 6 – FASTENER TENSION TEST RESULTS

① Specimen Dimensions; Diameter 0.350" with gage length of 1.40"

② Specimen fractured outside of the marked gage

③ Percent elongation was measured using elongation-after-fracture measurements

(4) Specimen fractured outside of middle half of 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.

Results	Average of Five Readings
Lug A1	80
Lug A2	54
Lug A3	53
Lug A4	53
Lug B1	75
Lug B2	77
Lug B3	76
Lug B4	53

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

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 Appendices A and B. Two representative welds are shown in Figures 10 and 11 with the dye penetrant test media remaining.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 10. Image of the Lug A1 exterior weld after dye penetrant media had been used during inspection.



Figure 11. Image of the Lug B1 exterior top weld after dye penetrant media had been used during inspection.

LG&E - Kentucky Utilities

Page 13 of 16



Materials Testing Laboratory

Respectfully submitted

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

Concurrence Aria Kelly

Brian Kelly Failure Analyst

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 – VISUAL INSPECTION RECORD

								W	ww.mistrasgroup.com
. Client		2. Work Loc				4. Mistras Job No.		6. Date	7. Page
10 4D T			listras,	Louisv	ville			11/18/2022	1 of 1
IMR Test	Labs	3. Client Cor		Miller		5. Purchase Order No. 7697FA		8. Client Reference	202294
		1	brett	winici		1 705714		202	202234
. Code/Specification			10. NO	OT Proc	edure & Revis		11. Acceptar		
A 2. Material	PI-1104	13. Weld Pro			100-VT-	-004 Rev3 14. Surface Condition		API-1104 15. Supplemental	
CS		15, Weld Pft		AW		Lugs brushed o	lean	IS. Supplemental	□ No
6. Technique		1	2010	Sarr.		17. Visual Aids		18. Light Meter Se	
Direct Visual [🗆 Yes 🗹 N	0		NA
9. Access within 24" &		20. 1/32" Line/				21. Dimensional Aids		22. Light Meter Ca	
Yes Additional Informati		□ Yes		⊡ No	,	☐ Yes ☑ N	0	Fla	shlight
upport lugs on 2022 4. Unit		25. System		_		26. Component ID		27. Drawing	
NA		25. 54500	N	IA		NA			NA
est Results									
28. ID/Weld No.	29. Indicatio	on Code(s)	30. Acc.	31. Rej.	32. Commer	nts			
Al	UC, UN	I, WP		X	Poor Workm	nanship			
A2	UC, UN			x	Poor Workm				
A3	UC, UN		-	X	Poor Workm				
A4	UC, UN	I, WP		X	Poor Workm	nanship			
B1	UC,UN	I,WP		х	Poor Workm	nanship			
B2	UC,UN			X	Poor Workm				
B3	UC,UN		_	X	Poor Workm				
B4	UC,UN	I,WP	-	X	Poor Workm	nanship			
			-	-					
			-						
			-		-				
						and controlled by Internatio			
istribute only to entitle	es meeting ITAR I	equirements.	. Uiscari	u by sh	redaing. At no	o time during testing did the	se parts or ma	AS Arc Strike	ntact with mercury.
CR Crack		CL Cold				ES Excessive Weld Spa	tter	GO Gouge	
IF Incomplete Fusic PO Porosity	on		ficient F ssive Rei			WP Weld Profile SF Surface Finish		PD Physical Da CO Corrosion	image
UC Undercut		SL Slag	or Flux			IP Incomplete Penetra		OT Other	
3 Technician (Print & 9	Sign), Level & Dat	te	34. Cu	stome	Signature (if	applicable)	35. Manage	ment Review (if app	licable)

APPENDIX B – LIQUID DYE PENETRANT INSPECTION RECORD

100 Bishop La	ne Louisville, KY 402	18 P: (502) 966-5	558; F: (502) 966-5401			www.n	nistrasgroup.cor	
lient: IMI	3		Date:	Date: 11-19-2022		Page:	Page: 1 of 1	
	LO ROBARDS LN		Job Num	ber:				
LOU	JISVILLE, KY 40218		Purchase	e Order:	7697FA			
Contact: BRI	ETT MILLER		Reference	Reference Number: 202202294				
Location: MGI SHOP				Description:	STEEL GAS C	OUPLINGS		
_					LIFTING LUG	S		
Code/Specific AM	cation SE SEC.V ARTICLE 6	Pro	cedure 100-PT-001 REV	V 22	Accepta	ance Criteria API 1104		
ype and Meth Fluorescen [Type I] Sensitivity Leve	t: Water Wash	ovable [Method C]	: [D]	C Rec [Type II]	о 	□ Water Wash [Me □ Solvent Removab □ Post Emulsified [I	le [Method C]	
		1	1			1		
	Manufacturer	Туре	Batch Number	(s) Applic	ation Method	Process Time (n		
classic	MACHINELIN					Pre-clean Dry Time:	5MIN	
Cleaner:	MAGNAFLUX	SKC-S SKL-SP2	20L01K	DA	MP CLOTH	Penetrant Dwell Time:		
Penetrant: Developer:	MAGNAFLUX	SKL-SP2 SKD-S2	18LO4K 21J046		BRUSH	Emulsifier Time: Developer Time:	N/A 10 MIN	
Emulsifier:	N/A	N/A	N/A			Post Clean Method:	N/A	
			le c. Water Suspende	d 🗌 d Noo	an and the f	e. Specific Application		
🛛 Origi	nal 🗌 Repair	Material & Thick	ness C/S			Test Temperature 67 F		
Surface Condition	on 🗌 As Ground 🔲	As Cast D Pour			Acats Cada Base	ulramente		
Test Results		Quantity In		uantity Accep	Neets Code Req	Quantity Rejected:	0	
rest nesults		Quantity in	pected. a	ианицу мссер	teu.	quantity Rejected.	0	
DESCRIPTIO WELD I.D.: / WELD I.D.: / WELD I.D.: / WELD I.D.: F WELD I.D.: E WELD I.D.: E	NE (202202294) C N: (202202294) C A1(REJECTED)UN A2(REJECTED)UN A3(REJECTED)UN B1(REJECTED)UN B2(REJECTED)UN B3(REJECTED)UN B4(REJECTED)UN	OUPLINGS- LUC DERCUT, UNDE DERCUT DERCUT,LACK DERCUT,LACK DERCUT,LACK DERCUT,LACK	R FILL, POROSITY DF FUSION DF FUSION DF FUSION	ις:				
						Distribute only to entities meeting	ITAD	

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: James McGough
- 2. Date of exposure: 06/29/2022
- 3. Location: Grandview Valve Nest (Approximate Address: 800 Cannons Ln. Louisville, KY 40207)
- 4. Size of coupling (based on pipe size if not exposed enough to determine): 12"
- 5. Type of soil:

 Sandy
 Clay
 Gravel
 Topsoil
 Other (take picture and describe)
- 6. Soil Density test: □ Type A X Type B □Type C
- 7. Status: X Removed □Abandoned in place □Backfilled- left in service

 8. Discovery Method: □ Leak on Coupler
 □Other Maintenance Excavation
 X Facility Replacement

 □Facility Retirement
 □Other:

9. Pressure Class: □ Medium Pressure (MP) X High Pressure (HP) □ Transmission

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
 - b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

yes

Leak Survey completed at time of backfill (circle one)

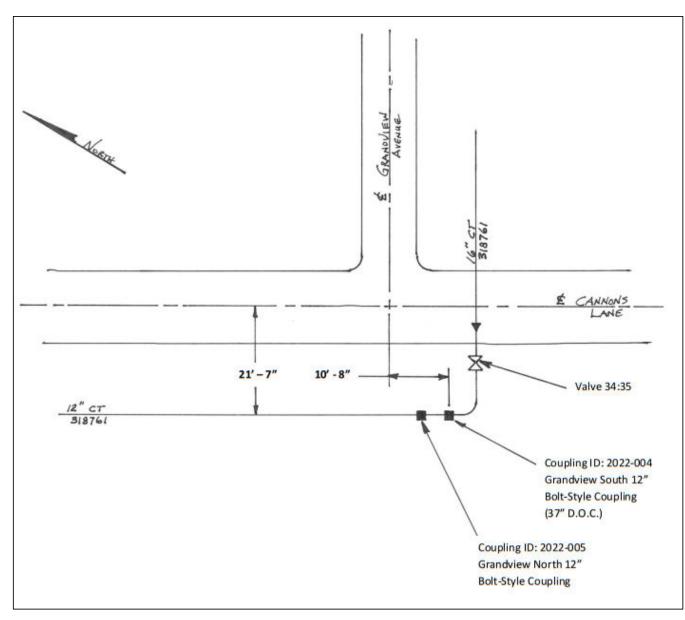
no (not applicable)

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at the second seco

Field Pictures







Sketch

Safety Briefing

Date: October 3, 2022

Employee Name	Employee ID
Sarah Nicholson	
Ethan Hinkson	

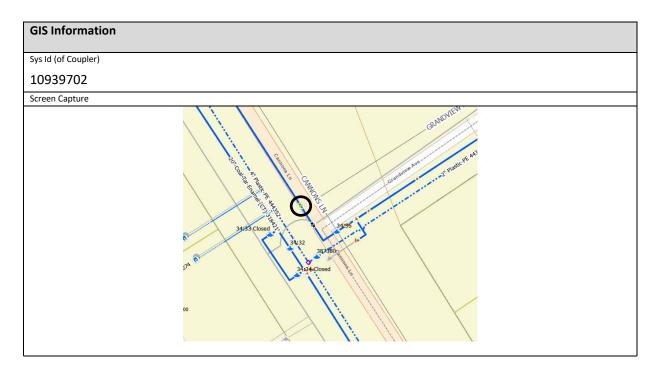
На	Hazards Identified				
Х	Sharp edges on cut pipe ends. Wear gloves when handling.				
Х	Pinch points on couplings. Wear gloves when handling.				
Х	Some couplings samples are heavy. Use a partner to assist with moving. Use proper lifting techniques.				
	Wear hard toes shoes.				
Х	Debris may on samples.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

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

Part B- Coupling Information

General Inform	ation		Tracking #: 2022-005
PO Number	Expense Org	Project	Task
1121185	004610	158276	COUPLER
Address/Location			
Grandview Nort	h @ 800 Cannons Ln. Louisvill	e, KY 40207	
Size	Material	Coating	МАОР
12"	STL	СТ	200 PSIG
Main/Service Number	Soil Type (from Part A)	Manufacturer	Model
318761	Clay (Type B)	Dresser	Style 39
Pipe Connection:	Steel to Steel	Steel to Plastic	Plastic to Plastic

Historical Information	
Installation Date	Document Source
11/23/1987	Quest
Installation Company	Document Source
Southern Pipeline	Quest
Foreman	Document Source
Campbell	Quest
Welder	Document Source
Paul Howard & Don Gousha	Quest



Pictures (Label the following parts before taking pictures.)



Figure 1 – Coupler Top View



Figure 2 – Pipe Side A (Top)



Figure 3 – Pipe Side B (Top)



Figure 4 – Coupler Bottom View



Figure 5 – Lug A1



Figure 6 – Lug A2



Figure 7 – Lug A3

Figure 8 – Lug A4

Exhibit B Page 24 of 29



Figure 9 – Lug B1



Figure 10 – Lug B2



Figure 11 – Lug B3



Figure 12 – Lug B4

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson & Sarah Nicholson

Date: 10/3/2022

Table 1- Component Quantities

Number of Bolts on Coupler Body	8
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?	No	No	No	No	Yes	No	No
Localized External Corrosion?	No	No	No	No	No	No	No
Pits Present?	No	No	No	No	Yes	No	No
Internal Corrosion?	No	No					

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

Table 3- Coupler Body

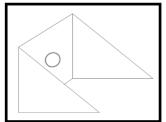
Bolt	Washer Present	Nut present?
1	No	Yes
2	No	Yes
3	No	Yes
4	No	Yes
5	No	Yes
6	No	Yes
7	No	Yes
8	No	Yes

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 ¾"	3/4"	Yes	Yes	Square	Standard
2	30 ¾"	3/4"	Yes	Yes	Square	Standard
3	30 ¾"	3/4"	Yes	Yes	Square	Standard
4	30 ¾"	3/4"	Yes	Yes	Square	Standard

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.)



