

NATIONAL TRANSPORTATION SAFETY BOARD

Office of Research and Engineering
Materials Laboratory Division
Washington, D.C. 20594



October 24, 2008

MATERIALS LABORATORY FACTUAL REPORT

Report No. 08-096

A. ACCIDENT

Place : Minneapolis, Minnesota
Date : August 1, 2007
Vehicle : I35W Highway Bridge
NTSB No. : HWY07MH024
Investigator : Mark Bagnard

B. COMPONENTS EXAMINED

Laser scans of gusset plates from nodes L11E and L11W to assess corrosion.

C. DETAILS OF THE EXAMINATION

Areas of corrosion were observed on all four of the gusset plates from nodes L11E and L11W. The corrosion was generally found in bands on the inside surfaces of the gusset plates; these bands ran along the top edges of the lower chord members, where those members were in contact with the inside surfaces of the gusset plates. The specified thickness of these gusset plates as shown in the design plans and shop drawings was 0.5 inch. The shop drawings list the plate as 74 inches wide and 101 inches long. ASTM A 6/A 6M, "Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, And Sheet Piling" lists the permitted variation in specified thickness for 0.5-inch thick plate up to 108 inches wide as from 0.01 inch under to 0.03 inch over the specified thickness.

Field measurements of areas of corrosion on the gusset plates from nodes L11E and L11W were documented in Appendix 3 of the Structural Investigation Group Chairman's Factual Report (Materials Laboratory Report 08-015). Those measurements were taken at approximately 1-inch intervals, using an electronic point micrometer to measure the thickness of the gusset plate, or using the depth probe of an electronic caliper to measure the depth of pitting (and then calculating the thickness by subtracting the depth of the pitting from 0.5 inch). The gusset plate thickness measurements were tabulated, and it was noted that the bands of corrosion were generally between 0.5 inch and 1.5 inches wide. The measurements quantify the minimum thickness at each location along the plate, and the measurement locations could vary in position vertically, so they do not necessarily represent material lost from a continuous region across the plate.

In order to more fully document the condition of the gusset plates from nodes L11E and L11W, the areas of corrosion were scanned with a laser line probe attached to a portable coordinate measuring arm, as documented in the attached 3D Engineering Solutions report. These scans produced a three-dimensional record of the surfaces of the scanned components. Software (Innovmetrics PolyWorks 10.1) was used to extract cross sections at approximately 0.5-inch intervals and take measurements of the gusset plate thickness or the depth of pitting. As with the field micrometer measurements, these measurements quantify the minimum thickness at each location along the plate, and the measurement locations could vary in position vertically, so they do not necessarily represent material lost from a continuous region across the plate. Some measurements of the widths of the bands of corrosion were also made, as were some reference measurements of the thickness of the gusset plate away from any corrosion (which generally included the thickness of paint on one or both surfaces). As with the field micrometer measurements, it should be noted that deformation such as necking associated with ductile fracture could reduce the apparent remaining thickness, making the section loss due to corrosion appear worse than it was before the fracture. Deformation as a result of extensive bending or impact also has the potential to affect the thickness measurements. Also, the presence of paint on the surface of the gusset plate opposite the surface with corrosion would affect the measured thickness of the plate. No attempt was made to quantify or correct for these effects.

Figures 1 through 4 show approximate maps of the fractures in the gusset plates from nodes L11E and L11W, which were overlaid on engineering drawings provided by the Federal Highway Administration. As can be seen in the figures, fractures occurred in all four of the gusset plates at least in part along the top edges of the lower chord members, near the area of corrosion. Three of the four gusset plates were severely damaged on the north end below the area of the connection to the L11/U12 member, and no measurements could be obtained from those areas. Further documentation of the damage to the L11E and L11W nodes can be found in Materials Laboratory Factual Report 08-031. Pieces are labeled in figures 1 through 4 to correspond to the labels used for the laser scans. Generally, the scans were limited to be within a few inches of the area of corrosion, but in some places the scans were expanded to include reference features such as rivet heads or to follow fractured edges to provide continuity.

The attached 3D Engineering Solutions report includes tables of the laser scan measurements, along with photographs and laser scan images of each piece scanned. Following the approach used for the field micrometer measurements, the measurements were identified as to their position from the south end of each gusset plate along the top edges of the lower chord members. The total length of a gusset plate along that line was approximately 98 inches; blank entries in the tables indicate no measurement was made. In some locations, measurements were made on two pieces separated by a fracture. All of the dimensions in the tables are in inches.

The laser-scan measurements of the corrosion were compared with the field micrometer measurements, and the agreement between the measurements was generally

good. Two errors were identified in the table reporting the field measurements in Appendix 3 of Materials Laboratory Report 08-015:

1. For the east gusset plate of node L11E, the measurements reported between 34 inches and 64 inches from the south end of the gusset plate were found to be shifted approximately 6 inches north from their correct position.
2. For the west gusset plate of node L11W, the table shows dashes (indicating no corrosion) between 82 inches and 98 inches from the south end of the gusset plate. However, the gusset plate was severely damaged in that area and no measurement was possible, so each dash should have been an X, indicating that the area of corrosion was inaccessible or missing.

A corrected version of Appendix 3 from Materials Laboratory Report 08-015 is appended to this report; the entries that were changed are highlighted.

Figures 5 through 8 plot the thickness measurements on the four gusset plates from the laser scans and from the (corrected) field micrometer measurements, showing the good agreement. Figure 9 plots measurements of the widths of the bands of corrosion from all four gusset plates. The corrosion generally occupied a relatively well-defined band, but sometimes occurred over a broader area of scattered pitting, as can be seen in the images in the attached 3D Engineering Solutions report. In the laser-scan images, the gray color indicates the exterior of the scanned object, and the blue color indicates that the view shows the opposite side of a surface that was scanned.

Table 1 provides the mean of the thickness measurements that were made for each plate, the standard deviation of the thickness measurements, and net section loss calculated from the laser scan data for each gusset plate, along with the minimum plate thickness in the corroded area, the maximum plate thickness along the line of corrosion, and the number of readings. Net section loss is calculated as the relative difference between the mean of the thickness measurements and the specified plate thickness of 0.5 inch. At positions where more than one measurement was reported from different pieces, the minimum thickness measurement was used. In Table 1, the maximum thickness measurement for each gusset plate exceeded 0.5 inch, possibly as a result of thickness variation from manufacturing, because of paint layers, or because of deformation. Table 2 presents the same statistical data as Table 1 for the field micrometer measurements. In general, the net section loss from the areas where the measurements were made varied from approximately 5 percent to 20 percent. The tables indicate that the section loss for the inside gusset plates (L11E West plate and L11W East plate) was larger than for the outside gusset plates. Compared to the laser scan data, the field micrometer measurements generally indicate a larger amount of section loss for each gusset plate.

Samuel Pond
Civil Engineer

Carl R. Schultheisz
Materials Research Engineer

	Node L11E East gusset plate	Node L11E West gusset plate	Node L11W East gusset plate	Node L11W West gusset plate
Mean (inches)	0.477	0.414	0.421	0.452
Standard Deviation (inches)	0.043	0.056	0.062	0.057
Number of Readings	125	197	133	129
Minimum (inches)	0.362	0.274	0.276	0.340
Maximum (inches)	0.534	0.530	0.569	0.545
Section loss (%)	4.7	17.1	15.8	9.6

	Node L11E East gusset plate	Node L11E West gusset plate	Node L11W East gusset plate	Node L11W West gusset plate
Mean (inches)	0.455	0.409	0.397	0.441
Standard Deviation (inches)	0.044	0.048	0.029	0.063
Number of Readings	59	99	63	65
Minimum (inches)	0.360	0.270	0.350	0.300
Maximum (inches)	0.500	0.500	0.460	0.500
Section loss (%)	8.9	18.2	20.6	11.8

