Public Quarterly Report

Date of Report: 4th Quarterly Report –August, 2023Contract Number: 693JK322RA0001Prepared for: US Pipeline and Hazardous Materials Safety AdministrationProject Title: Rapid Ultraviolet (UV) Cured Adhesive for Gas Main Cured-in-Place-Lining (CIPL)Prepared by: Progressive Pipeline ManagementContact Information: Casey Giambrone, cfg@progressivepipe.com, 631-339-3075For quarterly period ending: August 31, 2023

1: Items Completed During this Quarterly Period:

Item #	Task #	Activity/Deliverable	Title	Federal Cost	Cost Share
21	19	Install Liner with Vortex UV adhesive to prepare physical property testing (Zebra Pipe)	Install Liner with Vortex UV adhesive to prepare physical property testing (Zebra Pipe)	\$59,657.00	\$59,657.00
22	20	In house testing at PPM - Peel Rate - Sheer Rate	In house testing at PPM - Peel Rate - Sheer Rate	\$59,657.00	\$59,657.00
23	21	Zebra Pipe Preparation for CUB	Zebra Pipe Preparation for CUB	\$16,457.00	\$16,457.00
24	22	Vortex/PPM Meeting to review results	Vortex/PPM Meeting to review results	\$ 1,200.00	\$ 1,200.00
25	23	Prepare and ship adhesive for bench testing to PPMPrepare and ship adhesiv for bench testing to PPM (200ft @ 6"x6mm)		\$ 1,774.00	\$ 1,774.00
26	24	Travel to PPM for bench testing phase 2	Travel to PPM for bench testing phase 2	\$ 950.00	\$ 950.00
27	25	Install Liner with Vortex UV adhesive for qualitative data	Install Liner with Vortex UV adhesive for qualitative data	\$32,133.50	\$32,133.50
28	26	Qualitative data to be gathered - Liner wetting out - Observe liner inversion on longer length & adhesive slugging - Long distance capabilities of UV light train - Ensure adhesive bond to pipe	Qualitative data to be gathered - Liner wetting out - Observe liner inversion on longer length & adhesive slugging - Long distance capabilities of UV light train - Ensure adhesive bond to pipe	\$ 1,500.00	\$ 1,500.00
29	27	Vortex/PPM Meeting to review results & prep for above ground pipeline trial	Vortex/PPM Meeting to review results & prep for above ground pipeline trial	\$ 900.00	\$ 900.00
30	28	Prepare and ship adhesive for above groud pipeline trial to PPM	Prepare and ship adhesive for above groud pipeline trial to PPM	\$ 355.00	\$ 355.00
31	7	4th Quarterly Status Report & Data Analysis	4th Quarterly Status Report & Data Analysis	\$13,680.00	\$13,680.00

Item #	Task #	Activity/Deliverable	Title	Federal Cost	Cost Share
11	10	ASTM D790 Flex Mod/Strength (5 coupons per adhesive version - 15 samples) ASTM D638 Tensile (5 coupons per adhesive version - 15 samples) ASTM D695 Compression Strength (5 coupons per adhesive version - 15 samples)	ASTM D790 Flex Mod/Strength (5 coupons per adhesive version - 15 samples) ASTM D638 Tensile (5 coupons per adhesive version - 15 samples) ASTM D695 Compression Strength (5 coupons per adhesive version - 15 samples)	\$ 6,135.50	\$ 6,135.50

2: Items Not-Completed During this Quarterly Period:

Item #	Task #	Activity/Deliverable	Title	Federal Cost	Cost Share
N/A	N/A	N/A	N/A	N/A	N/A

3: Project Financial Tracking During this Quarterly Period:



4: Project Technical Status -

- Item No. 21.19 (Install Liner with Vortex UV adhesive to prepare physical property testing)
- Item No. 22.20 (In House testing at PPM; Peel Rate & Shear Rate)
- Item No. 27.5 (Install Liner with Vortex UV adhesive for qualitative data

Mechanical tests were performed at Progressive Pipeline Management's facility on 2 segments of 12" steel pipe designed to demonstrate aging corroded pipes and the potential spacing within a compression coupling. The objective of this testing was to examine whether The resin has the necessary properties to remain bonded to the gas host pipe, while still maintaining normal gas operating pressure of $\frac{1}{4}$ lb. – 60 PSI, in a distribution steel gas main. All test samples were prepared with conventional inversion methods, while the curing of the resin was performed by means or Ultra Violet (UV) light.