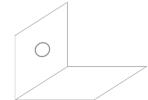




Table 5- Lugs (Measurements)

	Lug		Circumfe	rence (in)
Pipe Side	Lug Number	Thickness (in.)	Distance to next lug, clockwise	Distance to next lug, counter- clockwise
А	1	0.23"	8″	6"
А	2	0.23"	7"	8″
А	3	0.23″	7"	7″
А	4	0.24"	6"	7″
В	1	0.23″	6"	8 ¼"
В	2	0.23″	8 ¼"	6"
В	3	0.22″	6 ¼"	7 ¼"
В	4	0.23"	7"	6"

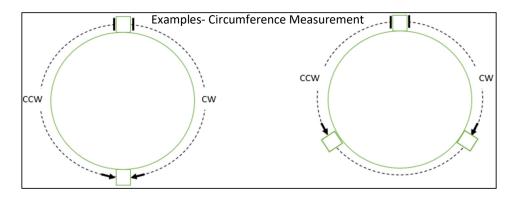


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	Yes	No	No
A2	B2	Yes	No	No
A3	B3	Yes	No	No
A4	B4	Yes	No	No

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
А	1	No	Yes	Yes
А	2	No	Yes	Yes
А	3	No	Yes	Yes
А	4	No	Yes	Yes
В	1	No	Yes	Yes
В	2	No	Yes	Yes
В	3	No	Yes	Yes
В	4	No	Yes	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
A	3	Yes	Yes
A	4	No	No
В	1	Yes	Yes
В	2	Yes	Yes
В	3	Yes	Yes
В	4	Yes	Yes

Exhibit B Page 28 of 29

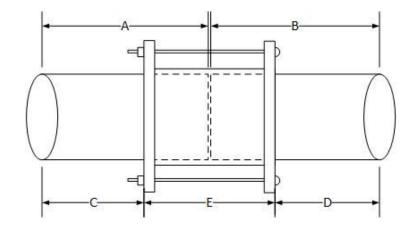


Table 8- Stab Depth

	Α	В	С	D	Stab Depth (A-C) or (B-D)
Pipe Side A	18 ½"		14 ¾"		3 ¾"
Pipe Side B		19"		16 ½"	2 1⁄2"
	Sum of stab depths (should be closely equal to measurement E)				6 ¼"
	Coupler Length (E)				8 ½"
		2 ¼"			

Additional Comments - General Observations, Pit Depths, etc.



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

November 29, 2022

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

Attention: Sarah Nicholson

Exhibit C

Report No. 202202295

Metallurgical Evaluation of a 12" Coupling and Associated Hardware

Location: Bardstown to Cannons Lane Designation: 2022-006

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 12" 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 Bardstown to Cannons Lane, approximately at 554 Cannons Lane. It had been originally installed on September 9, 1987. 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. It was also noted that the coupling was slightly tilted from the pipe axis, as shown in Figure 1.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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 approximate angle measurement. The angle measurements are depicted 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.

Compound	Angle	Deviation from 90°	Image
Rod A1 / Rod A2	80	- 10	Figure 3
Rod A2 / Rod A3	108	18	Figure 3
Rod A3 / Rod A4	106	16	Figure 3
Rod A4 / Rod A1	66	- 24	Figure 3
Rod B1 / Rod B2	72	- 18	Figure 4
Rod B2 / Rod B3	120	30	Figure 4
Rod B3 / Rod B4	109	19	Figure 4
Rod B4 / Rod B1	59	- 31	Figure 4

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling
Pipe A	22.5"	0.625"
Pipe B	21.375"	(Original sample length – 44.5")

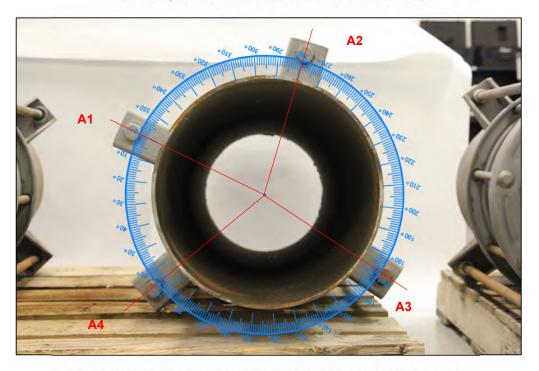


Figure 3. End facing image of the sample at End A with a superimposed protractor.

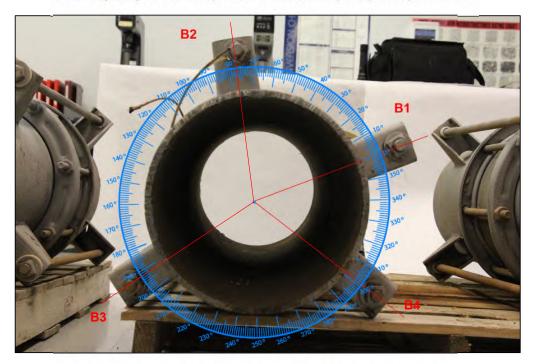


Figure 4. End facing image of the sample at End A with a superimposed protractor.

Page 4 of 17

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. Locations that had not been welded were identified as None. 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. It was noted that several areas contained fillet weld evidence outside of the primary welds. It was not known if these welds were intentionally fractured in order to re-position the lugs.

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
	Exterior	Тор	None
L	Exterior	Bottom	Substantial
Lug A1	Interior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A2	Interior	Тор	Obscured
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A3	Interior	Тор	Substantial
	Interior	Bottom	Minimal
	Exterior	Тор	Substantial
		Bottom	Substantial
Lug A4	Interior	Тор	Substantial
		Bottom	Substantial
	Exterior	Тор	Substantial
Lug P1		Bottom	Substantial
Lug B1	Interior	Тор	None
	Interior	Bottom	Minimal
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug B2	Interior	Тор	Obscured
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B3	Exterior	Bottom	Substantial
Luy Do	Interior	Тор	Obscured
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B4	EXIGNO	Bottom	Substantial
LUY D4	Interior	Тор	Minimal
	Interior	Bottom	Minimal

LG&E - Kentucky Utilities

TABLE 4 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Straight – slight corrosion
Rod 2	Straight – slight corrosion
Rod 3	Straight – slight corrosion
Rod 4	Straight – slight corrosion
Bolt 1	Straight – slight corrosion
Bolt 2	Straight – slight corrosion
Bolt 3	Straight – slight corrosion
Bolt 4	Straight – slight corrosion
Bolt 5	Straight – slight corrosion
Bolt 6	Straight – slight corrosion
Bolt 7	Straight – slight corrosion
Bolt 8	Straight – slight corrosion



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

LG&E - Kentucky Utilities

Page 7 of 17

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 6. Image of the Lug A1 exterior top weld which was not welded.



Figure 7. Image of the Lug A2 exterior top weld which exhibited substantial fusion along with undercutting.



Figure 8. Image of the Lug B2 welds which exhibited substantial fusion along with undercut and overlap.



Figure 9. Image of the Lug B3 weld showing the remainder of a weld adjacent to the primary weld.

Page 9 of 17



Figure 10. Image of the Lug B3 welds which exhibited substantial fusion except for some undercut, overlap, arc strikes, and spatter. The interior weld to the left was obscured.

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 eight coupling bolts and four harness rods exhibited torque values ranging from 5 to 100 ft.-lbs. Rod 2 rotated when torque was applied to the nut. No requirements were utilized for comparison as the coupler model was not specified.

Component	Breakaway Torque	Observations
Rod 1	20 ftlbs.	
Rod 2	5 ftIbs.	Rod rotated freely - loose nut
Rod 3	35 ftlbs.	
Rod 4	90 ftIbs.	
Bolt 1	80 ftlbs.	
Bolt 2	100 ftIbs.	Two nuts were present
Bolt 3	80 ftlbs.	
Bolt 4	70 ftlbs.	
Bolt 5	70 ftlbs.	
Bolt 6	85 ftlbs.	
Bolt 7	60 ftlbs.	
Bolt 8	35 ftlbs.	

TABLE 5 – FASTENER TORQUE MEASUREMENT

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the four harness rods and the eight 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 1 ①	107	65.5	26	51
Rod 2 ①	115	63.5	23	44
Rod 3 1 4	122	69.5	20	49
Rod 4 ①	112	61.5	24	49
Bolt 1 ①	78.0	51.0	38	77
Bolt 2 ①	80.0	53.5	37	75
Bolt 3 ①	80.0	58.0	38	76
Bolt 4 ①	79.0	56.0	39	77
Bolt 5 ①	82.5	56.5	37	74
Bolt 6 ①	79.5	56.5	39	77
Bolt 7 ①	78.5	55.0	38	77
Bolt 8 ① ②	79.5	58.0	37	77

① Specimen Dimensions; Diameter 0.350" with gage length of 1.40"

② Specimen fractured outside of the marked gage

③ Percent elongation was measured using elongation-after-fracture measurements

④ Specimen fractured outside of middle half of marked gage

SECTION 5- ROCKWELL HARDNESS TESTING, 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.

Results	Average of Four Measurements
Lug A1	54
Lug A2	79
Lug A3	77
Lug A4	53
Lug B1	70
Lug B2	49
Lug B3	61
Lug B4	62

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

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 A2 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.