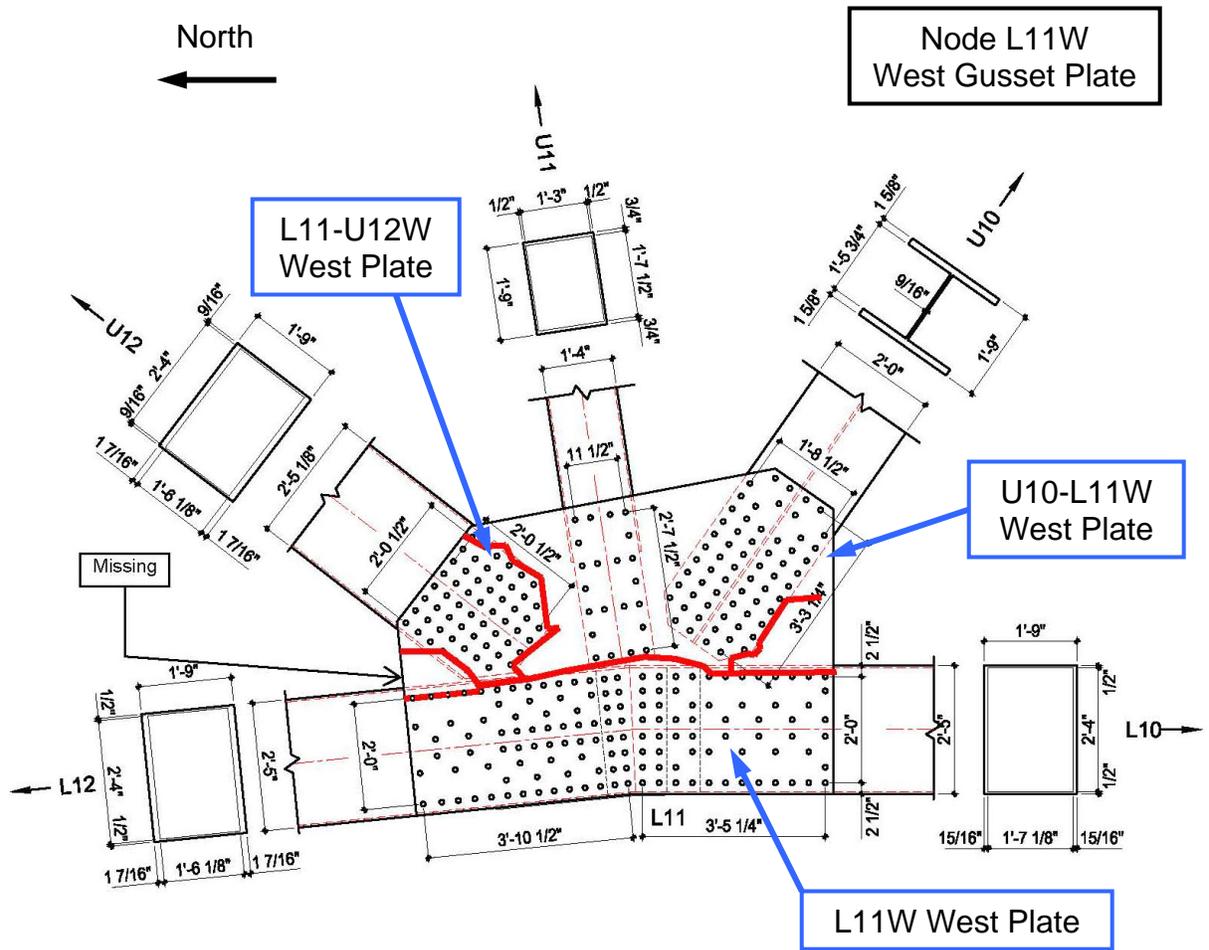


Figure 4. Solid red lines indicate the approximate locations of fractures in the west gusset plate of node L11W. This gusset plate was fractured into four pieces, one of which was missing. The labels in the blue boxes correspond to the pieces identified in the photographs, laser scan images and tables in the attached 3D Engineering Solutions report. The gusset plate segment L11-U12W West Plate was too deformed and damaged to scan.

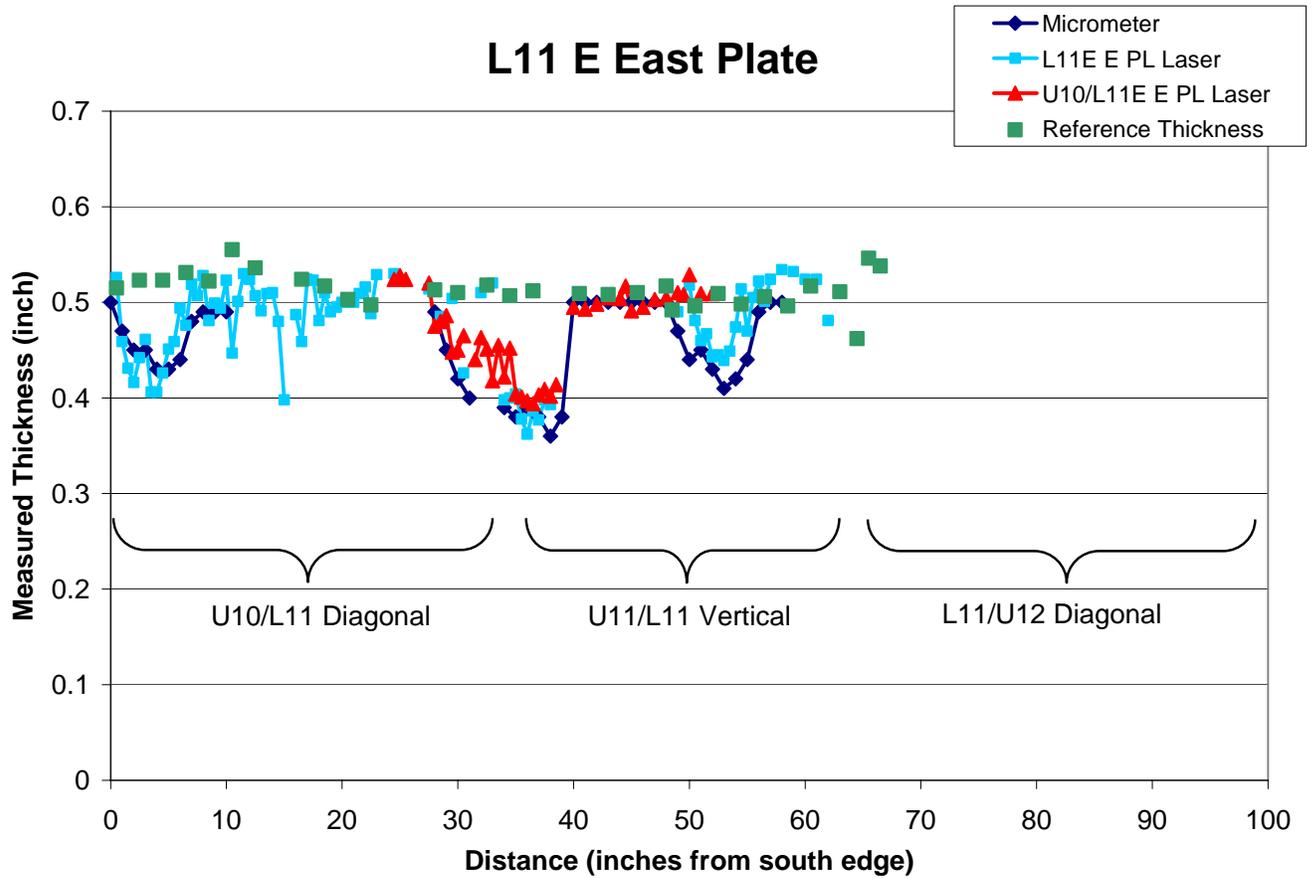


Figure 5. Measured thickness for the east gusset plate of node L11E. North is to the right, matching the orientation of the components in figure 1.

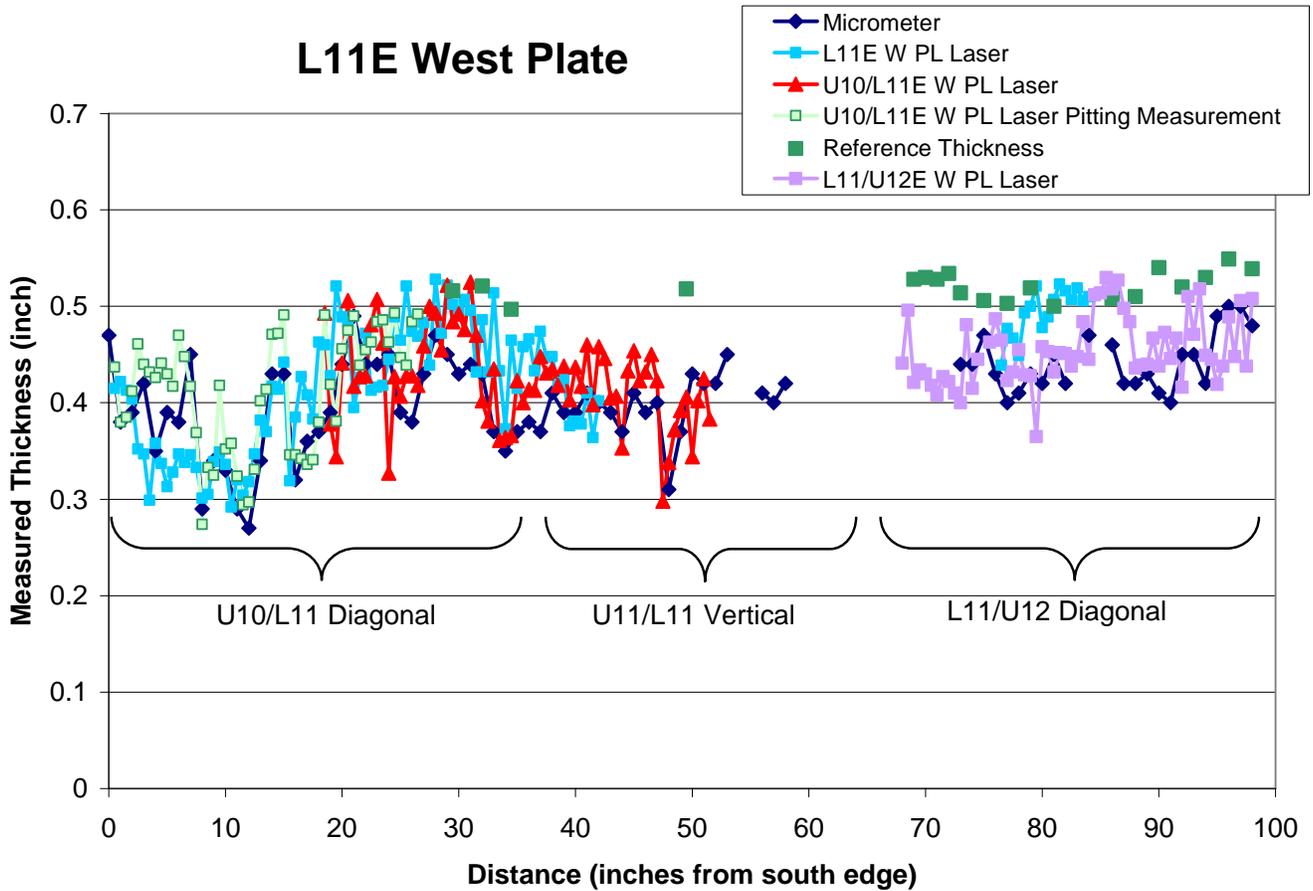


Figure 6. Measured thickness for the west gusset plate of node L11E. North is to the right, opposite the orientation of the components in figure 2.

