STRESS ENGINEERING SERVICES INC.
an employee-owned company

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HOUSTON • CINCINNATI • NEW ORLEANS
BATON ROUGE • CALGARY (STRESS ENGINEERING SERVICES CANADA)

May 31, 2013 SES Doc No : 611015-PL-RP-0010 Rev 0

Mr. Franz Worth, P.E.
Air Logistics Corporation
925 North Todd Avenue
Azusa, CA 91702
Phone: 626-633-0294
E-mail: fworth@airlog.com

SUBJECT: Long-term Composite Repair Study, Year 3 Burst Results

Franz,

This letter report provides a summary of the burst testing that was performed for the Year 3 samples by Stress Engineering Services, Inc. (SES).

The test program is attached to this letter report and provides the specific activities completed in the burst test. The Year 3 samples were removed from the burial area at our Waller facility in December 2012. The three samples (40%, 60% and 75% wall loss) were then pressured to failure while pressure and strain were recorded. The burst pressures for the samples are listed in the table below.

Sample Number	Burst Pressure (psi)
40	4,121
60	4,135
75	4,046

The following figures are provided on the attached pages.
- Figure 1 – Pressure vs. Hoop Strain, 40% Corrosion Sample
- Figure 2 – Pressure vs. Hoop Strain, 60% Corrosion Sample
- Figure 3 – Pressure vs. Hoop Strain, 75% Corrosion Sample
- Figure 4 – Photograph of Failure Location, 40% Corrosion Sample
- Figure 5 – Photograph of Failure Location, 60% Corrosion Sample
- Figure 6 – Photograph of Failure Location, 75% Corrosion Sample
- Figure 7 – Pressure Transducer Calibration Certificate

As discussed in previous communication, we plan to write a comprehensive report for you that summarizes all three years of testing. We will have this completed by the end of June. Thank you for your patience.

Please contact me if you have any questions.

Regards,

Chris Alexander

Chris Alexander, Ph.D., P.E.
Chris.alexander@stress.com
(281) 955-2900 (office)