LG&E - Kentucky Utilities

Page 14 of 17



Materials Testing Laboratory

Respectfully submitted

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

Concurrence

Brian Kelly Failure Analyst

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 – VISUAL INSPECTION RECORD

1. Clent 2. Work Location 4. Matrix Job No. 6. Date 7. Page IMR Test Labs 3. Clent Constat 5. Purchase Order No. 6. Date 11/3/2022 1 of 1 0. Code/Specification API-1104 10. NDT Proceedure & Revision No. 11. Acceptance Citeria 202202255 0. Code/Specification 13. Wold Process 12. Surface Condition 15. Supplemental Lighting 0. Code/Specification 13. Wold Process 12. Surface Condition 13. Light Meter Serial No. 0. Dreces Visual Remote Visual Translucent Visual 12. Supplemental Lighting 12. Light Meter Serial No. 0. Access within 24 ⁶ & B0 ⁷ 0. Vigo Use Dimensional Alds 12. Light Meter Serial No. No 13. Additional Information NA 26. Component ID NA NA 4. Unit NA 25. System NA 26. Component ID NA A1 UC, UN, WP X Poor Workmanship NA NA 81 UC, UN, WP X Poor Workmanship NA NA 81 UC, UN, WP X Poor Workmanship NA NA 81										www.mistrasgroup.co
IMR Test Labs 3. Client Contact. Brett Miller S. Purchase Order No. 7697FA B. Client Reference No. 2020/295 2. Code/Specification 10. ND T Procedure & Revision No. 11. Acceptance Criteria AP1-1104 11. Acceptance Criteria AP1-1104 2. Material 13. Weld Process 14. Surface Condition 15. Surface Condition CS SMAW 14. Surface Condition 15. Surface Criteria AP1-1104 Direct Visual Remote Visual Translucent Visual Pres No Access with 2-4 & 30° 20. % trunsfammed sequence mousteent Q. Ves No NA 3. Additional Information wupport lugs on 202202295 A&B 26. Component ID 27. Drawing 4. Unit NA 25. System 26. Component ID 27. Drawing A.1 UC, UN, WP X Poor Workmanship A.2 UC, UN, WP X Poor Workmanship A.3 UC, UN, WP X Poor Workmanship A.3 UC, UN, WP X Poor Workmanship B.1 UC, UN, WP X Poor Workmanship B.3 UC, UN, WP X Poor Workmanship B.3 UC, UN, WP X Poor Workmanship B.3 UC, UN, WP X Poor Workmanship B.4 UC, UN, WP X Poo	. Client		2. Work Loo	ation			4. Mistras Job No.		6. Date	7. Page
Brett Miller 7697FA 20220295 0. Code/Specification API-1104 100-VT-008 Rev3 API-1104 1.2. Material 13. Weld Process 14. Surface Condition 15. Surface Condition 6. Technique 13. Weld Process 14. Surface Condition 15. Surface Condition 15. Surface Condition 9. Access within 24* 8 30* 20. fs* Une/Simulande imperfections Used 12. Visual Alds 18. Light Meter Serial No. 9. Access within 24* 8 30* 20. fs* Une/Simulande imperfections Used 12. Orimensional Alds 22. Light Meter Cal. Due 9. Access within 24* 8 30* 25. System NA 26. Component ID Yes NA 9. Unit NA 25. System NA 26. Component ID 27. Drawing NA 40. Unit NA 25. System NA 26. Component ID NA NA 41. U/C, UN, WP X Poor Workmanship 27. Drawing NA NA 42 U/C, UN, WP X Poor Workmanship 27. Orawing NA 43 U/C, UN, WP X Poor Workmanship 27. O	IMR Test Labs 3. Client				Louis	ville		_	11/18/20	22 1 of 1
A Code/Specification 10. NDT Procedure & Revision No. 11. Acceptance Criteria API-1104 100-VT-008 Rev3 API-1104 2. Material 13. Weld Process 24. Surface Condition 15. Supplemental Lighting CS SMAW 12. Surface Condition 15. Supplemental Lighting Direct Visual Remote Visual Translucent Visual 17. Visual Ads 18. Uight Meter Senal No. Access with 2-4 S a0* 2.0, "torts/manue/memerterions used 12. Dimensional Aids 22. Light Meter Cal. Due Fer Results 7. Yasual Ads 12. Dimensional Aids 22. Light Meter Cal. Due Ander Onder No. 23. distingtion code(s) 30. 31. Acceptance Criteria 7. Traving A.1 UC, UN, WP X Poor Workmanship X NA 7. Drawing A.3 UC, UN, WP X Poor Workmanship 7. Drawing 7. Drawing A.4 UC, UN, WP X Poor Workmanship 7. Poor Workmanship A.4 UC, UN, WP X Poor Workmanship 7. Poor Workmanship B3 UC, UN, WP X Poor Workmanship 7. Poor Workmanship B4			3. Client Co							
API-1104 100-VT-004 Rev3 API-1104 2. Material 13. Weld Process 14. Surface Condition 15. Supplemental Lighting 6. Technique 17. Visual Ads 18. Light Meter Serial No. No No 0. Direct Visual Remote Visual Translucent Visual 17. Visual Ads 18. Light Meter Serial No. NA 0. Access within 24" & 30" 10. Vys No 12. Visual Ads 12. Uight Meter Cal. Due Flashlight 3. Additional Information 10. Vys No 19. Vys No Flashlight 3. Additional Information NA NA NA NA 14. Unit 25. System No 26. Component ID 27. Drawing A4. Unit 25. System NA 26. Component ID 27. Drawing A4. UIL U.C. UN, WP X Poor Workmanship A A3 U.C. UN, WP X Poor Workmanship A4 U.C. UN, WP X Poor Workmanship B1 U.C. UN, WP X Poor Workmanship B2 U.C. UN, WP X Poor Workmanship B2 U.C. UN, WP X Poor Workmanship B3 U.C. UN, WP X Poor Workmanship B3 U.C. UN,				Brett	Miller		7697FA			202202295
2. Material 13. Weld Process 14. Surface Condition 15. Supplemental Lighting CS SNAW Lugs brushed clean Pers No Direct Visual Remote Visual Translucent Visual Pres No NA 9. Access within 24* 8.30* 20. ½°, "unp/Simulated imperfections Used 17. Visual Aids 22. Light Meter Cal. Due 9. Access within 24* 8.30* 20. ½°, "unp/Simulated imperfections Used 21. Otherstonial Aids 22. Light Meter Cal. Due 9. Access within 24* 8.30* 20. ½°, "unp/Simulated imperfections Used 26. Component ID 27. Drawing 9. Access within 24* 8.30* 29. Indication Code(s) Acc 31. 32. Comments 44. Unit 25. System 26. Component ID 27. Drawing NA A1 UC, UN, WP X Poor Workmanship A2 UC, UN, WP X Poor Workmanship A3 UC, UN, WP X Poor Workmanship A4 UC, UN, WP X Poor Workmanship B3 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B4 U	. Code/Specification			10. NI	OT Proc	edure & Revi	sion No.	11. Acceptar	nce Criteria	
CS SMAW Lugs brushed clean Image of the stand of		PI-1104			_	100-VT-				
6. Technique 17. Visual Adds 18. Ught Meter Serial No. Direct Visual 20. ½: Um/smutated imperfections Used 19. Ves No NA 20. Access within 24. 8. 30° 20. ½: Um/smutated imperfections Used 21. Uminestional Adds 22. Ught Meter Cal. Due 23. Additional Information NA 25. System 26. Component ID 27. Drawing 3. Additional Information NA 25. System 26. Component ID 7. Visual Adds 3. Additional Information NA 25. System 26. Component ID 7. Drawing 3. Additional Information NA NA NA NA rest Results 28. ID/Weld No. 29. Indication Code(s) 30. 31. 32. Comments A1 U.C., UN, WP X Poor Workmanship 20. 20. 20. A4 U.C., UN, WP X Poor Workmanship 20. 20. 20. B3 U.C., UN, WP X Poor Workmanship 20. 20. 20. B3 U.C., UN, WP X Poor Workmanship 20. 20. 20. B3 U.C., UN, WP X			13. Weld Pr							
Direct Visual Remote Visual Translucent Visual Yes No NA 9. Access within 24" & 30" 20. ½" time/s/mulated imperfections Used 21. Dimensional Aids 22. Light Meter Cal. Due 3. Additional Information 3. DC, UN, WP 4. U. C, UN, WP 4. U. C, UN, WP 5. System 5. Source Control 5. Source Control 5. Source Control 5. Source Control 6. Additional Information 7. Additional Information 7. NA 7. NA 7. NA 7. NA 7. Source Control 7. NA 7. Source Control 8. Output 8. Output <td></td> <td>-</td> <td></td> <td>SIV</td> <td>IAW</td> <td></td> <td></td> <td>clean</td> <td></td> <td></td>		-		SIV	IAW			clean		
19. Access within 24" & 30" 20. ½« LuncySimulated timperfections Used 21. Dimensional Aids 22. Light Meter Cal. Due Flashlight 23. Additional information Support lugs on 202202295 A&B 4. Unit A 25. System NA NA 26. Component ID 27. Drawing NA		Remote Vis	iual 🗆 T	ransluc	ent Vi	sual	and a second	lo	10. Light Wete	
3. Additional Information NA 26. Component ID 27. Drawing NA NA NA NA NA 14. Unit 25. System NA NA NA 14. Unit NA NA NA NA NA 15. ID/Weld No. 29. Indication Code(s) 30. Acc. 31. Acc. 32. Comments NA NA 14. UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID NA 14. UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID Image: Component ID 14. UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID 15. UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID 18.1 UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID 18.3 UC, UN, WP X Poor Workmanship Image: Component ID Image: Component ID Image: Component ID 18.4 UC, UN, WP X Poor Workmanship Image: Component ID Image: ComponentID Image: Component ID 19	9. Access within 24" &	30°	20. 1/32" Line/	Simulate	d Imperf	ections Used	21. Dimensional Aids		22. Light Mete	
Audinit NA 25. System NA 26. Component ID NA			□ Yes		☑ No	D	🗆 Yes 🖾 M	No		Flashlight
NA NA NA rest Results 29. Indication Code(s) 30. Acc. 31. Acc. 32. Comments A1 UC, UN, WP X Poor Workmanship		02295 A&B								
Test Results 29. Indication Code(s) 30. Acc. 31. Ref. 32. Comments A1 UC, UN, WP X Poor Workmanship A2 UC, UN, WP X Poor Workmanship A3 UC, UN, WP X Poor Workmanship A4 UC, UN, WP X Poor Workmanship A4 UC, UN, WP X Poor Workmanship B1 UC, UN, WP X Poor Workmanship B2 UC, UN, WP X Poor Workmanship B3 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B5 L L L B6 UC, UN, WP X Poor Workmanship			25. System		ΔL				27. Drawing	NA
ZB. ID/Weid No. Z9. Indication Code(s) Acc. Rej. 32. Comments A1 UC, UN, WP X Poor Workmanship			-			-	10			NA .
A2 UC, UN, WP x Poor Workmanship A3 UC, UN, WP X Poor Workmanship A4 UC, UN, WP X Poor Workmanship B1 UC, UN, WP X Poor Workmanship B2 UC, UN, WP X Poor Workmanship B3 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B5 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B5 UC, UN, WP X Poor Workmanship B5 UC, UN, WP X Poor Workmanship <td< td=""><td>28. ID/Weld No.</td><td>29. Indicati</td><td colspan="6">29. Indication Code(s) 32. Comments</td></td<>	28. ID/Weld No.	29. Indicati	29. Indication Code(s) 32. Comments							
A3 UC, UN, WP X Poor Workmanship A4 UC, UN, WP X Poor Workmanship B1 UC, UN, WP X Poor Workmanship B2 UC, UN, WP X Poor Workmanship B3 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B5 Excessive Line State Stat	A1	UC, UM	I, WP		X	Poor Workm	kmanship			
A4 UC, UN, WP X Poor Workmanship B1 UC, UN, WP X Poor Workmanship B2 UC, UN, WP X Poor Workmanship B3 UC, UN, WP X Poor Workmanship B4 UC, UN, WP X Poor Workmanship B5 Excession Excession B6 LIN, WP X Poor Workmanship B6 LIN, WP X Poor Workmanship B7 LIN, WP X Poor Workmanship B8 UC, UN, WP X Poor Workmanship LIN, WP X	A2	UC, UN	I, WP		x	Poor Workmanship				
B1 UC,UN,WP X Poor Workmanship B2 UC,UN,WP X Poor Workmanship B3 UC,UN,WP X Poor Workmanship B4 UC,UN,WP	A3	UC, UN	I, WP		Х	Poor Workmanship				
B2 UC,UN,WP X Poor Workmanship B3 UC,UN,WP X Poor Workmanship B4 UC,UN,WP X Z B4	Α4	UC, UN	I, WP	/P X Poor Workmanship						
B3 UC,UN,WP X Poor Workmanship B4 D D D B4 D D B4 D D <td>B1</td> <td>UC,UM</td> <td>I,WP</td> <td></td> <td>Х</td> <td>Poor Workm</td> <td>anship</td> <td></td> <td></td> <td></td>	B1	UC,UM	I,WP		Х	Poor Workm	anship			
B4 UC,UN,WP X Poor Workmanship B4 I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I I	B2	UC,UM	I,WP		X	Poor Workm	anship			
A Arc Strike CR Crack CL Cold Lap F Incomplete Fusion UN Insufficient Fill or Undersize F Incomplete Fusion UN Insufficient Fill or Undersize VP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion					-	Poor Workmanship				
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion	B4	UC,UN	I,WP	-	X	Poor Workm	anship			
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				-	-					
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				-						
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				-	-					
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				-	-					
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				-	-					
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion										
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion										
Idstribute only to entities meeting ITAR requirements. Discard by shredding. At no time during testing did these parts or material come into contact with mercury. Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO COrrosion				1.5						
Adication Codes AS Arc Strike CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO Corrosion	he content of this docu	ment may be de	fense article/	service i	elated	as described	and controlled by Internation	onal Traffic in A	Arms Regulation	s (ITAR)(22 CFR 120-130)
CR Crack CL Cold Lap ES Excessive Weld Spatter GO Gouge IF Incomplete Fusion UN Insufficient Fill or Undersize WP Weld Profile PD Physical Damage PO Porosity ER Excessive Reinforcement SF Surface Finish CO Corrosion		s meeting ITAR I	equirements	Discard	d by shi	redding. At no	time during testing did the	ese parts or ma		
	CR Crack IF Incomplete Fusio	n	UN Insuf ER Exces	ficient Fi sive Rei			WP Weld Profile SF Surface Finish		GO Gouge PD Physica	l Damage
3. Technician (Print & Sign), Level & Date 34. Customer Signature (if applicable) 35. Management Review (if applicable)		ign), Level & Dat			stome	Signature (if				applicable)