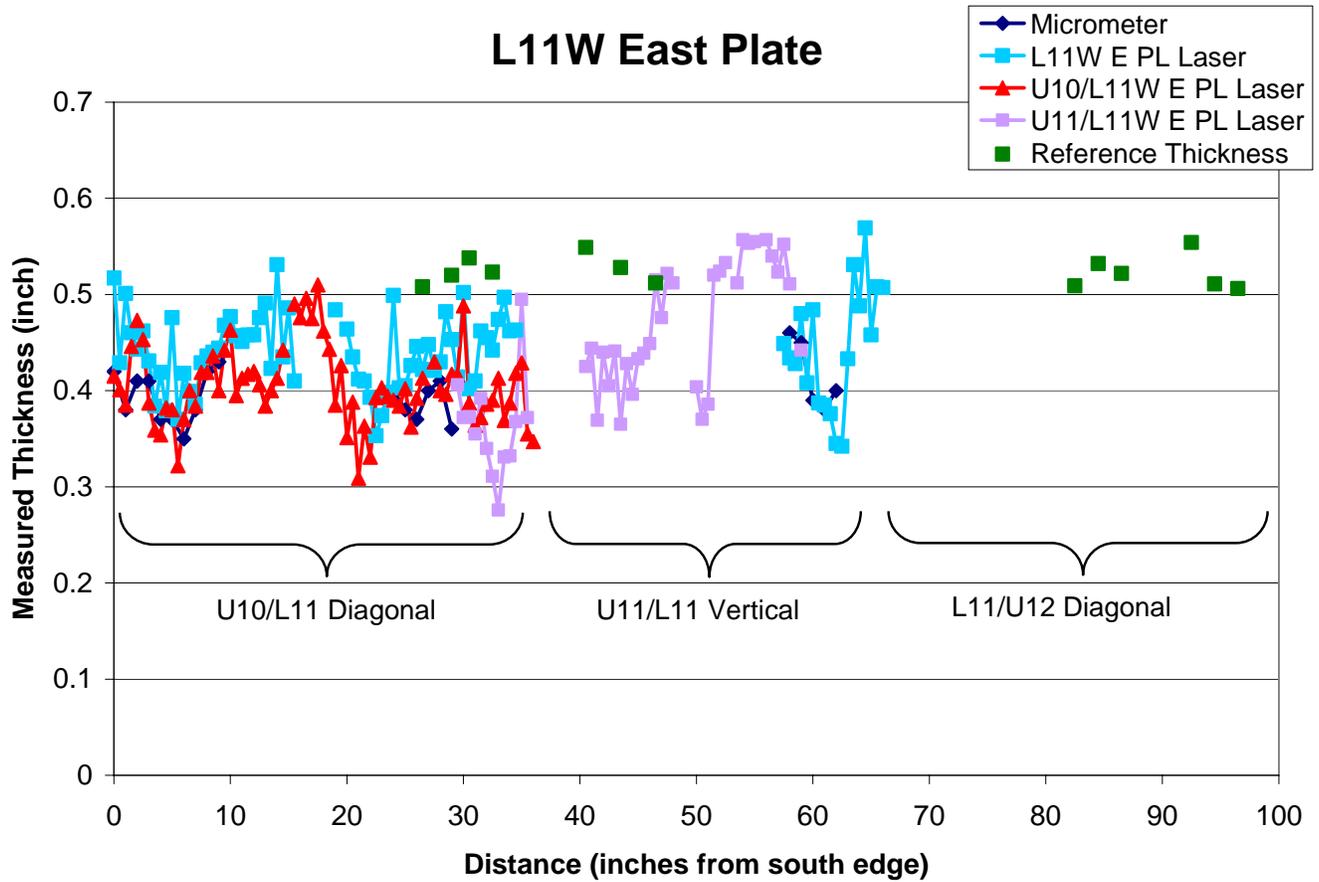


Figure 7. Measured thickness for the east gusset plate of node L11W. North is to the right, matching the orientation of the components in figure 3.

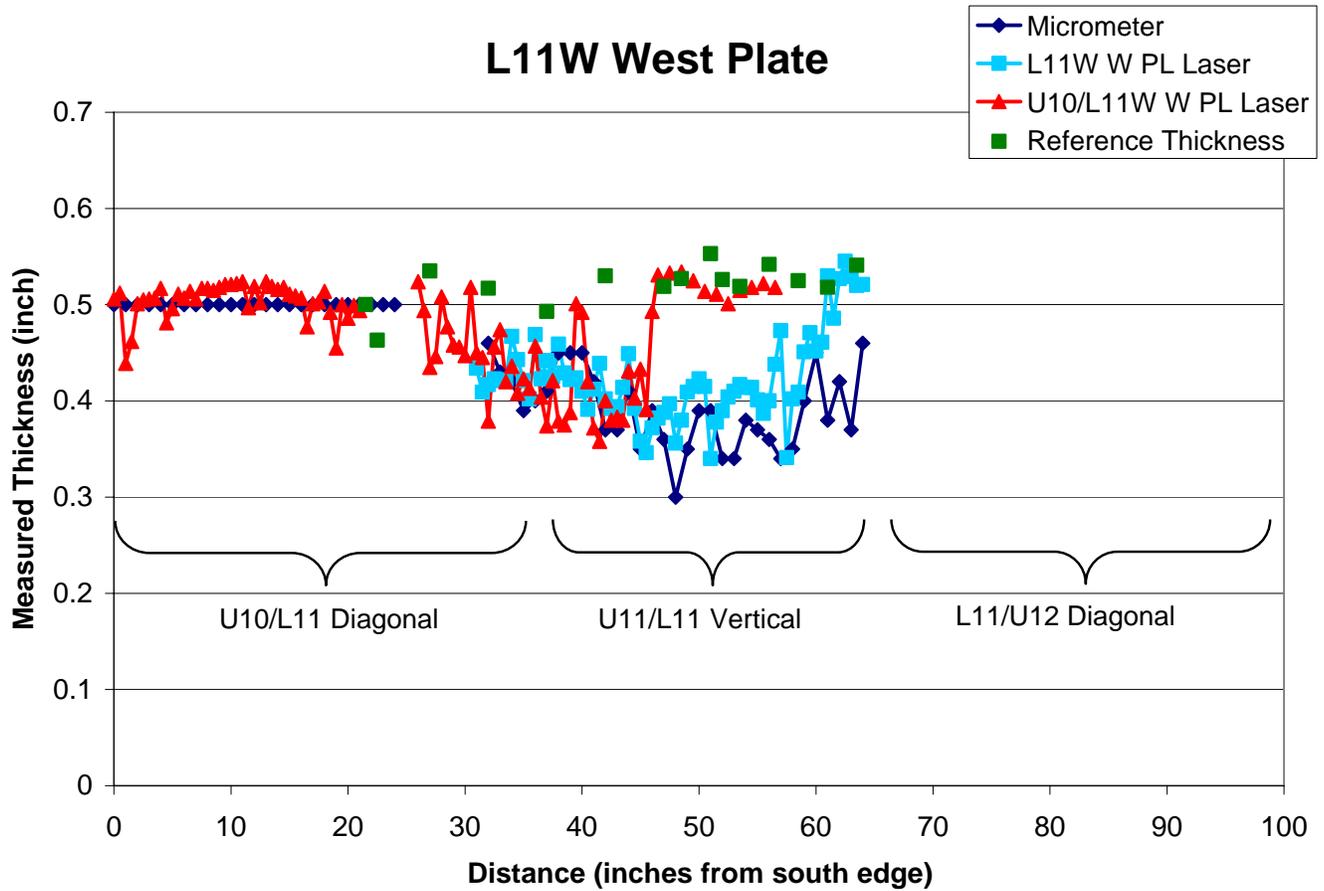


Figure 8. Measured thickness for the west gusset plate of node L11W. North is to the right, opposite the orientation of the components in figure 4.

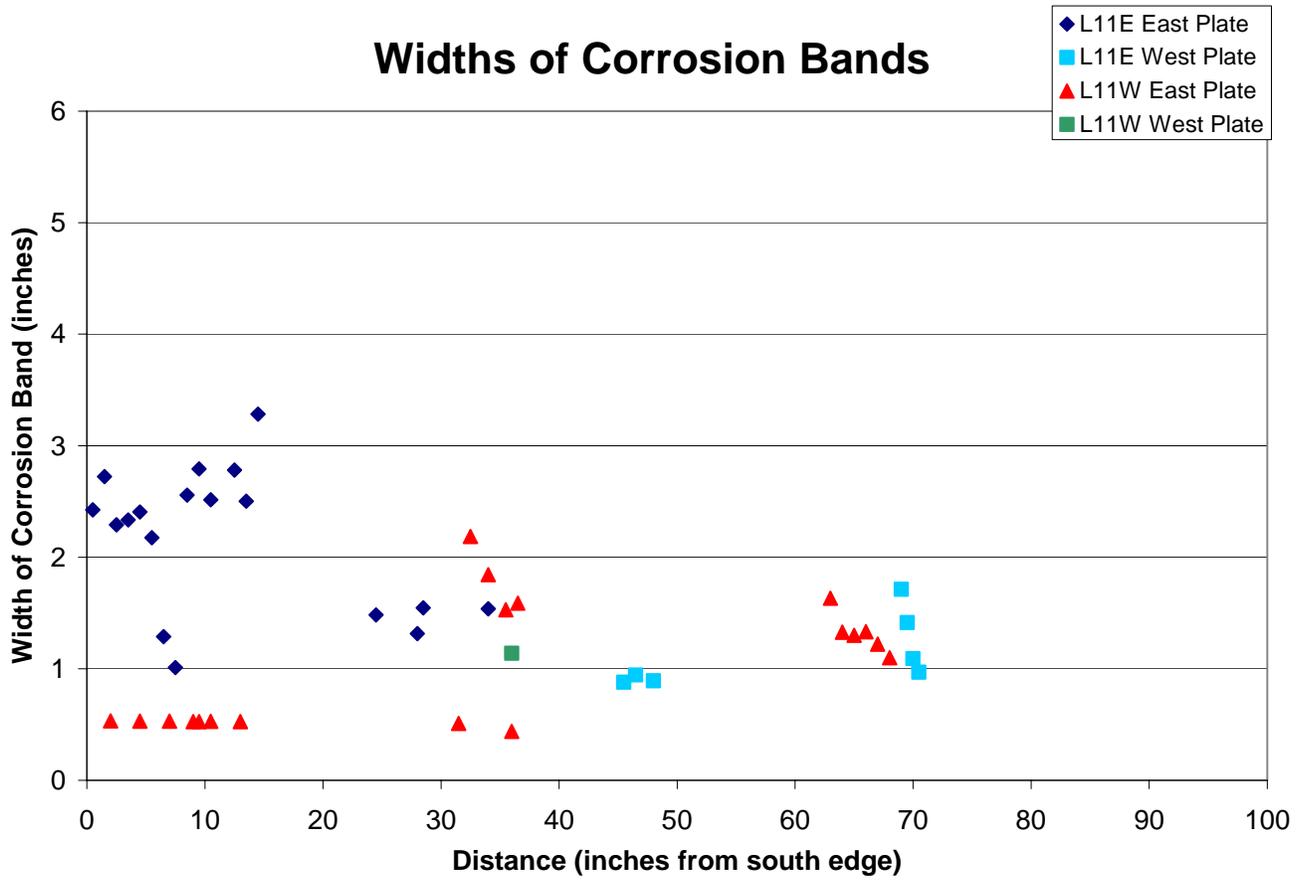


Figure 9. Widths of the bands of corrosion measured from the laser scans.