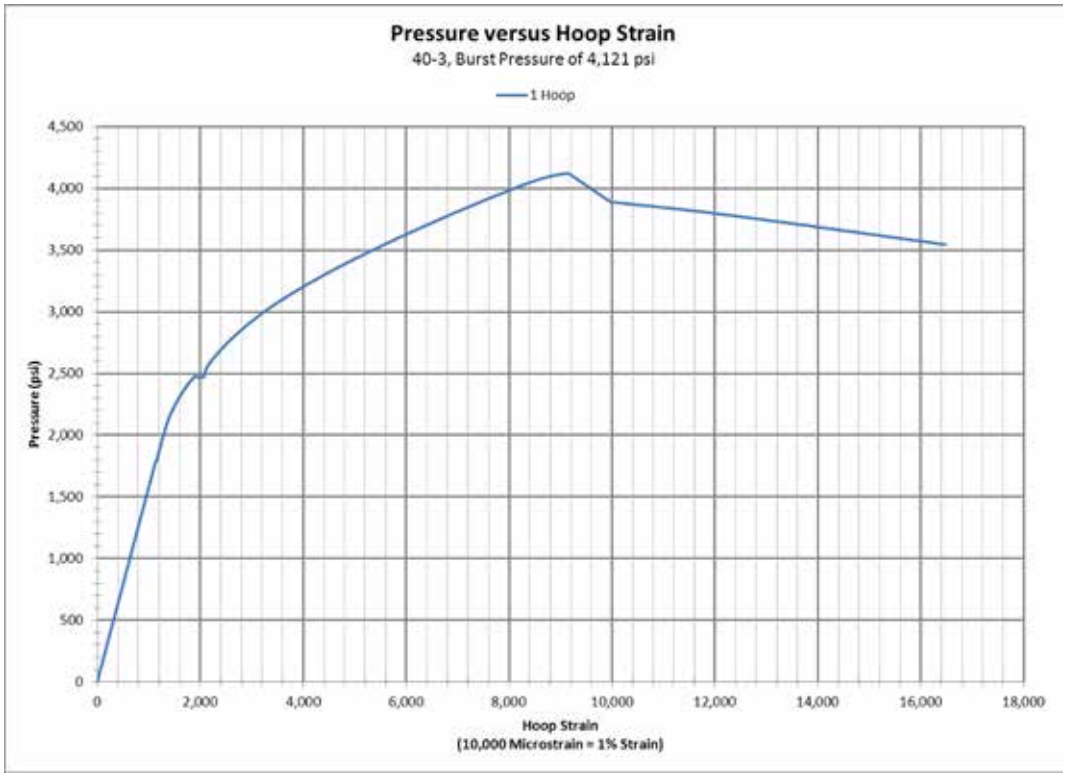

Figure 1 – Pressure vs. Hoop Strain, 40% Corrosion Sample

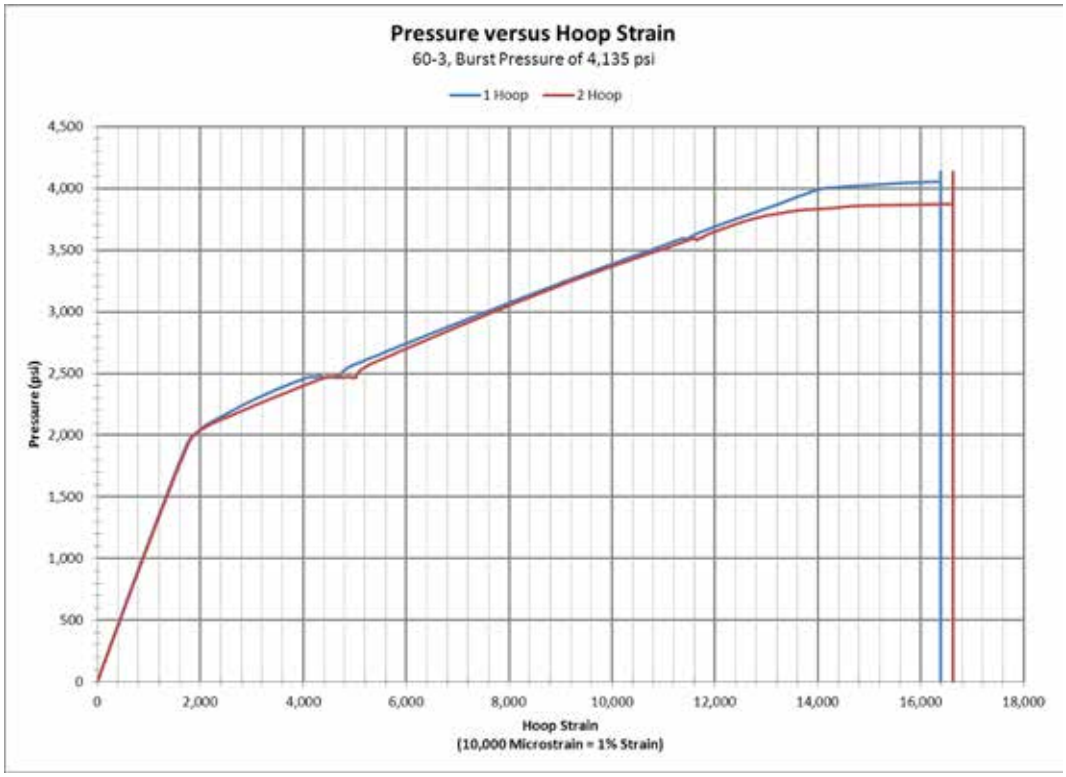

Figure 2 – Pressure vs. Hoop Strain, 60% Corrosion Sample

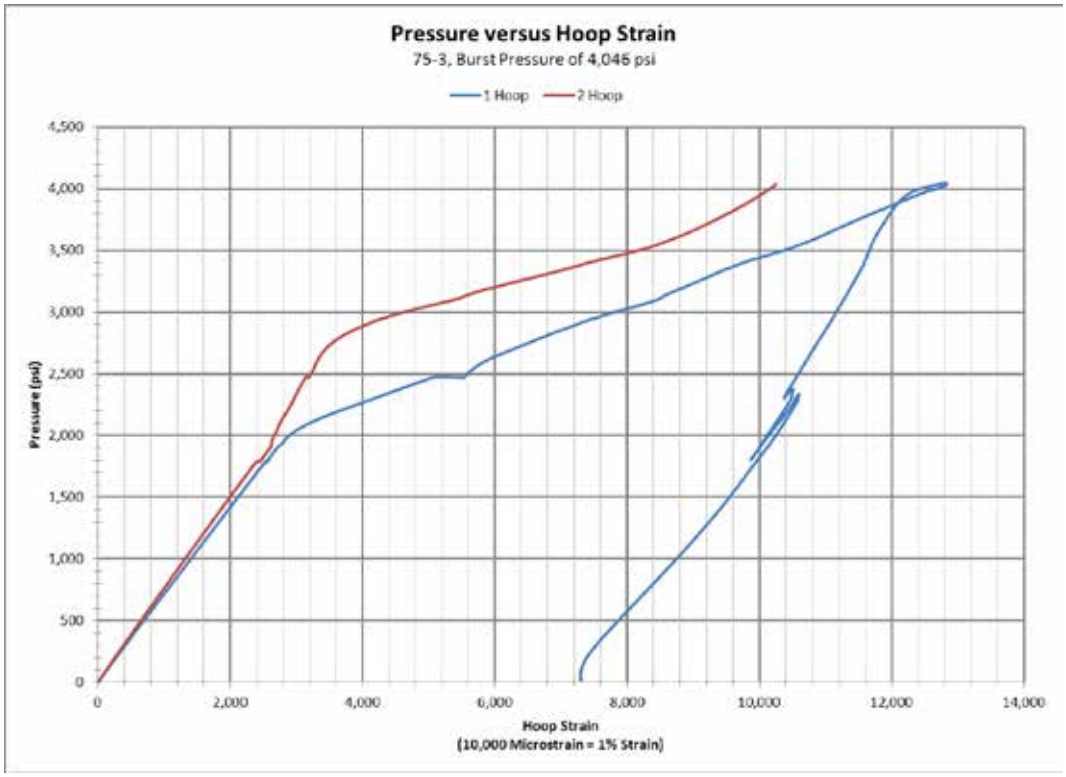

Figure 3 – Pressure vs. Hoop Strain, 75% Corrosion Sample

Figure 4 – Photograph of Failure Location, 40% Corrosion Sample

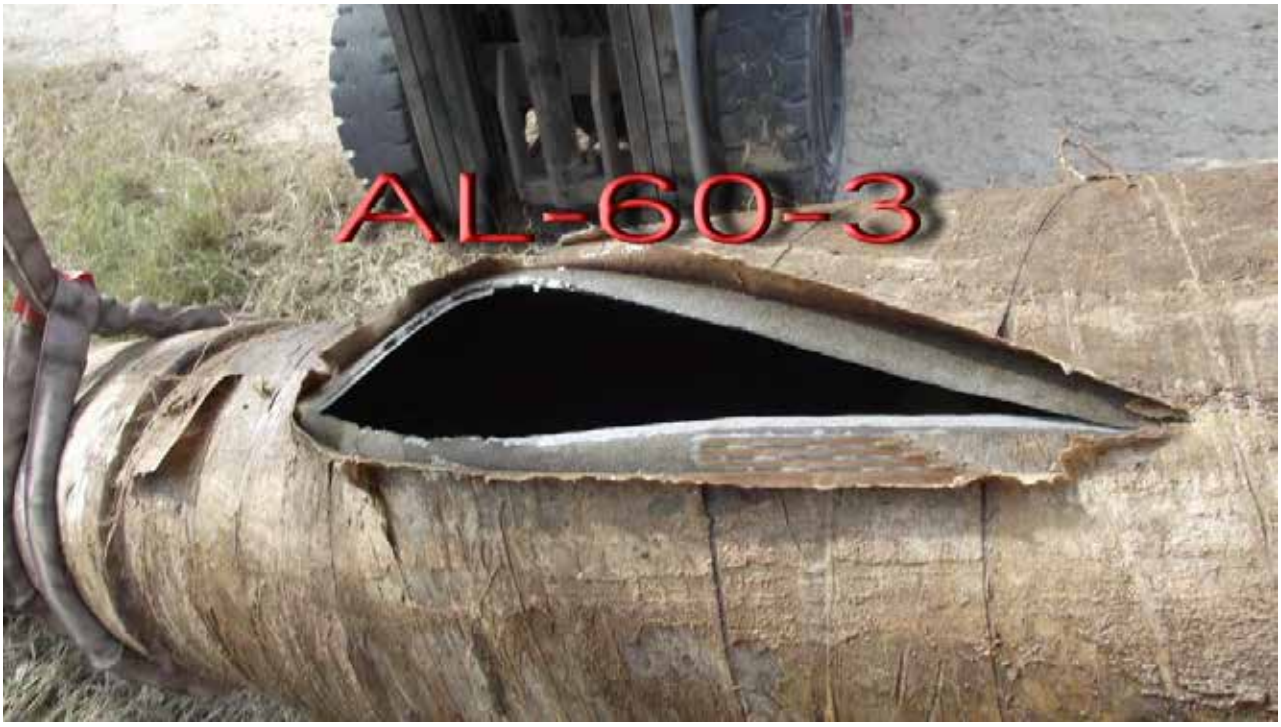

Figure 5 – Photograph of Failure Location, 60% Corrosion Sample

Figure 6 – Photograph of Failure Location, 75% Corrosion Sample

28694 Denn Rd. Montgomery, Tx 77356
Phone - 713-515-3619

CALIBRATION CERTIFICATE

CUSTOMER: **MOHR ENGINEERING**

13602 WESTLAND EAST BLVD

Transducer Make:	Delta Metrics	Transducer Model:	N/A
Transducer S/N:	60879	Transducer Range:	0 - 10000 psi
Reference and testing conditions:		979.312 gals	19°C +/- 1.5 deg
		Excitation	5.047 volts

CALIBRATION READINGS (as found as left)

ACTUAL (psi)	READING 1 (mv)	CONVERTED (psi)	PERCENT ERROR % of FS
0	0.040	0	0.00
500	0.545	501	0.01
1000	1.049	1000	0.00
2000	2.057	2000	0.00
4000	4.073	3999	-0.01
6000	6.089	5998	-0.02