APPENDIX A – LIQUID DYE PENETRANT INSPECTION RECORD

100 Bishop Lar	ne Louisville, KY 402	18 P: (502)	966-5558; F:	(502) 966-5401			www.n	nistrasgroup.co
lient: IMF	2			Date:		11-19-2022	Page:	1 of 1
ddress: 451	0 ROBARDS LN			Job Number	Job Number:			
LOUISVILLE,KY 40218				Purchase Or	der:	7697FA		
Contact: BRETT MILLER				Reference N	umber:	202202295		
ocation: MG	I SHOP			Part No/Des	cription:	STEEL GAS C	OUPLINGS	
						LIFTING LUG	S	
Code/Specific AM!	ation SE SEC.V ARTICLE 6		Procedure	2 100-PT-001 REV 22		Accepta	ance Criteria API 1104	
ype and Metho Fluorescent [Type I] Sensitivity Leve	t: 🗌 Water Wash Solvent Rem Post Emulsifi	ovable [Metl ed: 🗌 Hydr	ophilic [D]] Lipophilic [B]	Red [Type II		Uwater Wash [Me Solvent Removab	le [Method C]
				1			1	
	Manufacturer		Туре	Batch Number(s)	Applic	ation Method	Process Time (n	ninutes)
							Pre-clean Dry Time:	5MIN
Cleaner:	MAGNAFLUX		SKC-S	20L01K	-	MP CLOTH	Penetrant Dwell Time:	
Penetrant:	MAGNAFLUX	-	KL-SP2	18LO4K		BRUSH	Emulsifier Time:	N/A
Developer: Emulsifier:	MAGNAFLUX N/A		KD-S2 N/A	21J046 N/A	-	SPRAY	Developer Time: Post Clean Method:	10 MIN N/A
	oval Method & Dry T DAMP CLOTH @ 51		Black Light	(Model and S/N) N/A		White Ligi	L.E.D. FLASHLIGH	Т
	nal 🗌 Repair	Material &	Thickness	C/S			Test Temperature 67 F	
urface Conditio	n 🗌 As Ground 🔲	As Cast	Rough Mach	ined 🔲 Final Machine		leets Code Reco	lirements	
Test Results			tity Inspected		ty Accept		Quantity Rejected:	8
DESCRIPTIO WELD I.D.: A WELD I.D.: A WELD I.D.: A WELD I.D.: A WELD I.D.: B WELD I.D.: B WELD I.D.: B	VETRANT INSPECT N: (202202295) C .1(REJECTED)UN .2(REJECTED)UN .3(REJECTED)UN .4(REJECTED)UN 2(REJECTED)UN 3(REJECTED)UN 4(REJECTED)UN	DUPLINGS DERCUT, F DERCUT, L DERCUT,L DERCUT,P DERCUT,U DERCUT,L	- LUG WELI POROSITY, J LACK OF FU ACK OF FU ACK OF FU OROSITY INDERFILL, J ACK OF FU	MISSSING WELD SION, POROSITY SION,POROSITY LACK OF FUSION SION, POROSITY				
	ument may be defense article/ At no time during testing did the	ervice related as d se parts or materia	lescribed and contro al come into contact	olled by International Traffic in Arms with mercury.	Regulations (I	TAR)(22 CFR 120-130).	Distribute only to entities meeting	ITAR requirements.
The content of this doo Discard by shredding, A							LD // LL.	
Discard by shredding. Technician Nan	ne. Level & Date		Customer	(if applicable):		Reviewe	d By (if applicable):	

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: James McGough
- 2. Date of exposure: 07/08/2022
- 3. Location: Bardstown to Cannons Line (Approximate Address: 554 Cannons Ln. Louisville, KY 40207)
- 4. Size of coupling (based on pipe size if not exposed enough to determine): 12"
- 5. Type of soil:

 Sandy
 Clay
 Gravel
 Topsoil
 Other (take picture and describe)
- 7. Status: X Removed □Abandoned in place □Backfilled- left in service
- 8. Discovery Method: □ Leak on Coupler
 □Other Maintenance Excavation
 X Facility Replacement

 □Facility Retirement
 □Other:
- 9. Pressure Class: □ Medium Pressure (MP) X High Pressure (HP) □ Transmission

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
 - b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

yes

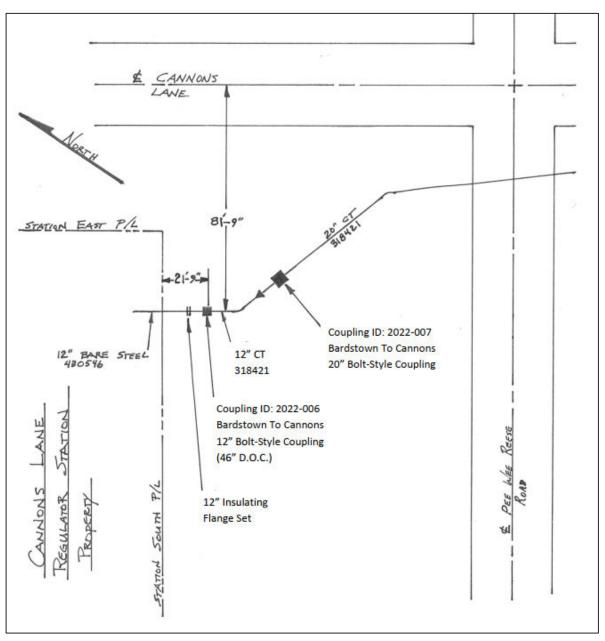
Leak Survey completed at time of backfill (circle one)

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 the second seco

Field Pictures





Safety Briefing

Date: October 3, 2022

Employee Name	Employee ID
Sarah Nicholson	
Ethan Hinkson	

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

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

Part B- Coupling Information

General Inform	ation		Tracking #: 2022-006			
PO Number	PO Number Expense Org		Task			
1121185	1121185 004610		COUPLER			
Address/Location	Address/Location					
Bardstown to Ca						
Size	Material	Coating	МАОР			
12"	STL	СТ	200 PSIG			
Main/Service Number	Soil Type (from Part A)	Manufacturer	Model			
318421	Clay (Type B)	Dresser	Style 39			
Pipe Connection: Steel to Steel		Steel to Plastic	Plastic to Plastic			

Historical Information	
Installation Date	Document Source
09/09/1987	Quest
Installation Company	Document Source
Southern Pipeline	Quest
Foreman	Document Source
Campbell	Quest
Welder	Document Source
Paul Howard & Don Gousha	Quest

GIS Information	
Sys Id (of Coupler)	
11594705	
Screen Capture	
	38407 27 *** ********************************

Pictures (Label the following parts before taking pictures.)



Figure 1 – Coupler Top View



Figure 2 – Pipe Side A



Figure 3 – Pipe Side B



Figure 4 – Coupler Bottom View



Figure 5 – Lug A1

Figure 6 – Lug A2



Figure 7 – Lug A3



Figure 8 – Lug A4

Exhibit C Page 25 of 30



Figure 9 – Lug B1



Figure 10 – Lug B2

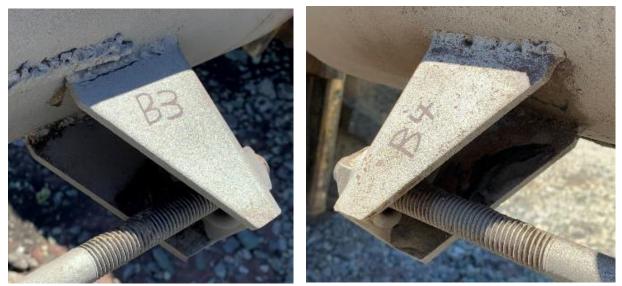


Figure 11 – Lug B3

Figure 12 – Lug B4

Exhibit C Page 26 of 30

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson & Sarah Nicholson

Date: 10/3/2022

Table 1- Component Quantities

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

Table 2- Corrosion

	Pipe A	Pipe B	Coupler Body	Bolts	Rods	Lugs	Nuts
General External	Yes	Yes	No	No	No	No	No
Corrosion?	105			110			No
Localized External	No	No	No	No	Ne	No	No
Corrosion?	No	No	No	No	No	No	No
Pits Present?	No	No	No	No	No	No	No
Internal Corrosion?	No	No					

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

Table 3- Coupler Body

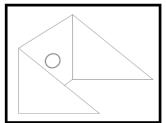
Bolt	Washer Present	Nut present?	
1	No	Yes	
2	No	Yes	
3	No	Yes	
4	No	Yes	
5	No	Yes	
6	No	Yes	
7	No	Yes	
8	No	Yes	

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 ½"	3⁄4″	Yes	Yes	Square	Standard
2	30 ½"	3/4"	Yes	Yes	Square	Standard
3	30 ¾"	3/4"	Yes	Yes	Square	Standard
4	30 ¾"	3/4"	Yes	Yes	Square	Standard

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.)



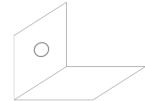




Table 5- Lugs (Measurements)

	Lug		Circumference (in)		
Pipe Side	Lug Number	Thickness (in.)	Distance to next lug, clockwise	Distance to next lug, counter- clockwise	
А	1	0.23"	6 ½"	4"	
А	2	0.23"	9″	6 ½"	
А	3	0.23″	8 ½"	9″	
А	4	0.23″	4"	8 ½"	
В	1	0.23″	3 ½"	8 ¾″	
В	2	0.23″	5 ¾″	3 ½"	
В	3	0.22″	9 ¾″	5 ¾″	
В	4	0.23″	8 ¾″	3 ½"	

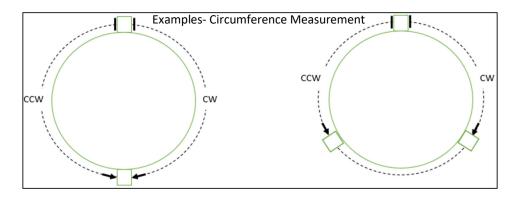


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	Yes	No	No
A2	B2	Yes	No	No
A3	B3	Yes	No	No
A4	B4	Yes	No	No

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
А	1	No	No (1 ext. weld)	Yes
A	2	No	Yes	Yes
A	3	No	Yes	Yes
А	4	No	Yes	Yes
В	1	No	Yes	Yes
В	2	No	Yes	Yes
В	3	No	Yes	Yes
В	4	No	Yes 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	N/A (Obscured)
A	3	Yes	Yes
A	4	No (1 int. weld)	No
В	1	No (1 int. weld)	Yes
В	2	N/A (Obscured)	N/A (Obscured)
В	3	N/A (Obscured)	N/A (Obscured)
В	4	Yes	Yes

Exhibit C Page 29 of 30

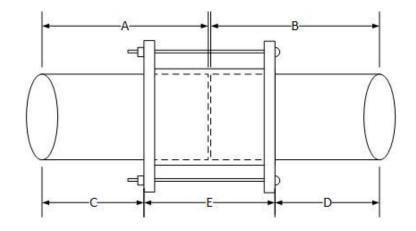


Table 8- Stab Depth

	А	В	С	D	Stab Depth (A-C) or (B-D)
Pipe Side A	22 ½"		18 ½"		4"
Pipe Side B		21 ½"		17"	4 ½"
	Sum of stab depths (should be closely equal to measurement E)				8 ½"
	Coupler Length (E) 8 ½"				
	Difference			0	

Additional Comments - General Observations, Pit Depths, etc.

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

November 29, 2022

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

Attention: Sarah Nicholson

Exhibit D

Report No. 202202296

Metallurgical Evaluation of a 20" Coupling and Associated Hardware

Location: Bardstown to Cannons Lane Designation: 2022-007

DESCRIPTION AND PURPOSE

A natural gas pipe section including a coupling was submitted for metallurgical evaluation. The section was a 20" pipe with a Dresser Style Insulating Coupling. Six 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 Bardstown to Cannons Lane, approximately at 554 Cannons Lane. It was installed on September 9, 1987. 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. Six lugs of the joint harnesses had been fillet welded to both pipe segments. Six 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, A4, A5, and A6 were welded to Pipe A, and Lugs B1, B2, B3, B4, B5 and B6 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.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218

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



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

Page 2 of 19

SECTION 1- DIMENSIONAL MEASUREMENT

The six 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.