Appendix 1

Corrected field micrometer measurements from Appendix 3 of the
Structural Investigation Group Chairman's Factual Report,
Materials Laboratory Report 08-015

Corrosion Measurements, Nodes L11E and L11W - corrected 9/4/2008

(NOTE: Corrections in the tables are indicated in **bold red** text.)

In an attempt to quantify section loss due to corrosion in the gusset plates at nodes L11E and L11W, plate thickness was measured, where possible, using an electronic point micrometer. These measurements were made at approximately 1-inch intervals along the line of corrosion, which was on the inside face of the gusset plate at approximately the level of the top surface of the lower chord upper cover plate. However, due to the extent of bending, impact and fracture damage near this line of corrosion, these measurements may include the effects of necking associated with ductile yielding on plate thickness. Where access of the micrometer to both sides of the plate in the line of corrosion was impossible, section loss due to corrosion was estimated by using the micrometer probe to assess the depth of pitting. That depth was then subtracted from the nominal plate thickness to calculate the remaining plate thickness. The table below contains the measured thicknesses.

Although there were a few areas of more localized pitting corrosion, in general the corrosion produced a distinct trough between ½ inch and 1-½ inches wide in the gusset plate. Measurements taken with the point micrometer were possible where the fracture of the gusset plate ran near to, or along, the corrosion line. At points where there was plastic necking at the fracture line, or impact damage, measurements were taken at the point slightly away from the fracture or damage in order to minimize the effect of plastic necking or impact damage on the result; that is to say, at these locations measurements were not taken of the absolute thinnest point in the gusset plate if that point was obviously damaged or necked. At locations where the micrometer could not be directly used, section loss was determined using the micrometer probe to estimate the depth of the corrosion from the edge of the trough to the bottom of the trough.

In the table below, the location is the distance from the south edge of the gusset plate to the point of measurement. In some locations on the west gusset plate of node L11W, the plate thickness was measured on each side of a fracture, and both sets of measurements are given. Where an “X” is listed, the corrosion area was either inaccessible or missing. Where a “-” is listed, no corrosion was present. The thicknesses estimated using the micrometer probe are marked with an asterisk (*).

Node L11E: East Gusset Plate		Node L11E: West Gusset Plate		Node L11W: East Gusset Plate		Node L11W: West Gusset Plate	
Location [in]	Plate Thickness [in]						
0	0.50*	0	0.47	0	0.42	0	-
1	0.47*	1	0.38	1	0.38	1	-
2	0.45*	2	0.39	2	0.41	2	-

3	0.45*	3	0.42	3	0.41	3	-	
4	0.43*	4	0.35	4	0.37	4	-	
5	0.43*	5	0.39	5	0.37	5	-	
6	0.44*	6	0.38	6	0.35	6	-	
7	0.48*	7	0.45	7	0.38	7	-	
8	0.49*	8	0.29	8	0.42	8	-	
9	0.49*	9	0.34	9	0.43	9	-	
10	0.49*	10	0.33	10	X	10	-	
11	X	11	0.29	11	X	11	-	
12	X	12	0.27	12	X	12	-	
13	X	13	0.34	13	X	13	-	
14	X	14	0.43	14	X	14	-	
15	X	15	0.43	15	X	15	-	
16	X	16	0.32	16	X	16	-	
17	X	17	0.36	17	X	17	-	
18	X	18	0.37	18	X	18	-	
19	X	19	0.39	19	X	19	-	
20	X	20	0.44	20	X	20	-	
21	X	21	0.49	21	X	21	-	
22	X	22	0.44	22	X	22	-	
23	X	23	0.44	23	X	23	-	
24	X	24	0.45	24	0.40	24	-	
25	X	25	0.39	25	0.38	25	X	
26	X	26	0.38	26	0.37	26	X	
27	X	27	0.43	27	0.40	27	X	
28	0.49	28	0.47	28	0.41	28	X	
29	0.45	29	0.45	29	0.36	29	X	
30	0.42	30	0.43	30	X	30	X	
31	0.40	31	0.44	31	X	31	X	
32	X	32	0.43	32	X	32	0.46	0.50
33	X	33	0.37	33	X	33	0.50	0.43
34	0.39	34	0.35	34	X	34	-	0.42
35	0.38	35	0.37	35	X	35	-	0.39
36	0.39	36	0.38	36	X	36	-	0.40
37	0.38	37	0.37	37	X	37	-	0.41
38	0.36	38	0.41	38	X	38	-	0.45
39	0.38	39	0.39	39	X	39	-	0.45
40	-	40	0.39	40	X	40	-	0.42
41	-	41	0.41	41	X	41	-	0.37

42	-	42	0.40	42	X	42	-	0.37
43	-	43	0.39	43	X	43	-	0.39
44	-	44	0.37	44	X	44	-	0.41
45	-	45	0.41	45	X	45	0.35	0.36
46	-	46	0.39	46	X	46	0.39	0.34
47	-	47	0.40	47	X	47	0.36	0.39
48	-	48	0.31	48	X	48	0.30	0.36
49	0.47	49	0.37	49	X	49	0.35	0.40
50	0.44	50	0.43	50	X	50	0.39	0.38
51	0.45	51	0.42	51	X	51	0.39	0.34
52	0.43	52	0.42	52	X	52	0.34	0.36
53	0.41	53	0.45	53	X	53	0.34	0.40
54	0.42	54	X	54	X	54	0.38	0.42
55	0.44	55	X	55	X	55	0.37	0.36
56	0.49	56	0.41	56	X	56	0.36	0.39
57	0.50	57	0.40	57	X	57	0.34	0.43
58	0.50	58	0.42	58	0.46	58	0.35	0.49
59	X	59	X	59	0.45	59	0.40	
60	X	60	X	60	0.39	60	0.45	
61	X	61	X	61	0.38	61	0.38	
62	X	62	X	62	0.40	62	0.42	
63	X	63	X	63	X	63	0.37	
64	X	64	X	64	X	64	0.46	
65	X	65	X	65	X	65	X	
66	X	66	X	66	X	66	X	
67	X	67	X	67	X	67	X	
68	X	68	X	68	X	68	X	
69	X	69	X	69	X	69	X	
70	X	70	X	70	X	70	X	
71	X	71	X	71	X	71	X	
72	X	72	X	72	X	72	X	
73	X	73	0.44	73	X	73	X	
74	X	74	0.44	74	X	74	X	
75	X	75	0.47	75	X	75	X	
76	X	76	0.43	76	X	76	X	
77	X	77	0.40	77	X	77	X	
78	X	78	0.41	78	X	78	X	
79	X	79	0.43	79	X	79	X	
80	X	80	0.42	80	X	80	X	

81	X	81	0.45	81	X	81	X
82	X	82	0.42	82	X	82	X
83	X	83	X	83	X	83	X
84	X	84	0.47	84	X	84	X
85	X	85	X	85	X	85	X
86	X	86	0.46	86	X	86	X
87	X	87	0.42	87	X	87	X
88	X	88	0.42	88	X	88	X
89	X	89	0.43	89	X	89	X
90	X	90	0.41	90	X	90	X
91	X	91	0.40	91	X	91	X
92	X	92	0.45	92	X	92	X
93	X	93	0.45	93	X	93	X
94	X	94	0.42	94	X	94	X
95	X	95	0.49	95	X	95	X
96	X	96	0.50	96	X	96	X
97	X	97	0.50	97	X	97	X
98	X	98	0.48	98	X	98	X

Appendix 2

3D Engineering Solutions Report
Laser scanning of L11 nodes

I-35W BRIDGE COLLAPSE MINNEAPOLIS, MN 08-01-07

Prepared for: National Transportation Safety Board
490 L'Enfant Plaza SW
Washington DC, 20594

Prepared by: Nick Clark

Approved by: Jerome L. Clark

Date: 08/26/08



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CERTIFICATE OF INSPECTION

CUSTOMER: National Transportation Safety Board
490 L'Enfant Plaza, SW
Washington DC, 20594

PO Number: NTSBPO80052

PART NUMBER: N/A Rev. N/A

PART DESCRIPTION: I-35W Bridge Gusset Plates (nodes L11 East and L11 West)

UNIT OF MEASURE: inches

INSPECTED BY: Greg Sullivan

INSPECTION EQUIPMENT: Faro Platinum Arm S/N P08-05-07-05240 (Cert #P0524039373)
Faro Laser Line Probe S/N LLP000702705 (Cert #L0270539618)

TEMPERATURE: On-site @ NTSB Training Center, Ashburn, VA

INSPECTION DATE: 06-25-08

This is to certify that the item listed above was inspected with instrument(s) calibrated with standards traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or an ISO17025 Accredited Laboratory. Expanded measurement uncertainty is $95.14 + 3.7L$ micrometers, where L = measured length in meters. Uncertainty is expressed at approximately a 95% Level of Confidence using $k = 2.00$.