8000	8.106	7997	-0.03
10000	10.122	9996	-0.04

All readings within manufacturer tolerence (+/- .5% F.S.)

CONVERSION FACTORS (Reading - Offset)*gain

Shunt Reading (millivolts)	Shunt Reading (psi)	Offset (millivolts)	Gain (psi/mv)
5.082	**4999**	0.04	991.50

Calibration performed per STS document PTC1001 and tracable to N.I.S.T.

Equipment used: Pressurements model M3800 SN:61205, Agilent model 34401A SN: MY47007060

Technician L. Wilson DATE: January 21, 2012

SIGNED: RECALL: January 21, 2013

Figure 7 – Calibration Certificate for Pressure Transducer

Test Overview

Test Sample Configuration

The basic elements of this program include the following:

- Fabrication of 180 12.75-inch x 0.375-inch, Grade X42 8-ft long test samples with welded end caps (36 Year 0 burst tests and 144 buried samples).
- Sample preparation included simulated corrosion installed via machining with depths of 40%, 60%, and 75% of the pipe's nominal wall thickness (refer to Figure A for geometry of the machined regions).
- All samples were repaired by the participating manufacturers. All manufacturers repaired samples for a three-year test period (12 total samples), while four of the manufacturers elected to participate for a 10-year study (requiring an additional 9 samples).
- Burst tests were planned for all of the repaired samples at 0, 1, 2, and 3 years. The 10-year participants will have additional burst periods at 5, 7.5, and 10 years.
- While 36 samples were burst during the Year 0 test period, 144 samples were buried in the ground (cover depth of approximately 18 inches) at Stress Engineering's Waller, Texas Test Facility. Samples will be pressurized continuously at 36% SMYS (890 psi) and cycled 75 times per month at 36% SMYS (890 – 1,780 psi) and once per quarter at 72% SMYS (0 to 1,780 psi). Burst test samples will be removed from the buried trenches at the designated test periods and taken to failure.
- During the testing period, strain gages will be used to monitor strain in the corroded steel beneath the composite repairs. Figure B and Figure C provide a schematic of the strain gage locations and a photograph of the machined region with strain gages, respectively.