The testing also included 5 samples each for peel and lap shear specimens, for a total of 10 samples. Each specimen sample was cut into a standard 1" X 6" steel sample strip, and bonded with the three-part composite system of woven polyester fabric, polyurethane coating, and UV resin. The object of these tests was to investigate the resilience of the resin's ability to remain gas tight. Focusing on these areas of testing, PPM has determined that under the most severe conditions of a simulated corroded pipe and a circumferential gap, the new composite lining system has proven to meet the parameters set in maintaining a safe distribution gas system.

The mechanical pressure testing was performed utilizing Carbon Dioxide (CO2) pressure to simulate the distribution system. CO2 was chosen so monitoring of any leaking gas can be measured verifying a leak proof system and while maintaining a zero Oxygen level. The concept of monitoring the CO2, along with monitoring the pressure gauges is a failsafe precise design, providing the utmost accuracy.

Flat Plate Peel Test Preparation and Results

- The flat plate samples were made with a sand blasted ¹/₄" thick 12" X 12" steel flat plate.
- Starline liner material was saturated with the UV resin and placed flatly onto the steel plate.
- Clear plexiglass was placed on top of the saturated liner and weighed down to equal inversion pressure
- UV light was introduced through the plexiglass activating the resin until cured
- The Peel test was performed with a hand-held meter and the pulling strengths were averaged
- Lap Shear was not performed on the flat plate.
- Average bonding strength of 11.4lb or 50.7n







Peel and Lap Shear Test Samples

Historically, peel and lap shear sample preparations have been difficult to craft. To combat this, PPM has developed a new approach called Zebra Pipe. Developed in 2020, and praised/used by Cornell University for its design. Zebra Pipe has been a game changer in the preparation for peel and Lap Shear testing samples. Peel and Lap shear testing is designed to quantify the bonding strength of the liner to the host pipe. Steel test strip samples will be prepared utilizing undisturbed bonded liner to each steel strips. The bonding strength must be compatible to the Starline bonding strengths and values to be considered an acceptable product.

Zebra Pipe - Peel & Lap Shear Preparations

- The Zebra pipe was prepared with 30 1" X 6" samples cut from a steel pipe and reassembled back into the pipe (20 more samples than needed)
- The Zebra was lined
- All samples were be tested for Peel and Lap shear strengths.





Zebra Pipe Peel Test Results

5 mechanical peel tests were performed at PPM's facility on 12" prepared steel Zebra pipe samples. These results concluded that the bonding strength is exactly the same as the existing Starline bonding strength of 7lb or 31.13n, which is currently being used. With matching peel test results, PPM is expecting the new resin and Starline liner to perform in the field as the existing adhesive and Starline liner has performed in the past.





Zebra Pipe Lap Shear Results

5 mechanical Lap Shear tests were performed at PPM's facility on

12" prepared steel Zebra pipe samples. The tests concluded that the bonding strength is

1,000lb or 4,450n equivalent to the existing Starline bonding strength currently being used.

Actual test results are 816lb or 3,630n, which is 22% less than the existing

bonding strength of 1,000lb or 4,450n. With similar lap shear test results, PPM is expecting the new resin and Starline liner to perform in the field as the existing adhesive and Starline liner has performed in the past.





Item No. 28.26 Qualitative data to be gathered:

- Liner wetting out
- Observe liner inversion on longer length & adhesive slugging
- Long distance capabilities of UV light train
- Ensure adhesive bond to pipe)

In Q4 Matt Peterson and Andrew Gonella traveled to PPM facility in Long Island New York for bench testing. Adhesive was shipped to PPM facility prior to Vortex arrival. During this visit the following items were verified (28.26):

- 1. Light intensity and spectrum of PPM light train.
- 2. CIPL wet out
- 3. Inversion equipment and process
- 4. Length limitations of PPM light train
- 5. Adhesive bonding to host pipe



Item No. 29.27 (Vortex Internal Review)

Vortex Team which is comprised of Matt Peterson, Scott Podhaisky and Andrew Gonella met With PPM team met multiple times during Q4 the final meeting held on August 29, 2023 to discuss results of bench testing performed at PPM facility

5: Project Schedule –

• Items not complete in Q3, expected to be included in the Q4 report are as follows:

Item #	Task #	Activity/Deliverable	Title
N/A	N/A	N/A	N/A