Approved By: 

Date: 08-26-08

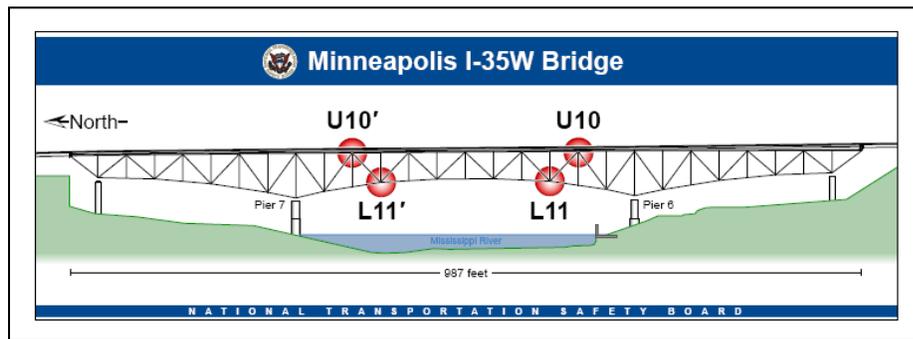
Jerome L. Clark
VP Operations

Measuring
and
Modeling
Quality

3DES Report #NTSB052708-01

1. Introduction

This report presents the results of the measurement of the section loss due to corrosion on the gusset plates from nodes L11 East and L11 West on the I-35W bridge which collapsed in Minneapolis, MN on August 1, 2007.



The report is the result of a collaboration of 3D Engineering Solutions and NTSB personnel. The following list describes the members of the team and their major area(s) of contribution.

Greg Sullivan	3D Engineering Solutions	Actual part laser scanning
Nick Clark	3D Engineering Solutions	Polygonal modeling, cross-section creation & final report generation
Jerome Clark	3D Engineering Solutions	Coordination; Supervision & Support
Sam Pond	NTSB	Cross section and corrosion measurement & documentation
Carl Schultheisz	NTSB	Coordination; Supervision & Support

2. Measurement Methodology

Areas of the fractured gusset plates designated by NTSB personnel were laser scanned by 3D Engineering Solutions using an 8 ft. Platinum Faro Arm (portable CMM) equipped with a Faro Laser Line Probe and Polyworks software by Innovmetrics. Further utilizing the Polyworks software, the point cloud generated by the laser scan was edited to eliminate any extraneous data and then meshed into a polygonal model. Cross sections were created every 1/2" through the entire length of the polygonal model. Using the dimensional measurement tools within the Polyworks IMInspect module, section minimum thickness and corrosion depth measurements were taken. Results of those measurements are contained herein.

The measurement uncertainty of the process is as stated in the "Certificate of Inspection", contained herein.



TYPICAL SETUPS





L11E EAST PLATE



L11E WEST PLATE



L11W EAST PLATE



L11W WEST PLATE



U11-L11W EAST PLATE



U10-L11E EAST PLATE



U10-L11E WEST PLATE



U10-L11W EAST PLATE

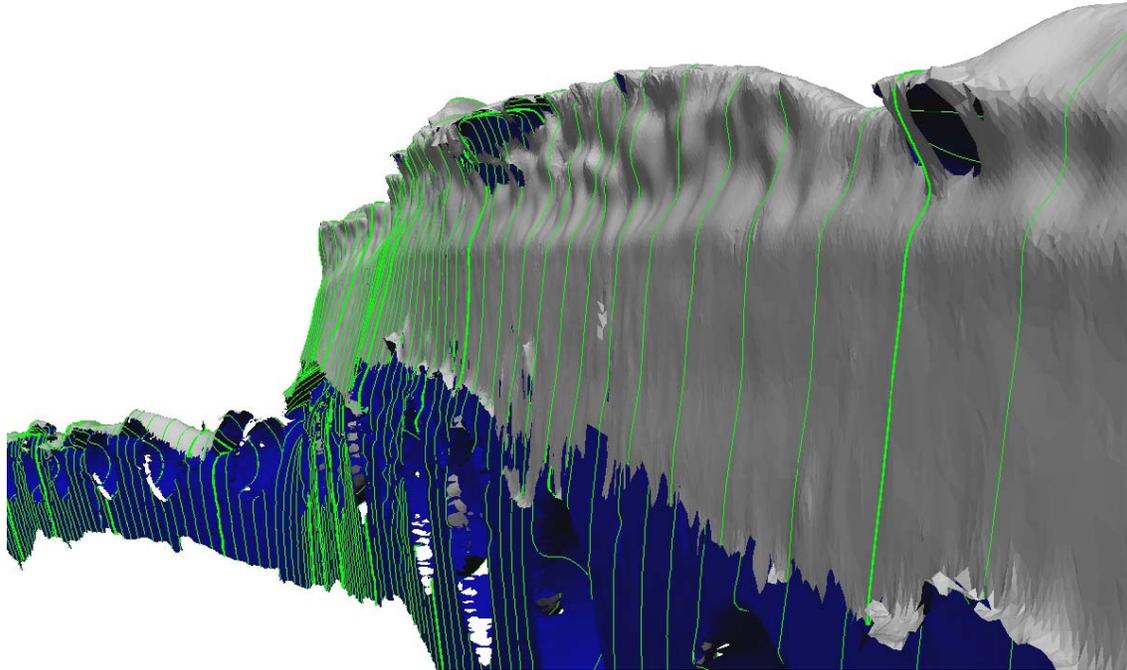


U10-L11W WEST PLATE

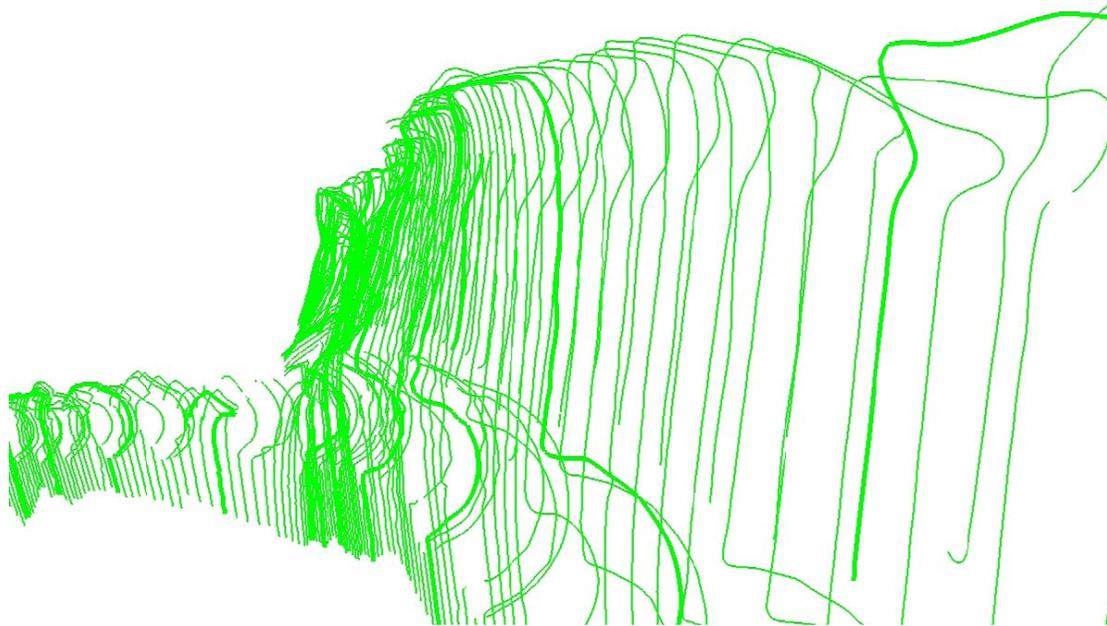


L11-U12E WEST PLATE

TYPICAL CROSS-SECTIONING



CROSS SECTIONS SHOWN WITH POLYGONAL MODEL



CROSS SECTIONS SHOWN WITHOUT POLYGONAL MODEL

Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
0.0						
0.5	0.526	2.425	0.515			
1.0	0.459					
1.5	0.431	2.724				
2.0	0.416					
2.5	0.442	2.29	0.523			
3.0	0.461					
3.5	0.406	2.335				
4.0	0.406					
4.5	0.426	2.406	0.523			
5.0	0.451					
5.5	0.459	2.175				
6.0	0.494					
6.5	0.476	1.288	0.531			
7.0	0.519					
7.5	0.507	1.011				
8.0	0.528					
8.5	0.481	2.557	0.522			
9.0	0.499					
9.5	0.494	2.793				
10.0	0.523					
10.5	0.447	2.515	0.555			
11.0	0.501					
11.5	0.53					
12.0	0.524					
12.5	0.507	2.782	0.536			
13.0	0.491					
13.5	0.509	2.502				
14.0	0.51					
14.5	0.48	3.283				
15.0	0.398					
15.5						
16.0	0.487					
16.5	0.459		0.524			