Compound	Angle	Deviation from 60°	Image
Rod A1 / Rod A2	60	0	Figure 3
Rod A2 / Rod A3	61	1	Figure 3
Rod A3 / Rod A4	57	- 3	Figure 3
Rod A4 / Rod A5	69	9	Figure 3
Rod A5 / Rod A6	56	- 4	Figure 3
Rod A6 / Rod A1	57	- 3	Figure 3
Rod B1 / Rod B2	61	1	Figure 4
Rod B2 / Rod B3	60	0	Figure 4
Rod B3 / Rod B4	55	- 5	Figure 4
Rod B4 / Rod B5	65	5	Figure 4
Rod B5 / Rod B6	62	2	Figure 4
Rod B6 / Rod B1	57	- 3	Figure 4

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

TABLE 2 – PIPE COUPLING DIMENSIONAL MEASUREMENTS

Component	Depth of Pipe into Coupling	Gap Between Pipes in Coupling	
Pipe A	15.75"	2.05"	
Pipe B	16.825"	(Original sample length – 34.625")	

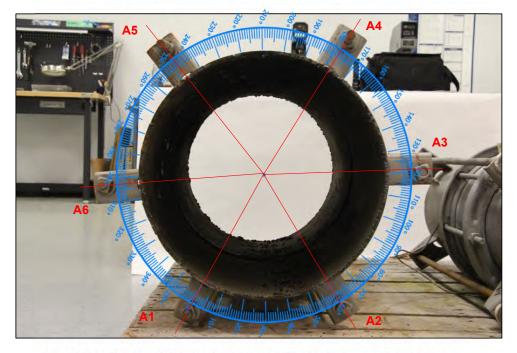


Figure 3. End facing image of the sample at End A with a superimposed protractor.

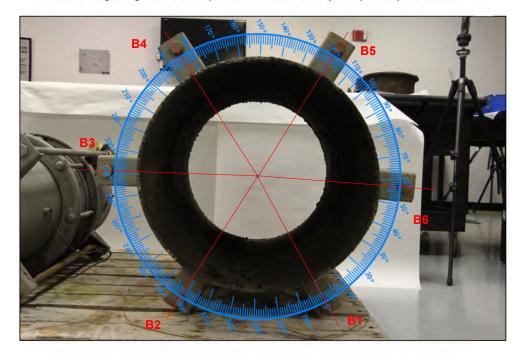


Figure 4. End facing image of the sample at End B with a superimposed protractor.

Page 4 of 19

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
		Тор	Substantial
	Exterior	Bottom	Substantial
Lug A1	lu ta di an	Тор	Substantial
	Interior	Bottom	Obscured
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A2	latarian	Тор	Substantial
	Interior	Bottom	Substantial
	Eutovian	Тор	Substantial
1	Exterior	Bottom	Substantial
Lug A3	Interior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
		Bottom	Substantial
Lug A4	Interior	Тор	Substantial
		Bottom	Substantial
	F actorian	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A5	Interior	Тор	Minimal
	Interior	Bottom	Minimal
	Exterior	Тор	Substantial
	Exterior	Bottom	Substantial
Lug A6	Interior	Тор	Substantial
	Interior	Bottom	Obscured
	Enderstein	Тор	Substantial
Lug B1	Exterior	Bottom	Substantial
LUY DI	Interior	Тор	Substantial
		Bottom	Substantial

Page 6 of 19

TABLE 3 – LUG WELD VISUAL EXAMINATION RESULTS – CONTINUED

Component	Location	Weld	Observations
	F ortonian	Тор	Substantial
Lug P2	Exterior	Bottom	Substantial
Lug B2	Interior	Тор	Substantial
	Intenoi	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B3	LXIENDI	Bottom	Substantial
Lug D3	Interior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B4		Bottom	Substantial
Lug D4	Interior	Тор	Substantial
		Bottom	Substantial
	Exterior	Тор	Substantial
Lug B5	LXIENDI	Bottom	Substantial
Lug D5	Interior	Тор	Substantial
	Interior	Bottom	Substantial
	Exterior	Тор	Substantial
Lug B6	LAGHUI	Bottom	Substantial
	Interior	Тор	Substantial
	Interior	Bottom	Substantial

Component	Observations		
Rod 1	Bent – slightly rusted		
Rod 2	Bent – slightly rusted		
Rod 3	Bent – slightly rusted		
Rod 4	Bent – slightly rusted		
Rod 5	Bent – slightly rusted		
Rod 6	Bent – slightly rusted		
Bolt 1	Straight – slightly rusted		
Bolt 2	Straight – slightly rusted		
Bolt 3	Straight – slightly rusted		
Bolt 4	Straight – slightly rusted		
Bolt 5	Bent – slightly rusted		
Bolt 6	Straight – slightly rusted		
Bolt 7	Straight – slightly rusted		
Bolt 8	Straight – slightly rusted		
Bolt 9	Straight – slightly rusted		
Bolt 10	Straight – slightly rusted		
Bolt 11	Straight – slightly rusted		
Bolt 12	Straight – slightly rusted		

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 5. Image of the Lug A1 welds showing undercut. The interior weld shown was obscured by deposits.



Figure 6. Image of the Lug A4 exterior bottom weld which exhibited substantial fusion except for some overlap and undercut.

LG&E - Kentucky Utilities

Page 9 of 19

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 7. Image of the Lug A6 exterior bottom weld which exhibited substantial fusion except for some undercut regions.



Figure 8. Image of the Lug B1 welds showing good fusion with some undercut and overlap.

LG&E - Kentucky Utilities

Page 10 of 19

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 9. Image of the Lug B3 weld which exhibited substantial fusion except for some undercut and spatter.



Figure 10. Image of the Lug B5 exterior bottom weld which exhibited substantial fusion except for some undercut and overlap.

LG&E - Kentucky Utilities

Page 11 of 19

IMR LVL # 202202296

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 twelve coupling bolts and six harness rods exhibited torque values ranging from 30 to 120 ft.-lbs. No requirements were utilized for comparison as the coupler model was not specified.

Component	Breakaway Torque	Observations
Rod 1	120 ftlbs.	
Rod 2	120 ftlbs.	
Rod 3	40 ftlbs.	
Rod 4	60 ftlbs.	
Rod 5	80 ftlbs.	
Rod 6	80 ftlbs.	
Bolt 1	80 ftlbs.	
Bolt 2	85 ftlbs.	
Bolt 3	50 ftlbs.	
Bolt 4	65 ftlbs.	
Bolt 5	45 ftlbs.	
Bolt 6	70 ftlbs.	
Bolt 7	60 ftIbs.	
Bolt 8	50 ftlbs.	
Bolt 9	70 ftlbs.	
Bolt 10	50 ftIbs.	
Bolt 11	90 ftIbs.	
Bolt 12	30 ftIbs.	

TABLE 5 – FASTENER TORQUE MEASUREMENT

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on round specimens that were removed from the six harness rods and the twelve 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.

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %@	Reduction in Area, %
Rod 1 ①	107	65.5	25	51
Rod 2 ①	108	65.0	25	50
Rod 3 ①	108	64.0	26	51
Rod 4 ①	108	65.0	25	50
Rod 5 ①	107	64.5	26	49
Rod 6 ①	108	65.0	25	49
Bolt 1 ①	85.5	60.0	34	75
Bolt 2 ①	85.5	63.0	34	74
Bolt 3 ①	86.5	65.5	33	72
Bolt 4 ①	83.0	60.0	35	76
Bolt 5 ①	85.0	62.5	34	74
Bolt 6 ①	86.0	60.5	35	74
Bolt 7 ①	83.0	62.0	36	76
Bolt 8 ①	86.0	58.5	34	74
Bolt 9 ①	85.5	62.5	33	74
Bolt 10 ①	85.5	64.0	34	75
Bolt 11 ①	85.5	62.5	35	75
Bolt 12 ①	85.5	62.0	34	75

TABLE 6 – FASTENER TENSION TEST RESULTS

① Specimen Dimensions; Diameter 0.350" with gage length of 1.40"

© Percent elongation was measured using elongation-after-fracture measurements

SECTION 5- ROCKWELL HARDNESS, ASTM E18-20

Small sections of the twelve 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.

Results	Average①
Lug A1	66
Lug A2	79
Lug A3	81
Lug A4	78
Lug A5	78
Lug A6	53
Lug B1	76
Lug B2	75
Lug B3	68
Lug B4	78
Lug B5	53
Lug B6	53

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

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 Appendices A and B. Two representative welds are shown in Figures 11 and 12 with the dye penetrant test media remaining.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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.

LG&E - Kentucky Utilities

Page 15 of 19





Respectfully submitted

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

Concurrence richelly

Brian Kelly Failure Analyst

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, fictilious, 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 – VISUAL INSPECTION RECORD

									www.mistrasgroup.com		
. Client		2. Work Loca	ation	_		4. Mistras Job No.		6. Date	7. Page		
			listras,	Louis	ville			11/18/2022			
IMR Test	Labs	3. Client Cor		Miller		5. Purchase Order No. 7697FA		8. Client Referen	ce No. 02202296		
			biett	willer		7097FA		20	12202296		
Code/Specification			10. NE	T Proc	edure & Revis		11. Acceptan				
2. Material	API-1104	13. Weld Pro			100-VT-	004 Rev3 14. Surface Condition		API-110			
2. Material CS		13. Weld Pro		AW		Lugs brushed c	lean	15. Supplementa			
6. Technique					17. Visual Aids	lean	18. Light Meter Serial No.				
Direct Visual		sual 🗆 Ti	ransluc	ent Vi	sual	🗆 Yes 🗹 No	0		NA		
9. Access within 24" 8		20. 1/32" Line/Simulated Imperfections Used			21. Dimensional Aids		22. Light Meter Cal. Due				
Yes	No	□ Yes	[J No	D	🗆 Yes 🖾 No	0	F	lashlight		
4. Unit		25. System	_	_	_	26. Component ID	_	27. Drawing			
NA			N	A		NA			NA		
est Results	1		30.	31.							
28. ID/Weld No.	29. Indicatio	29. Indication Code(s)			32. Commer	its					
A1	UC, UN		_	Х	Poor Workm						
A2	UC, UN		-	x		Poor Workmanship					
A3	UC, UN		-	X	Poor Workm						
A4 A5	UC, UN UC, UN		-	X X		Poor Workmanship Poor Workmanship					
AG	UC,UN		-	X	Poor Workm						
10	00,01		-	0		unamp					
B1	UC,UN	I,WP		х	Poor Workm	anship	-				
B2	UC,UN	I,WP		Х	Poor Workm	anship					
83	UC,UN	I,WP		х	Poor Workm	anship					
B4	UC,UN	I,WP		х	Poor Workm	anship					
B5	UC,UN	I,WP		Х	Poor Workm	anship					
B6	UC,UN	I,WP	-	х	Poor Workm	anship					
			-								
					110						
						and controlled by Internatio					
dication Codes	es meeting HAR I	equirements.	Distart	oy sh	reduing. At ho	time during testing did the	se parts of ma	AS Arc Strike			
CR Crack		CL Cold				ES Excessive Weld Spa	tter	GO Gouge			
IF Incomplete Fusio PO Porosity	n	UN Insuff ER Exces				WP Weld Profile SF Surface Finish		PD Physical D CO Corrosion			
UC Undercut		SL Slag o	or Flux			IP Incomplete Penetra	-	OT Other			
3. Technician (Print &	Sign), Level & Da Dig tally signed		34. Cu	stome	r Signature (if	applicable)	35. Manager	nent Review (if ap	oplicable)		