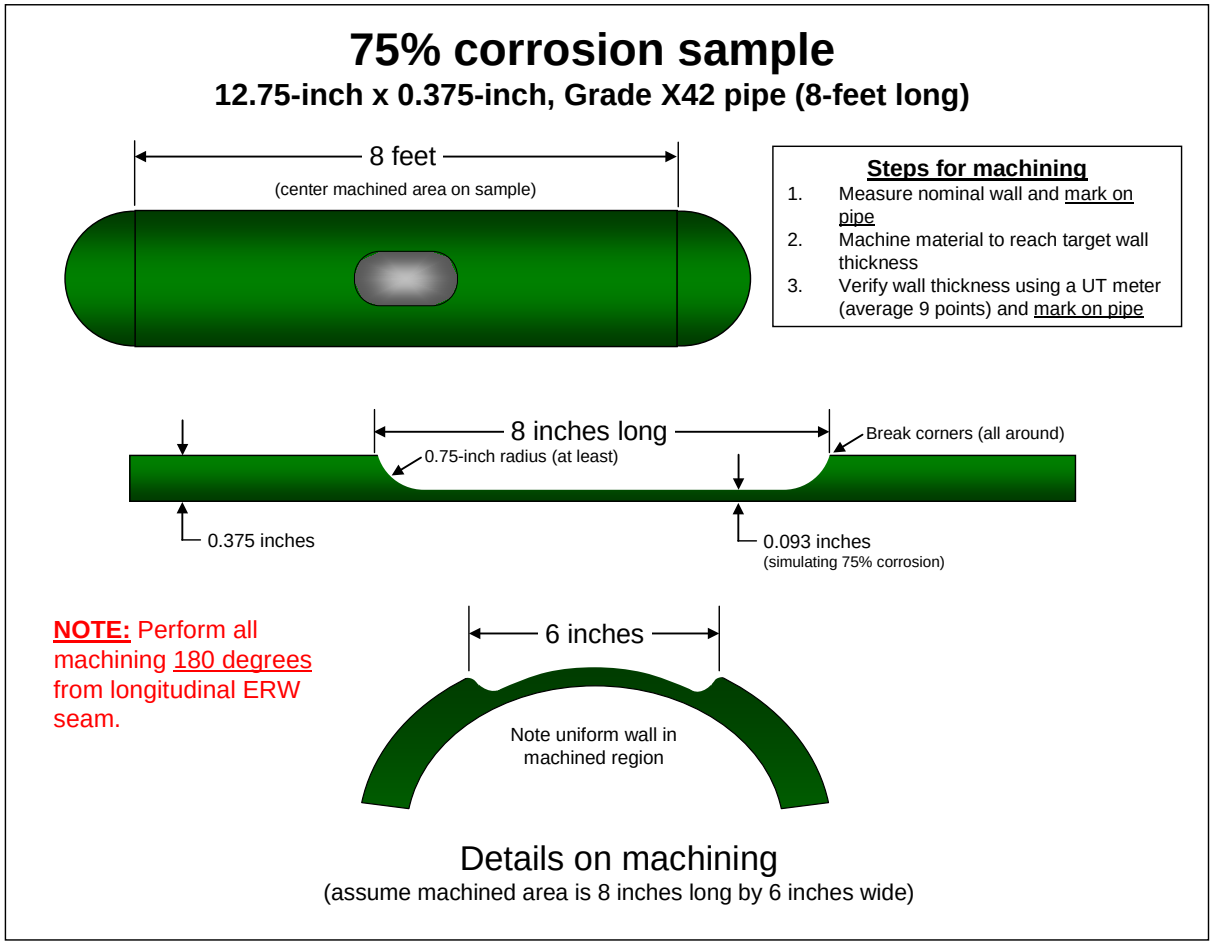

Figure A - Sketch of simulated corrosion

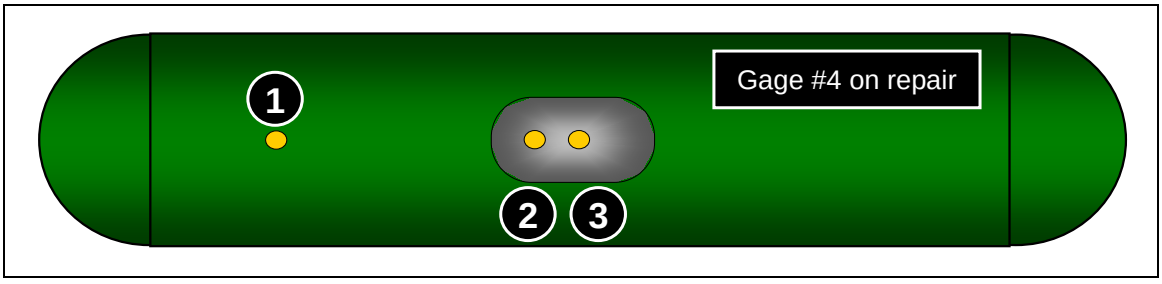

Figure B- Diagram of strain gage locations

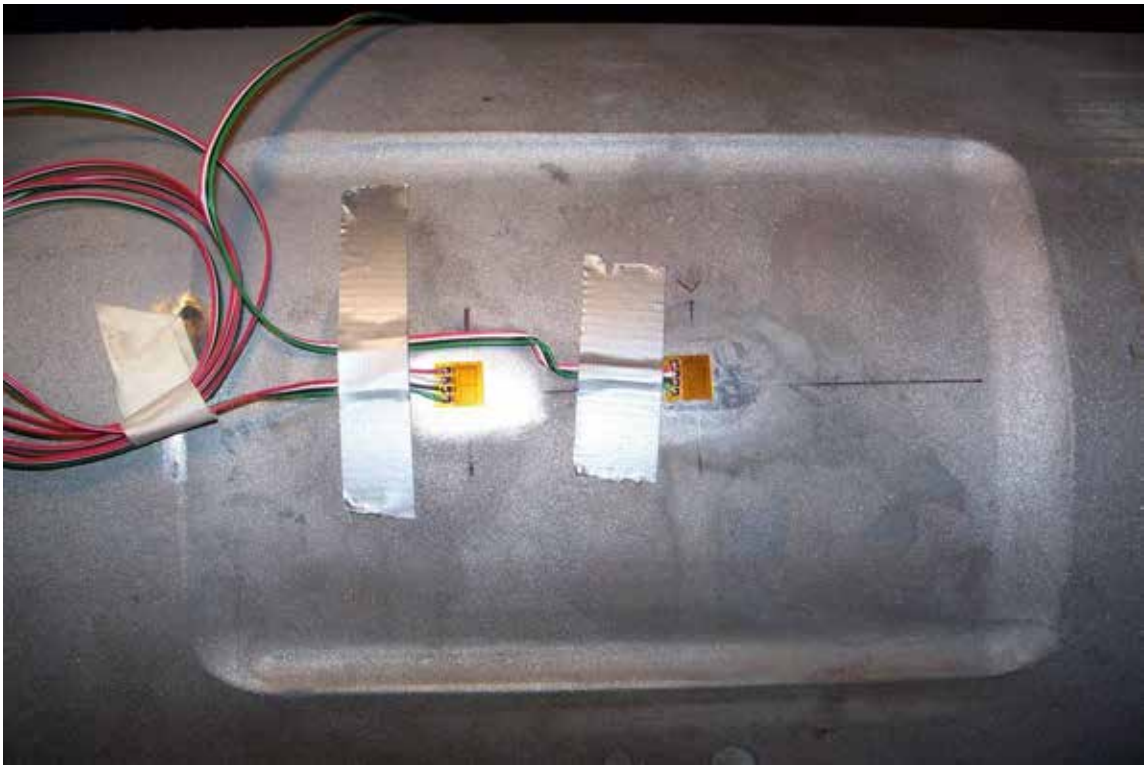

Figure C - Strain gages in simulated corrosion

Pipe Removal Activities

The 35 samples from the Year 3 group were unearthed prior to burst testing. Figure D provides photographs taken during the pipe removal activities. The same process was used for the samples removed for the Year 2 phase of work.

Figure D - Photographs from Year 1 sample removal