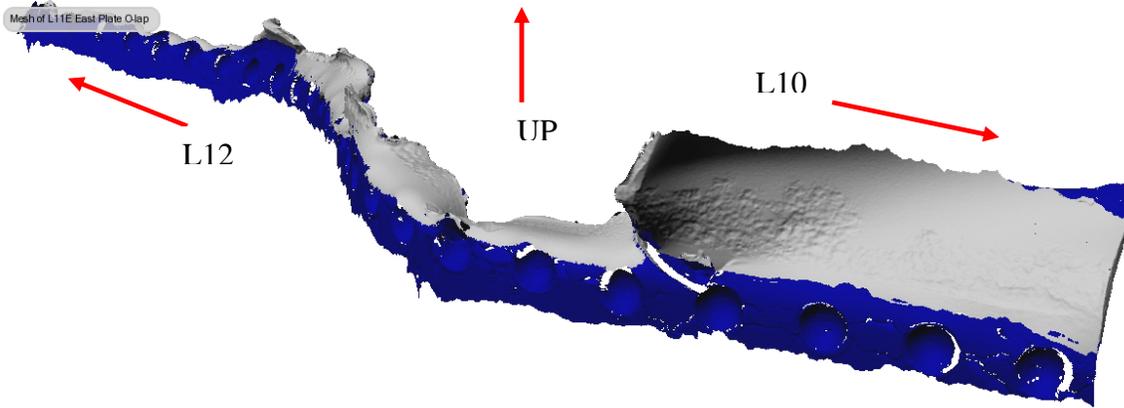
Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
17.0	0.524					
17.5	0.523					
18.0	0.481					
18.5	0.51		0.517			
19.0	0.49					
19.5	0.495					
20.0	0.5					
20.5	0.5		0.503			
21.0	0.5					
21.5	0.509					
22.0	0.516					
22.5	0.488		0.497			
23.0	0.529					
23.5						
24.0						
24.5	0.53	1.484		0.524	2.061	
25.0				0.528		
25.5				0.524		
26.0						
26.5						
27.0						
27.5	0.514			0.52		
28.0		1.315	0.513	0.475		
28.5	0.485			0.48	1.546	
29.0				0.486		
29.5	0.504			0.448		
30.0			0.51	0.45		
30.5	0.426			0.465		
31.0						
31.5				0.44		0.546
32.0	0.51			0.463		
32.5			0.518	0.451		
33.0	0.52			0.418		
33.5				0.455		
34.0	0.398			0.422	1.538	0.511

Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
34.5	0.4		0.507	0.452		
35.0	0.404			0.404		
35.5	0.378			0.401		
36.0	0.362			0.397		
36.5	0.386		0.512	0.394		
37.0	0.377			0.403		
37.5	0.398			0.409		
38.0	0.393			0.402		
38.5				0.414		
39.0						
39.5						
40.0				0.495		
40.5			0.509			
41.0				0.493		
41.5						
42.0				0.498		
42.5						
43.0			0.508	0.505		
43.5						
44.0				0.504		
44.5				0.517		0.517
45.0				0.491		
45.5			0.51			
46.0				0.495		
46.5						
47.0				0.503		0.51
47.5						
48.0			0.517	0.505		
48.5			0.492			
49.0	0.49			0.51		
49.5				0.508		0.508
50.0	0.518			0.529		
50.5	0.481		0.496			
51.0	0.46			0.509		
51.5	0.467					

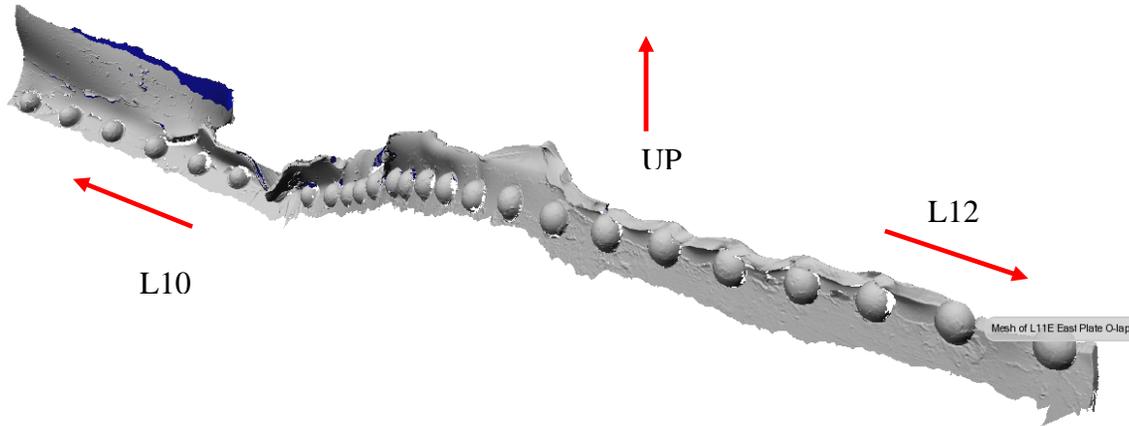
Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
52.0	0.443			0.509		0.509
52.5	0.445	0.514	0.509			
53.0	0.439					
53.5	0.449					
54.0	0.474					
54.5	0.514	0.562	0.498			
55.0	0.47					
55.5	0.505					
56.0	0.522					
56.5	0.501		0.506			
57.0	0.524					
57.5						
58.0	0.534					
58.5			0.496			
59.0	0.532					
59.5						
60.0	0.524					
60.5			0.517			
61.0	0.524					
61.5						
62.0	0.481					
62.5						
63.0			0.511			
63.5						
64.0						
64.5			0.462			
65.0						
65.5			0.546			
66.0						
66.5			0.538			
67.0						
67.5						
68.0						
68.5						
69.0						

Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
69.5						
70.0						
70.5						
71.0						
71.5						
72.0						
72.5						
73.0						
73.5						
74.0						
74.5						
75.0						
75.5						
76.0						
76.5						
77.0						
77.5						
78.0						
78.5						
79.0						
79.5						
80.0						
80.5						
81.0						
81.5						
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83.5						
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84.5						
85.0						
85.5						
86.0						
86.5						

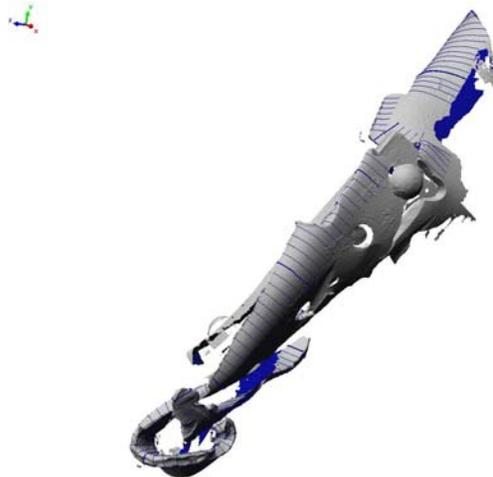
Distance (in) (from S Edge of Plate)	Node L11 E. East Gusset Plate.					
	Laser Scan					
	L11E E PL Scan			U10/L11E E PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
87.0						
87.5						
88.0						
88.5						
89.0						
89.5						
90.0						
90.5						
91.0						
91.5						
92.0						
92.5						
93.0						
93.5						
94.0						
94.5						
95.0						
95.5						
96.0						
96.5						
97.0						
97.5						
98.0						



L11E East Plate Inner Surface



L11E East Plate outer surface



U10/L11E East Plate

Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
0.0										
0.5	0.415					0.063	0.437			
1.0	0.422					0.12	0.38			
1.5	0.413					0.115	0.385			
2.0	0.404					0.088	0.412			
2.5	0.352					0.039	0.461			
3.0	0.347					0.06	0.44			
3.5	0.299					0.068	0.432			
4.0	0.358					0.074	0.426			
4.5	0.337					0.059	0.441			
5.0	0.313					0.07	0.43			
5.5	0.328					0.083	0.417			
6.0	0.347					0.03	0.47			
6.5	0.338					0.052	0.448			
7.0	0.346					0.083	0.417			
7.5	0.333					0.131	0.369			
8.0	0.301					0.226	0.274			
8.5	0.305					0.167	0.333			
9.0	0.339					0.175	0.325			
9.5	0.349					0.082	0.418			
10.0	0.336					0.148	0.352			
10.5	0.292					0.142	0.358			
11.0	0.32					0.176	0.324			
11.5	0.304					0.206	0.294			
12.0	0.318					0.203	0.297			
12.5	0.347					0.169	0.331			
13.0	0.382					0.098	0.402			
13.5	0.37					0.086	0.414			
14.0	0.417					0.029	0.471			
14.5	0.414					0.028	0.472			
15.0	0.442					0.009	0.491			

Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
15.5	0.319					0.154	0.346			
16.0	0.385					0.154	0.346			
16.5	0.427					0.158	0.342			
17.0	0.408					0.164	0.336			
17.5	0.383					0.159	0.341			
18.0	0.463					0.12	0.38			
18.5	0.46			0.493		0.009	0.491			
19.0	0.428			0.378		0.081	0.419			
19.5	0.521			0.344		0.119	0.381	0.531		
20.0	0.489			0.441		0.044	0.456			
20.5	0.484			0.506		0.025	0.475			
21.0	0.395			0.417		0.01	0.49			
21.5	0.426			0.427		0.061	0.439			
22.0	0.472			0.428		0.045	0.455			
22.5	0.413			0.481		0.037	0.463			
23.0	0.416			0.507		0.016	0.484			
23.5	0.418			0.462		0.014	0.486			
24.0	0.445			0.327		0.037	0.463			
24.5	0.489			0.427		0.007	0.493	0.524		
25.0	0.465			0.407		0.053	0.447			
25.5	0.521			0.428		0.061	0.439			
26.0	0.474			0.428		0.016	0.484			
26.5	0.469			0.418		0.008	0.492			
27.0	0.483			0.459						
27.5	0.439			0.5						
28.0	0.528			0.493						
28.5	0.472			0.455						
29.0	0.522			0.522						
29.5	0.502		0.516	0.484				0.516		
30.0	0.494			0.492						
30.5	0.507			0.476						