APPENDIX B - LIQUID DYE PENETRANT INSPECTION RECORD

TOO RISUO	D Lane Louisville, KY 40	218 P: (502)	966-5558; F:	(502) 966-5401			www.mistrasgroup		
Client:	IMR			Date:	Date: 11		11-19-2022 Page: 1 of 2		
Address:	4510 ROBARDS LN			Job Number:					
	LOUISVILLE, KY 40218			Purchase Ord	ler:	7697FA			
Contact:	BRETT MILLER			Reference No	umber:	202202296	02202296 FEEL GAS COUPLINGS		
ocation:	MGI SHOP			Part No/Desc	ription:	STEEL GAS C			
						LIFTING LUG	S		
Code/Spe	cification AMSE SEC.V ARTICLE 6	5	Procedure	2 100-PT-001 REV 22		Accepta	ance Criteria API 1104		
ype and M Fluores [Type I] Sensitivity	icent: Water Wash	novable (Met fied: 🗌 Hydi	rophilic [D]] Lipophilic [B]	Red [Type II]		Uwater Wash [Method A] Solvent Removable [Method Post Emulsified [Method B]		
	1	-		T			1		
	Manufacturer		Туре	Batch Number(s)	Applica	ation Method	Process Time (minutes)		
-		_					Pre-clean Dry Time: 5MIN		
Cleaner:	MAGNAFLUX		SKC-S KL-SP2	20L01K		MP CLOTH	Penetrant Dwell Time: 10 MIN		
Penetrant: Developer				18LO4K		BRUSH	Emulsifier Time: N/A		
Emulsifier			D-52 21J046 5			SPRAY	Developer Time: 10 MIN Post Clean Method: N/A		
510	C-S DAMP CLOTH @ 5		Thickness	N/A			L.E.D. FLASHLIGHT		
57	Original Repair			C/S			67 F		
urface Con	dition						Annual		
iurface Con	dition ded 🔲 As Ground 🗌								
Gurface Con As Wel Test Resu	dition ded As Ground [Its	Quar	tity Inspected	d: 12 Quanti	ed 🛛 M ty Accept		Quantity Rejected: 12		
RED DYE DESCRIP WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C	dition ded 🔲 As Ground 🗌	Quar TION PERF COUPLINGS NDERCUT, I NDERCUT, L NDERCUT, L NDERCUT, L NDERCUT, L	ORMED ON - LUG WEL LACK OF FU ACK OF FU ACK OF FU ACK OF FU ACK OF FU	d: 12 Quanti N THE FOLLOWING: DS USION SION SION SION,POROSITY,UNE SION	ty Accept				
iurface Con	dition ded As Ground I Its PENETRANT INSPEC TION: (202202296) (D:: A1(REJECTED)UI D:: A2(REJECTED)UI D:: A3(REJECTED)UI D:: A4(REJECTED)UI D:: A5(REJECTED)UI	Quar TION PERF COUPLINGS NDERCUT, NDERCUT,L NDERCUT,L NDERCUT,L NDERCUT,L NDERCUT,L NDERCUT,L NDERCUT,L	ORMED ON - LUG WEL LACK OF FU ACK OF FU ACK OF FU ACK OF FU ACK OF FU ACK OF FU OROSITY ACK OF FU	4: 12 Quanti A THE FOLLOWING: DS ISION SION SION SION,POROSITY,UNI SION SION	ty Accept				
UITACE CON Market State Test Resu RED DYE DESCRIP' WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C The content of f	dition ded As Ground ded Its PENETRANT INSPEC TION: (202202296) (D: A1(REJECTED)UI D: A2(REJECTED)UI D: A3(REJECTED)UI D: A6(REJECTED)UI D: B1(REJECTED)UI D: B1(REJECTED)UI D: B3(REJECTED)UI D: B4(REJECTED)UI D: B4(REJECTED)UI D: B4(REJECTED)UI	Quar TION PERF COUPLINGS NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT	ORMED ON - LUG WEL LACK OF FU: ACK OF F	1: 12 Quanti 1:	DERFILL	ed:			
As Wel Test Resu RED DYE DESCRIP' WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C WELD I.C The content of fi Test notice	dition ded As Ground ded lts PENETRANT INSPEC TION: (202202296) (20220296) (202202296) (202202296) (202202296) (2020)	Quar TION PERF COUPLINGS NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT, I NDERCUT	ORMED ON - LUG WEL LACK OF FU ACK OF FU COROSITY ACK OF FU ACK OF FU ACK OF FU	1: 12 Quanti 1:	DERFILL	red: TAR)(22 CFR 120-130).	Quantity Rejected; 12		

APPENDIX B – LIQUID DYE PENETRANT INSPECTION RECORD (CONTINUED)

	ne Louisville, KY 4021	.8 P: (502) 966-5558; F	: (502) 966-5401			www.mistrasgroup.co		
lient: IMI	3		Date:	Date: 11-19-202		2 Page: 2 of 2		
ddress: 451	0 ROBARDS LN		Job Number:					
LOU	JISVILLE, KY 40218		Purchase Ord	er:	7697FA			
ontact: BRE	ETT MILLER		Reference Nu	Reference Number: 202202296				
ocation: MG	I SHOP		Part No/Desc	ription:	STEEL GAS C	DUPLINGS		
_					LIFTING LUG	S		
Code/Specification Procedure AMSE SEC.V ARTICLE 6 10			e 100-PT-001 REV 22			ance Criteria API 1104		
ype and Meth Fluorescen [Type I] Sensitivity Leve	t: 🗌 Water Wash (Solvent Remo	Method A] vable [Method C] cd: Hydrophilic [D] [2] 3] 4] N/A	Lipophilic [B]	Red [Type II]		Water Wash [Method A] Solvent Removable [Method C] Post Emulsified [Method B]		
		1	1					
	Manufacturer	Туре	Batch Number(s)	Applica	ation Method	Process Time (minutes)		
Cleaner:	MACHINE	EVC C	201.0414		MD CLOTU	Pre-clean Dry Time: 5MIN Penetrant Dwell Time: 10 MIN		
Cleaner: Penetrant:	MAGNAFLUX	SKC-S SKL-SP2	18LO4K	20L01K DAMP CLOT 18L04K BRUSH		Emulsifier Time: N/A		
Developer:	MAGNAFLUX	SKD-S2	21J046		SPRAY	Developer Time: 10 MIN		
Emulsifier:	N/A	N/A	N/A			Post Clean Method: N/A		
SKC-S	DAMP CLOTH @ 5M	lin	N/A			L.E.D. FLASHLIGHT		
	DAMP CLOTH @ 5M	IIN Material & Thickness				Test Temperature		
Origi urface Conditio	nal 🗌 Repair	Material & Thickness	c/s	. 53		Test Temperature 67 F		
☑ Origi urface Conditio ☑ As Welded	nal 🗌 Repair	Material & Thickness	C/S			Test Temperature 67 F uirements		
⊠ Origi urface Conditio ⊠ As Welded Test Results	nal 🗌 Repair Dn 🗌 As Ground 🛄 J	Material & Thickness As Cast Quantity Inspecte	C/S hined Final Machine d: 12 Quanti	d 🛛 M ty Accept		Test Temperature 67 F		
∑ origi urface Conditio As Welded Test Results RED DYE PE DESCRIPTIO WELD I.D.: F WELD I.D.: F	nal Repair As Ground / NETRANT INSPECT N: (202202296) CC 35(REJECTED)UNI 36(REJECTED)UNI 36(REJECTED)UNI	Material & Thickness As Cast Quantity Inspecte ION PERFORMED OI DUPLINGS- LUG WEI DERCUT, UNDER FIL DERCUT, LACK OF FU envice related as described and cont e parts or material come into coma	C/S hined Final Machine d: 12 Quanti N THE FOLLOWING: LDS (CONTINUED) L JSION	ty Accept	rtar)(22 CFR 120-130).	Test Temperature 67 F uirements		

Page 19 of 19

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: James McGough
- 2. Date of exposure: **07/08/2022**
- 3. Location: Bardstown to Cannons Line (Approximate Address: 554 Cannons Ln. Louisville, KY 40207)
- 4. Size of coupling (based on pipe size if not exposed enough to determine): 12"
- 5. Type of soil: Sandy X Clay Gravel Topsoil Other (take picture and describe)
- 6. Soil Density test: □ Type A X Type B □Type C
- 7. Status: X Removed □Abandoned in place □Backfilled- left in service

8. Discovery Method:
Leak on Coupler
Other Maintenance Excavation
X Facility Replacement

□Other:

□Facility Retirement

9. Pressure Class: □ Medium Pressure (MP) X High Pressure (HP) □ Transmission

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
 - 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)

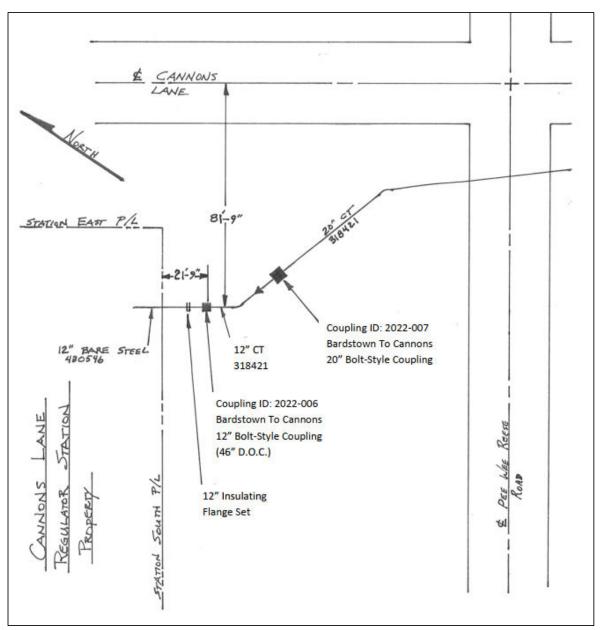
yes no (not applicable

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at the second seco

Field Pictures







Safety Briefing

Date: October 3, 2022

Employee Name	Employee ID
Sarah Nicholson	
Ethan Hinkson	

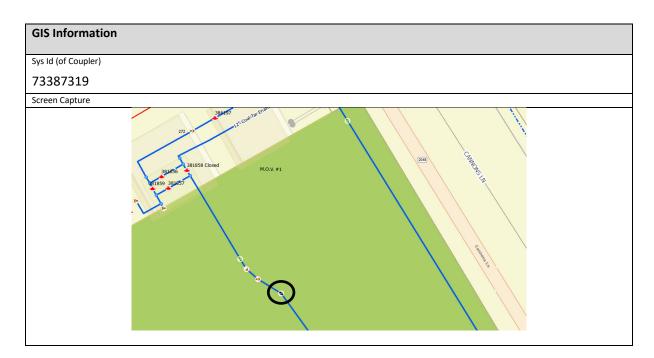
На	Hazards Identified				
Х	Sharp edges on cut pipe ends. Wear gloves when handling.				
Х	Pinch points on couplings. Wear gloves when handling.				
Х	Some couplings samples are heavy. Use a partner to assist with moving. Use proper lifting techniques.				
	Wear hard toes shoes.				
Х	Debris may on samples.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

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

Part B- Coupling Information

General Informa	ation	Tracking #: 2022-00	
PO Number	Expense Org	Project	Task
1121185	004610	158276	COUPLER
Address/Location			
Bardstown to Ca	annons Line @ 554 Cannons L	n. Louisville, KY 40207	
Size	Material	Coating	МАОР
20"	STL	СТ	178 PSIG
Main/Service Number	Soil Type (from Part A)	Manufacturer	Model
318421	Clay (Type B)	Dresser	Style 38
Pipe Connection: Steel to Steel		Steel to Plastic	Plastic to Plastic

Historical Information				
Installation Date	Document Source			
09/09/1987	Quest			
Installation Company	Document Source			
Southern Pipeline	Quest			
Foreman	Document Source			
Campbell	Quest			
Welder	Document Source			
Paul Howard & Don Gousha	Quest			



Pictures (Label the following parts before taking pictures.)



Figure 1 – Coupler Top View



Figure 2 – Pipe Side A (Top)

Exhibit D Page 26 of 35



Figure 3 – Pipe Side B



Figure 4 – Coupler Bottom View

Exhibit D Page 27 of 35



Figure 5 – Lug A1





Figure 7 – Lug A3

Figure 8 – Lug A4

Exhibit D Page 28 of 35



Figure 9 – Lug A5



Figure 10 – Lug A6



Figure 11 – Lug B1



Figure 12 – Lug B2

Exhibit D Page 29 of 35



Figure 13 – Lug B3

Figure 14 – Lug B4



Figure 15 – Lug B5



Figure 16 – Lug B6

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson & Sarah Nicholson Date: 10/3/2022

Table 1- Component Quantities

Number of Bolts on Coupler Body	12
Number of Reinforcement Rods	6
Number of Lugs	12

Table 2- Corrosion

	Pipe A	Pipe B	Coupler Body	Bolts	Rods	Lugs	Nuts
General External Corrosion?	Yes	Yes	No	No	No	No	No
Localized External Corrosion?	No	No	No	No	No	No	No
Pits Present?	No	No	No	No	No	No	No
Internal Corrosion?	No	No					

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

Table 3- Coupler Body

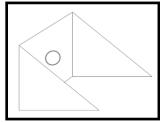
Bolt	Washer Present	Nut present?
1	No	Yes
2	No	Yes
3	No	Yes
4	No	Yes
5	No	Yes
6	No	Yes
7	No	Yes
8	No	Yes
9	No	Yes
10	No	Yes
11	No	Yes
12	No	Yes

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 ½"	3/4"	Yes	Yes	Hexagonal & Square	Standard
2	30 ½"	3/4"	Yes	Yes	Hexagonal & Square	Standard
3	30 ¾″	3/4"	Yes	Yes	Hexagonal & Square	Standard
4	33″	3/4"	Yes	Yes	Hexagonal & Square	Standard
5	33″	3/4"	Yes	Yes	Hexagonal & Square	Standard
6	31"	3/4"	Yes	Yes	Hexagonal & Square	Standard

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.)



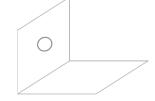




Table 5- Lugs (Measurements)

	Lug		Circumfe	rence (in)
Pipe Side	Lug Number	Thickness (in.)	Distance to next lug, clockwise	Distance to next lug, counter- clockwise
А	1	0.22"	7"	6 ½"
А	2	0.22"	7"	7″
А	3	0.22"	7 ½"	6 ½"
А	4	0.22"	6 ½"	9″
А	5	0.22″	9"	6 ½"
А	6	0.23″	6 ½"	7"
В	1	0.23″	7 ¼"	7 ¼"
В	2	0.23″	7 ½"	7 ¼"
В	3	0.23"	7"	7 ½"
В	4	0.22"	8 ¼"	7"
В	5	0.23″	7 ½"	8 ¼"
В	6	0.23″	7 ¼"	7 ½"

version 7.0 (10/27/2020)

Examples- Circumference Measurement

Exhibit D Page 32 of 35

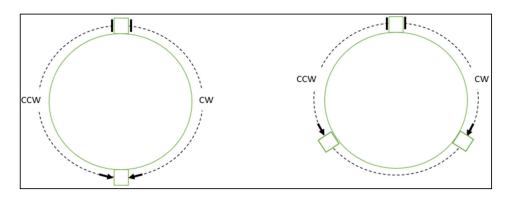


Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	Yes	No	No
A2	B2	Yes	No	No
A3	В3	Yes	No	No
A4	B4	Yes	No	No
A5	B5	Yes	No	No
A6	B6	Yes	No	No

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
А	1	No	Yes	Yes
А	2	No	Yes	Yes
А	3	No	Yes	Yes
А	4	No	Yes	Yes
А	5	No	Yes	Yes
А	6	No	Yes	Yes
В	1	No	Yes	Yes
В	2	No	Yes	Yes
В	3	No	Yes	Yes
В	4	No	Yes	Yes
В	5	No	Yes	Yes
В	6	No	Yes	Yes

Pipe Side	Lug Number	Welded on all sides of interior? If no, describe	Are welds on interior continuous? If no, describe
А	1	N/A (Obscured)	N/A (Obscured)
А	2	Yes	Yes
А	3	Yes	Yes
А	4	Yes	Yes
А	5	Yes	Yes
А	6	Yes	N/A (Obscured)
В	1	Yes	Yes
В	2	Yes	Yes
В	3	Yes	Yes
В	4	Yes	Yes
В	5	Yes	Yes
В	6	Yes	Yes

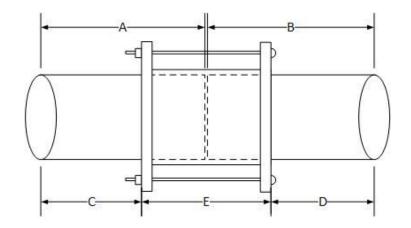


Table 8- Stab Depth

	А	В	С	D	Stab Depth (A-C) or (B-D)
Pipe Side A	16 ¾"		13"		3 ¾"
Pipe Side B		16 ½"		12 ½"	4″
	Su	7 ¾"			
		8 ¼"			
		1⁄2″			

Additional Comments - General Observations, Pit Depths, etc.



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

December 16, 2022

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

Attention: Sarah Nicholson

Exhibit E

Report No. 202202625

Metallurgical Evaluation of a 6" Coupling and Associated Hardware

Location: 26th and Bank Street

DESCRIPTION AND PURPOSE

A natural gas pipe section was submitted for metallurgical evaluation. The section was a 6" pipe with a Dresser Style 39 coupling which had been disassembled prior to receipt. Two 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 26th and Bank Street on August 10, 1951. 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 is shown in Figures 1 through 4. Four lugs of the joint harnesses had been fillet welded to both pipe segments. Only one of the tension rods was submitted with the pipes. Prior to receipt, the ends of the pipe segments were labelled as Ends A and B, as shown in Figures 1 and 2. The top and bottom of the coupling sections were not marked but were inferred by the condition of the welds. Lugs A1 and A2 were welded to Pipe A, and Lugs B1 and B2 were welded to Pipe B.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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 two 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. No requirements were provided for these characteristics.

TABLE 1 – LUG SPACING DIMENSIONAL MEASUREMENTS

Compound	Angle	Deviation from 180°	Image
Rod A1 / Rod A2	171	9	Figure 3
Rod B1 / Rod B2	173	7	Figure 4

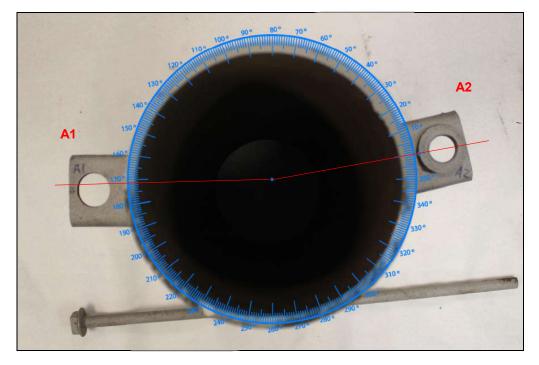


Figure 3. End facing image of the sample at End A with a superimposed protractor.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218

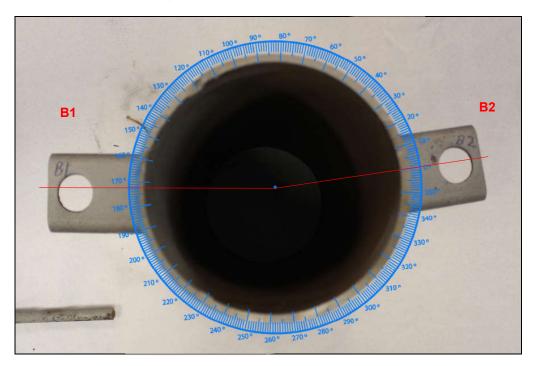


Figure 4. End facing image of the sample at End B with a superimposed protractor.

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 2. Representative weld regions are shown in Figures 5 through 8. 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 single harness rod was also inspected for damage. The observations for the rod are provided in Table 3. No corrosion cracking was evident. The rod was not necked down or stretched.

Component	Location	Weld	Observations		
	Exterior	Тор	Substantial		
1	Exterior	Bottom	No fusion		
Lug A1	Interior	Тор	No fusion		
	Interior	Bottom	Substantial		
	Exterior	Тор	Substantial		
	Exterior	Bottom	No fusion		
Lug A2	Interior	Тор	No fusion		
		Bottom	Substantial		
	Exterior	Тор	Substantial		
Lug R1	Exterior	Bottom	No fusion		
Lug B1	Interior	Тор	No fusion		
	Interior	Bottom	Substantial		
	Exterior	Тор	Substantial		
Lug B2	Exterior	Bottom	No fusion		
	Interior	Тор	No fusion		
	Interior	Bottom	Substantial		

TABLE 2 – LUG WELD VISUAL EXAMINATION RESULTS

TABLE 3 – FASTENER VISUAL EXAMINATION RESULTS

Component	Observations
Rod 1	Straight

Exhibit E Page 6 of 24

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



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



Figure 6. Image of the Lug A1 exterior bottom weld which exhibited no fusion.

Page 6 of 12

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218

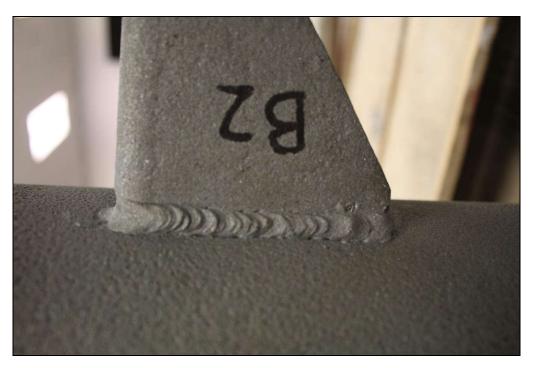


Figure 7. Image of the Lug B2 exterior top weld which exhibited substantial fusion except for some undercut and arc strikes.



Figure 8. Image of the Lug B1 interior bottom weld which exhibited substantial fusion except for some undercut and arc strikes.

LG&E - Kentucky Utilities

Page 7 of 12

SECTION 4- TENSILE TESTING, ASTM A370-19

Tensile testing was performed on a round specimen that was removed from the harness rod. The tensile mechanical properties of the fastener were measured and the results are summarized in Table 4. No mechanical property requirements were provided for the fastener.

TABLE 4 – FASTENER TENSION TEST RESULTS

Component	Ultimate Tensile Strength, ksi	0.2% Offset Yield Strength, ksi	Elongation, %	Reduction in Area, %	
Rod 1	69.0	42.7	37	65	

Specimen Dimensions; Diameter 0.350" with gage length of 1.40"

Percent elongation was measured using elongation-after-fracture measurements

SECTION 5- ROCKWELL HARDNESS, ASTM E18-20

Small sections of the four 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 5 and are suggestive of a moderate strength level. No requirements were provided for comparison.

TABLE 5 – LUG HARDNESS TEST RESULTS – ROCKWELL B – HRBW

Results	Average of Five Measurements
Lug A1	75
Lug A2	75
Lug B1	76
Lug B2	75

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 Appendices A and B. Two representative welds are shown in Figures 9 and 10 with the dye penetrant test media remaining.

IMR Metallurgical Services • 4510 Robards Lane • Louisville, KY 40218



Figure 9. Image of the Lug A4 exterior top weld after dye penetrant media had been used during inspection.



Figure 10. Image of the Lug B2 exterior top weld after dye penetrant media had been used during inspection.