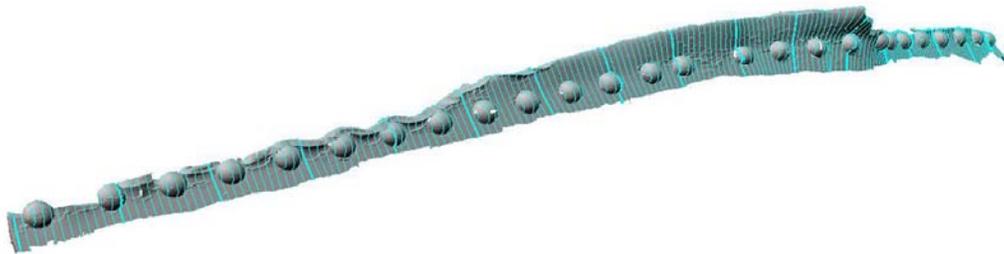
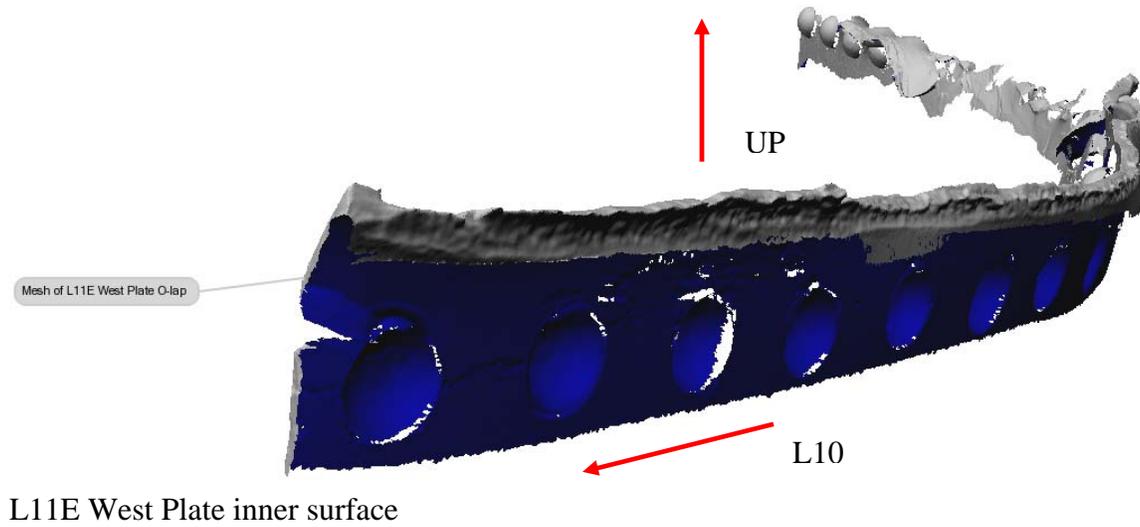
Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
31.0	0.496			0.525						
31.5	0.432			0.47						
32.0	0.486		0.521	0.402						
32.5	0.432			0.381						
33.0	0.514			0.435						
33.5	0.433			0.361						
34.0	0.373			0.364						
34.5	0.465		0.497	0.366				0.508		
35.0	0.415			0.423						
35.5	0.458			0.4						
36.0	0.466			0.414						
36.5	0.433			0.413						
37.0	0.474			0.448						
37.5	0.447			0.431						
38.0	0.448			0.435						
38.5	0.419			0.418						
39.0	0.425			0.438						
39.5	0.376			0.403				0.503		
40.0	0.381			0.437						
40.5	0.378			0.417						
41.0	0.41			0.46						
41.5	0.364			0.398						
42.0	0.402			0.458						
42.5				0.446						
43.0				0.405						
43.5				0.407						
44.0				0.353						
44.5				0.433				0.5		
45.0				0.454						
45.5				0.423	0.879					
46.0				0.432						

Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
46.5				0.45	0.945					
47.0				0.423						
47.5				0.298						
48.0				0.338	0.892					
48.5				0.372						
49.0				0.392						
49.5			0.518	0.406				0.518		
50.0				0.344						
50.5				0.402						
51.0				0.425						
51.5				0.383						
52.0										
52.5										
53.0										
53.5										
54.0										
54.5										
55.0										
55.5										
56.0										
56.5										
57.0										
57.5										
58.0										
58.5										
59.0										
59.5										
60.0										
60.5										
61.0										
61.5										

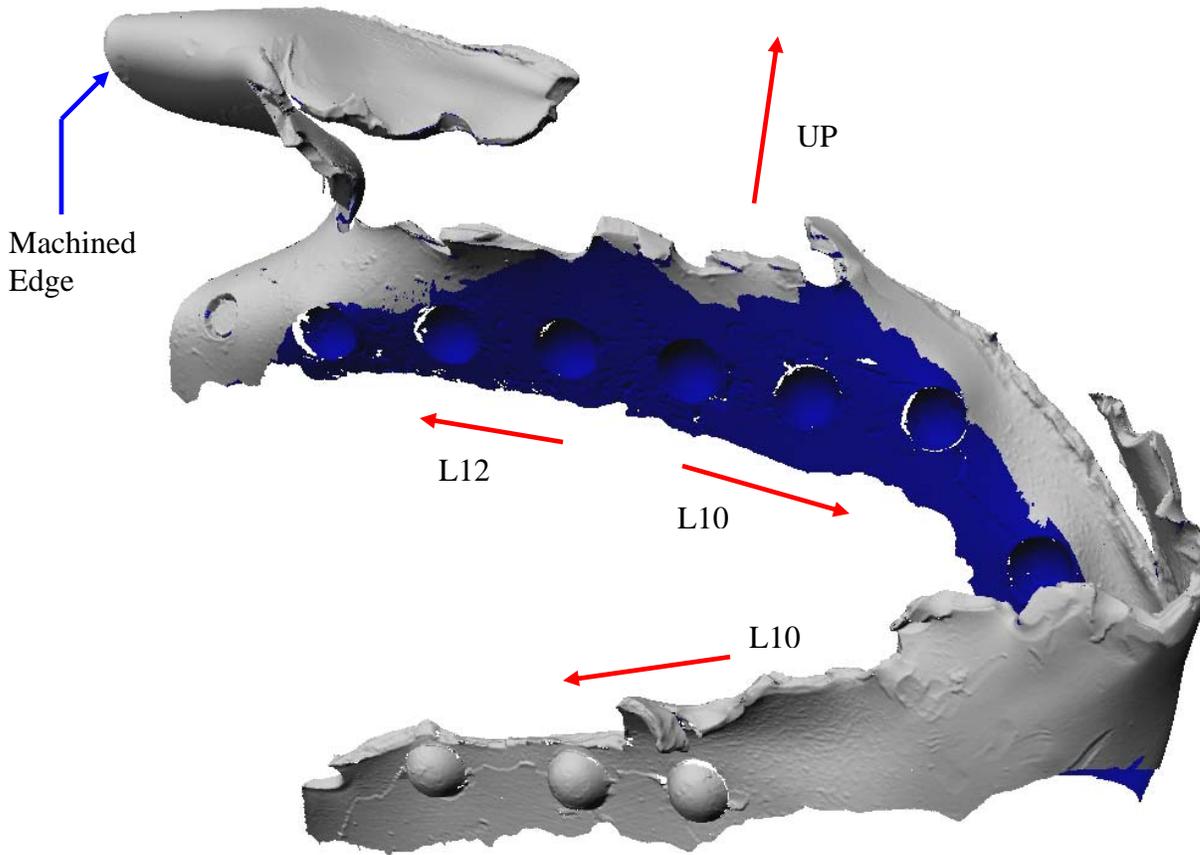
Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
62.0										
62.5										
63.0										
63.5										
64.0										
64.5										
65.0										
65.5										
66.0										
66.5										
67.0										
67.5										
68.0									0.441	
68.5									0.496	
69.0			0.528						0.421	1.712
69.5									0.434	1.413
70.0			0.53						0.43	1.091
70.5									0.418	0.97
71.0			0.528						0.408	
71.5									0.427	
72.0			0.534						0.422	
72.5									0.41	
73.0			0.514						0.4	
73.5									0.481	
74.0									0.415	
74.5									0.445	
75.0			0.506							
75.5									0.463	
76.0									0.487	
76.5	0.439								0.465	
77.0	0.477		0.503						0.423	

Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
77.5	0.467								0.432	
78.0	0.449								0.455	
78.5	0.493								0.429	
79.0	0.5		0.519						0.428	
79.5	0.521								0.365	
80.0	0.478								0.458	
80.5	0.489								0.453	
81.0	0.507		0.5						0.432	
81.5	0.523								0.452	
82.0	0.516								0.451	
82.5	0.507								0.438	
83.0	0.519								0.448	
83.5	0.506								0.484	
84.0	0.51								0.445	
84.5									0.512	
85.0									0.514	
85.5									0.53	
86.0			0.508						0.518	
86.5									0.527	
87.0									0.498	
87.5									0.484	
88.0			0.51						0.436	
88.5									0.439	
89.0									0.44	
89.5									0.467	
90.0			0.54						0.438	
90.5									0.473	
91.0									0.446	
91.5									0.467	
92.0			0.52						0.416	
92.5									0.51	

Distance (in) (from S Edge of Plate)	Node L11E. West Gusset Plate.									
	Laser Scan									
	L11E W PL Scan			U10-L11E W PL Scan				L11/U12E W PL Scan		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Depth of Pitting	Estimated section at corrosion =.50- depth of pitting	Nominal Thickness	Section @ Corrosion	Corrosion Width
93.0									0.471	
93.5									0.518	
94.0			0.53						0.449	
94.5									0.445	
95.0									0.419	
95.5									0.438	
96.0			0.549						0.489	
96.5									0.448	
97.0									0.506	
97.5									0.438	
98.0			0.539						0.508	



L11E West Plate outer surface



L11/U12E West Plate inner surface

Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
0.0	0.517			0.415				
0.5	0.429			0.401				
1.0	0.501			0.385				
1.5	0.46			0.446				
2.0	0.443			0.473	0.533			
2.5	0.462			0.453				
3.0	0.431			0.387				
3.5	0.384			0.359				
4.0	0.419			0.354				
4.5	0.379			0.382	0.53			
5.0	0.476			0.380				
5.5	0.37			0.322				
6.0	0.418			0.370				
6.5	0.399			0.400				
7.0	0.386			0.384	0.53			
7.5	0.429			0.419				
8.0	0.436			0.419				
8.5	0.44			0.436				
9.0	0.444			0.400	0.527			
9.5	0.468			0.442	0.527			
10.0	0.477			0.463				
10.5	0.457			0.395	0.529			
11.0	0.451			0.413				
11.5	0.458			0.417				
12.0	0.458			0.420				
12.5	0.476			0.406				
13.0	0.491			0.384	0.526			
13.5	0.423			0.400				
14.0	0.531			0.413				
14.5	0.435			0.442				
15.0	0.486							
15.5	0.41			0.490				
16.0				0.476				
16.5				0.496				