LG&E - Kentucky Utilities

Page 9 of 12

IMR LVL # 202202625



ACCREDITED

Materials Testing Laboratory



Respectfully submitted

Concurrence

Jennifer Bree

Jennifer Breetz Laboratory 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. IMR's liability is be exercised for 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 – VISUAL INSPECTION RECORD



Visual Examination Report

									w	w.mistrasgroup.c
1. Client		2. Work Loo	ation Aistras,	Louisv	rille	4. Mistras Jo Mi	o No. 36833-4113		5. Date 12/13/2022	7. Page 1 of
IMR Test	Labs	3. Client Contact Brett Miller			S. Purchase Order No. 7719FA			8. Client Reference No. 202202625		
9. Code/Specification			110 M	T Drov	edure & Revis	tion No		11. Acceptance	Critoria	
	API-1104		10, 141	1 1100		004 Rev3		11. Acceptones	API-1104	
2. Material	13. Weld Pr	0085	-	100.11	14. Surface C	ondition		5. Supplemental L	ighting	
CS			AW		Lower Strades	gs brushed	- 0x	Contraction of the second second	No No	
6. Technique						17. Visual Aid			.8. Light Meter Ser	ial No.
Direct Visual	Remote Vi	sual 🗆 T	ransluc	ent Vi	sual	🗆 Yes	Ø	No	- 3	NA
9. Access within 24" 8	k 30*	20. 1/32" Line;	Simulated	Impert	ections Used	21. Dimensio	nal Aids	-	12. Light Meter Cal	. Due
🗹 Yes 🛛	No	□ Yes	1	I Ni	0	□ Yes	2	No	Fla	shlight
3. Additional Informa	tion									
Support lugs A&B 01	4 202202625									
24. Unit		25. System	1			26. Compon	ent ID NA		27. Drawing	NA
NA Fest Results			P	A	_		na		2	NA.
28. ID/Weld No.	29. Indicati	ion Code(s)	30. Acc.	31. Rej.	32. Commer	nts				
A1	UC, UN	, WP, IF		×.	Poor Workm	anship				
A2	UC. UN	, WP, IF		×	Poor Workm	anship				
B1	UC,UN	,WP, IF		X	Poor Workn	hanship				
82	UC,UN	,WP, If		X	Poor Workn	nanship				
The content of this do Distribute only to entit	cument may be d ties meeting ITAR	efense article requirement	/service s. Discar	related d by sl	I as described iredding. At n	and controlle o time during	d by interna testing did t	tional Traffic in Ar hese parts or mati	erial come into cor	AR)(22 CFR 120-13 stact with mercury
ndication Codes CR Crack IF Incomplete Fus PO Porosity UC Undercut	ion (Sign), Level & Di	UN Insu ER Exci SL Slag	essive Re or Flux	inforce	ndersize ment rr Signature (i	WP Weld SF Surfa IP Incor	sive Weld S Profile ce Finish nplete Pene	tration	AS Arc Strike GO Gouge PD Physical Da CO Corrosion OT Other ent Review (if app	

APPENDIX B – LIQUID DYE PENETRANT INSPECTION RECORD

100 Bisnop Lan	e Louisville, KY 402	18 P: (502)	966-5558; F:	(502) 966-5401			www.mistrasgroup.c
1 4 9 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	ess: 4510 ROBARDS LN				Date: <u>12-</u> Job Number:		Page: 1 of 1
						771054	
STORAGE CONTRACT	JISVILLE, KY 40218				nase Order: rence Number:	7719FA 2022022	
ontact: BRETT MILLER ocation: MGI SHOP					No/Description:		S COLIDUINGS
Cation. MG	1 SHOP			rait	Noy Description.	LIFTING LUG	
ode/Specific	ation SE SEC.V ARTICLE 6		Procedure	100-PT-001	BEU 22	Accept	ance Criteria API 1104
AIVIS	SE SEC. V ARTICLE D			100-P1-001	REV 22		API 1104
ype and Metho Fluorescent [Type I]	:: 🗌 Water Wash Solvent Rem Post Emulsifi	ovable [Meth ied: 🗌 Hydr	ophilic [D]	Lipophilic (B)	⊠ Rec [Type I	17 I	Water Wash [Method A] Solvent Removable [Method C Post Emulsified [Method B]
Sensitivity Leve	t: □% □1 ⊠	2 [] 3 []	4 🗌 N/A		LIOth	ier:	
	22 100121000-0000	-		200000000000000000000000000000000000000			Process Time (minutes)
	Manufacturer	1 3	Гуре	Batch Num	ber(s) Applic	ation Method	Pre-clean Dry Time: 5MIN
leaner:	MAGNAFLUX	5	KC-S	20L01	K DA	MP CLOTH	Penetrant Dwell Time: 10 MIN
enetrant:	MAGNAFLUX	SK	L-SP2	18LO4	к	BRUSH	Emulsifier Time: N/A
eveloper:	MAGNAFLUX	SI	CD-S2	21/04	6	SPRAY	Developer Time: 10 MIN
mulsifier:	N/A	12	N/A	N/A			Post Clean Method: N/A
Developer Forr	n: 🗌 a. Dry Powder	b. Water	Soluble	c. Water Suspe	nded 🔲 d. Non	aqueous Wet	e. Specific Application
enetrant Rem	oval Method & Dry T	ime	Black Light	(Model and S/I	N)	White Lig	sht Source
SKC-S	DAMP CLOTH @ 51	MIN		N/A			L.E.D. FLASHLIGHT
🛛 Origi	nal 🗌 Repair	Material &	Thickness	c/s			Test Temperature 67 F
urface Conditio	And a state of the second						
As Welded	As Ground		Rough Mach			Veets Code Rec	
fest Results		Quan	tity Inspected	1:4	Quantity Accep	ited:	Quantity Rejected: 4
DESCRIPTION WELD I.D.: A	NETRANT INSPEC N: (2022022) C 1(REJECTED)UN 2(REJECTED)UN	OUPLINGS- IDERCUT, L	LUG WELI	DS SION	WING:		
	1(REJECTED)UN 2(REJECTED)UN						
	ournept may be defense article/						

Certification of Inspection, Liquid Penetrant [Basic Report Form]

IMR LVL # 202202625

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: Lee Perry
- 2. Date of exposure: **11/11/2022**
- 3. Location: 26th & Bank St. Louisville, KY 40212
- 4. Size of coupling (based on pipe size if not exposed enough to determine): 6"
- 5. Type of soil: X Sandy \Box Clay \Box Gravel \Box Topsoil \Box Other (take picture and describe)

- 8. Discovery Method:
 □ Leak on Coupler
 □ Other Maintenance Excavation
 □ Facility Replacement

□Facility Retirement X Other:

9. Pressure Class: High Pressure

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
 - b. If Gas Regulatory is not available contact Gas Dispatch to have the survey assigned to a Gas Trouble Technician.

ves

Leak Survey completed at time of backfill (circle one)

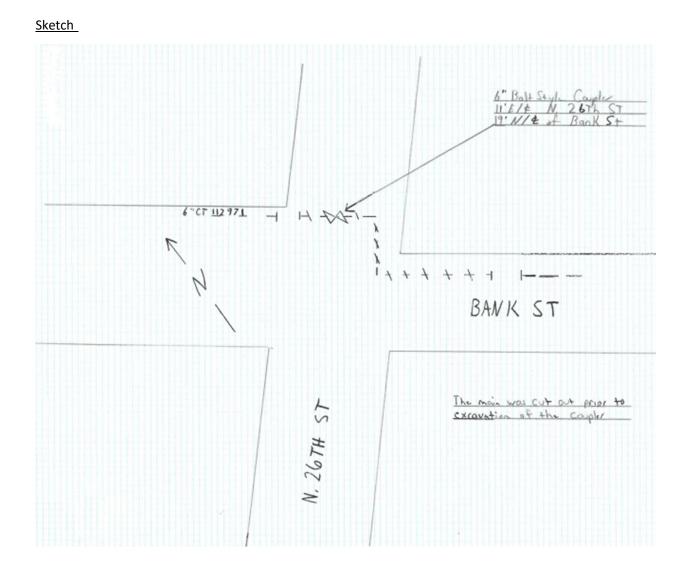
no (not applicable)

Include completed form in the main report and email a scanned copy of the completed form (back and front) to the DIMP group at the second seco

Field Pictures



Exhibit E Page 15 of 24



Safety Briefing

Date: 11/22/2022

Employee Name	Employee ID
Sarah Nicholson	
Ethan Hinkson	

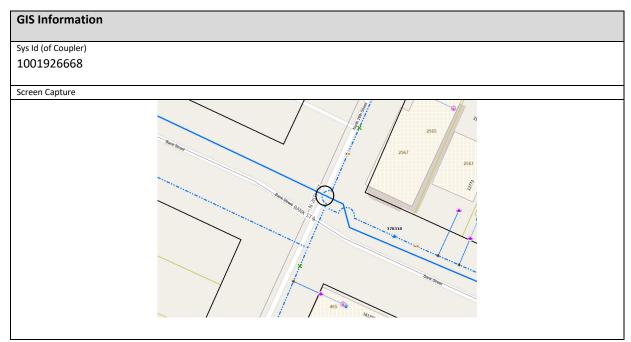
На	azards Identified
х	Sharp edges on cut pipe ends. Wear gloves when handling.
х	Pinch points on couplings. Wear gloves when handling.
х	Some couplings samples are heavy. Use a partner to assist with moving. Use proper lifting techniques.
	Wear hard toes shoes.
х	Debris may on samples. Wear eye protection.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

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

Part B- Coupling Information

General Information	on	Tracking #: 2022			
PO Number	Expense Org	Project	Task		
1124937	1124937 004610		COUPLER		
Address/Location					
N 26 th St. @ Bank S	St. Louisville, KY 40212				
Size	Material	Coating	МАОР		
6-inch	STL	MW	99 PSIG		
Main/Service Number	Soil Type (from Part A)	Manufacturer	Model		
112971	Sand	Dresser	Style 39		
Pipe Connection:	Steel to Steel	Steel to Plastic	Plastic to Plastic		

Historical Information				
Installation Date	Document Source			
August 10, 1951	Quest			
Installation Company	Document Source			
N/A				
Foreman	Document Source			
C. Young	Quest			
Welder	Document Source			
N/A				



Pictures (Label the following parts before taking pictures.)



Figure 1 2022-021 Coupling



Figure 2 Coupler Top View



Figure 3 Lugs - Pipe Side A

Exhibit E Page 19 of 24





Figure 4 Lugs - Pipe Side B

Part C- Visual Inspection of Coupling

Visual Inspection Performed by: Ethan Hinkson

Date: 11/22/2022

Table 1- Component Quantities

Number of Bolts on Coupler Body	1
Number of Reinforcement Rods	1
Number of Lugs	4

Table 2- Corrosion

	Pipe A	Pipe B	Coupler Body	Bolts	Rods	Lugs	Nuts
General External	Vaa						
Corrosion?	Yes	-	-	-	-	-	-
Localized External							
Corrosion?	-	-	-	-	-	-	-
Pits Present?	-	-	-	-	-	-	-
Internal Corrosion?	-	-					

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

Table 3- Coupler Body

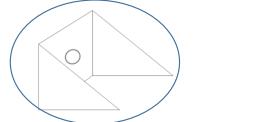
Bolt	Washer Present	Nut present?
1	N/A	Yes
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-

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	26 ¼"	0.67″	Yes	N/A (cut off)	Square	Standard

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.)



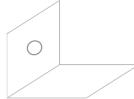




Table 5- Lugs (Measurements)

	Lug		Circumference (in)		
Pipe Side	Number	Thickness (in.)	Distance to next lug, clockwise	Distance to next lug, counter- clockwise	
А	1	0.23"	6 ¾″	8 ¼"	
А	2	0.23″	8 ¼"	6 ¾″	
В	1	0.23″	7 ¼"	8″	
В	2	0.23"	8″	7 ¼"	

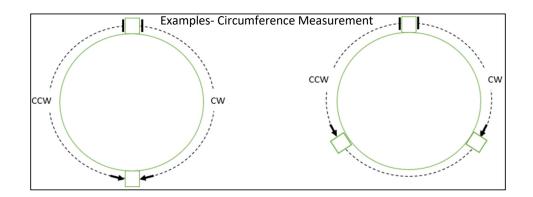


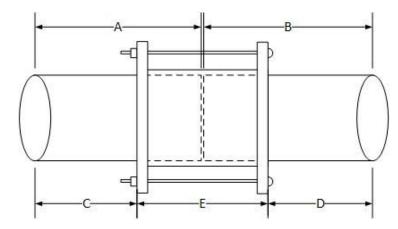
Table 6- Lugs (Observations)

Lug	Lug	Assembly sets aligned?	Deformed?	Deflected? (angle of)
A1	B1	No	N/A	N/A
A2	B2	No	N/A	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
А	1	No	No, only 1 weld	Yes
А	2	No	No, only 1 weld	Yes
В	1	No	No, only 1 weld	Yes
В	2	No	No, only 1 weld	Yes

Pipe Side	Lug Number	Welded on all sides of interior? If no, describe	Are welds on interior continuous? If no, describe
A	1	No, only 1 weld	Yes
A	2	No, only 1 weld	Yes
В	1	No, only 1 weld	Yes
В	2	No, only 1 weld	Yes



Not applicable; coupler disassembled

Table 8- Stab Depth

	А	В	С	D	Stab Depth (A-C) or (B-D)
Pipe Side A					0
Pipe Side B					0
	Su	0			
	Difference				

<u>Additional Comments</u> - General Observations, Pit Depths, etc.

Coupler received by DIMP cut apart with no evidence of previous failure. According to Inspection group, had to be disassembled due to other facilities obstructing removal.