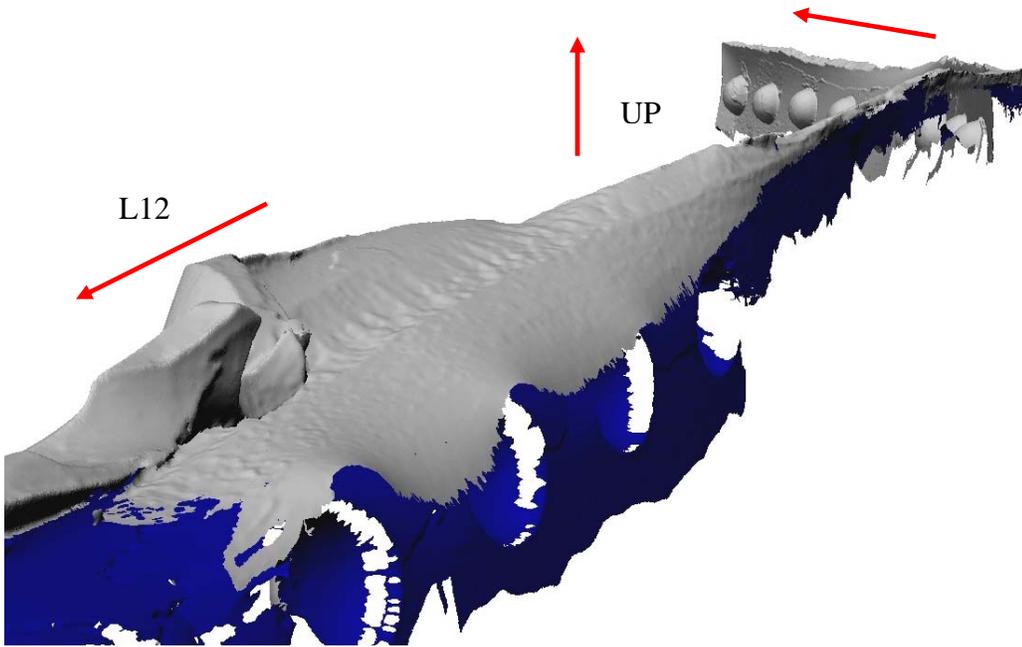
Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
17.0				0.475				
17.5				0.510				
18.0				0.462				
18.5				0.443				
19.0	0.484			0.385				
19.5				0.426				
20.0	0.464			0.351				
20.5	0.435			0.388				
21.0	0.412			0.309				
21.5	0.41			0.363				
22.0	0.393			0.331				
22.5	0.353			0.393				
23.0	0.374			0.403				
23.5	0.398			0.394				
24.0	0.499			0.390				
24.5	0.403			0.384				
25.0	0.405			0.402				
25.5	0.426			0.362				
26.0	0.446			0.392				
26.5	0.422		0.508	0.413				
27.0	0.448							
27.5	0.421			0.430				
28.0	0.43			0.400				
28.5	0.482			0.396				
29.0	0.453		0.52	0.417				
29.5	0.414			0.416		0.406		
30.0	0.502			0.488		0.372		
30.5	0.402		0.538	0.387		0.373		
31.0	0.41			0.364		0.355		
31.5	0.462			0.372	0.509	0.392		
32.0	0.455			0.386		0.34		
32.5	0.442		0.523	0.390		0.311	2.185	
33.0	0.474			0.413		0.276		
33.5	0.497			0.369		0.331		
34.0	0.462			0.387	0.524	0.332	1.844	

Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
34.5	0.463			0.418		0.368		
35.0				0.429		0.495		
35.5				0.355		0.372	1.53	
36.0				0.347	0.439			
36.5							1.588	
37.0								
37.5								
38.0								
38.5								
39.0								
39.5								
40.0								
40.5			0.549			0.425		0.549
41.0						0.444		
41.5						0.369		
42.0						0.44		
42.5						0.405		
43.0						0.441		
43.5			0.528			0.365		0.528
44.0						0.428		
44.5						0.396		
45.0						0.433		
45.5						0.439		
46.0						0.449		
46.5			0.512			0.515		0.512
47.0						0.476		
47.5						0.522		
48.0						0.512		
48.5								
49.0								
49.5								
50.0						0.404		
50.5						0.37		
51.0						0.386		
51.5						0.52		

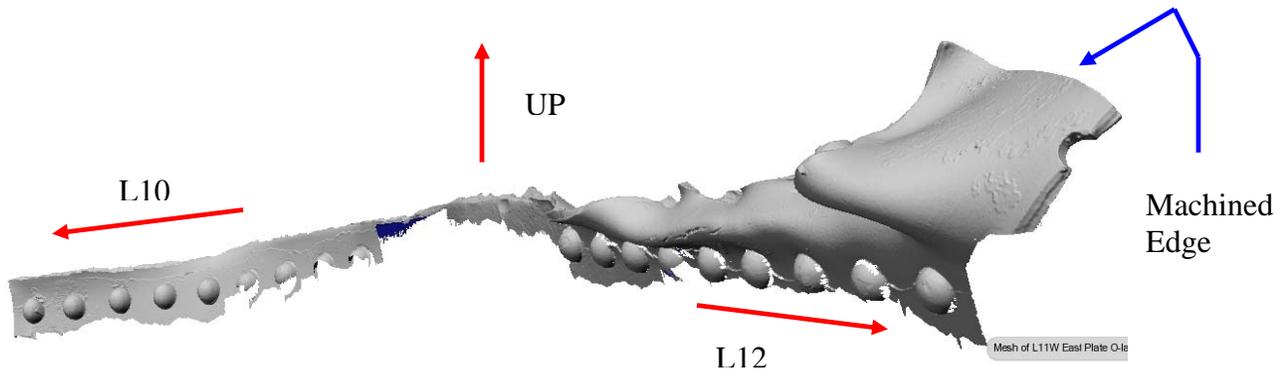
Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
52.0						0.524		
52.5						0.533		
53.0								
53.5						0.512		
54.0						0.557		
54.5						0.553		
55.0						0.555		
55.5								
56.0						0.557		
56.5						0.54		
57.0						0.523		
57.5	0.449					0.552		
58.0	0.434					0.511		
58.5	0.428							
59.0	0.48					0.442		
59.5	0.408							
60.0	0.484							
60.5	0.387							
61.0	0.385							
61.5	0.376							
62.0	0.345							
62.5	0.342							
63.0	0.433	1.633						
63.5	0.531							
64.0	0.488	1.328						
64.5	0.569							
65.0	0.458	1.3						
65.5	0.508							
66.0	0.507	1.332						
66.5								
67.0		1.222						
67.5								
68.0		1.1						
68.5								
69.0								

Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
69.5								
70.0								
70.5								
71.0								
71.5								
72.0								
72.5								
73.0								
73.5								
74.0								
74.5								
75.0								
75.5								
76.0								
76.5								
77.0								
77.5								
78.0								
78.5								
79.0								
79.5								
80.0								
80.5								
81.0								
81.5								
82.0								
82.5			0.509					
83.0								
83.5								
84.0								
84.5			0.532					
85.0								
85.5								
86.0								
86.5			0.522					

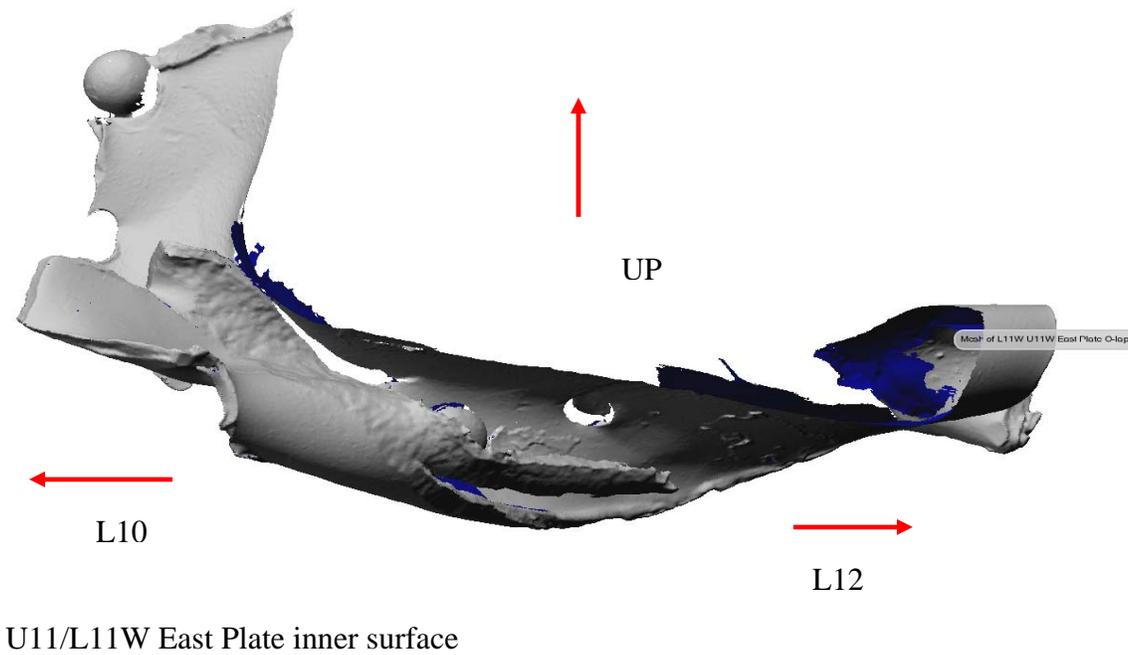
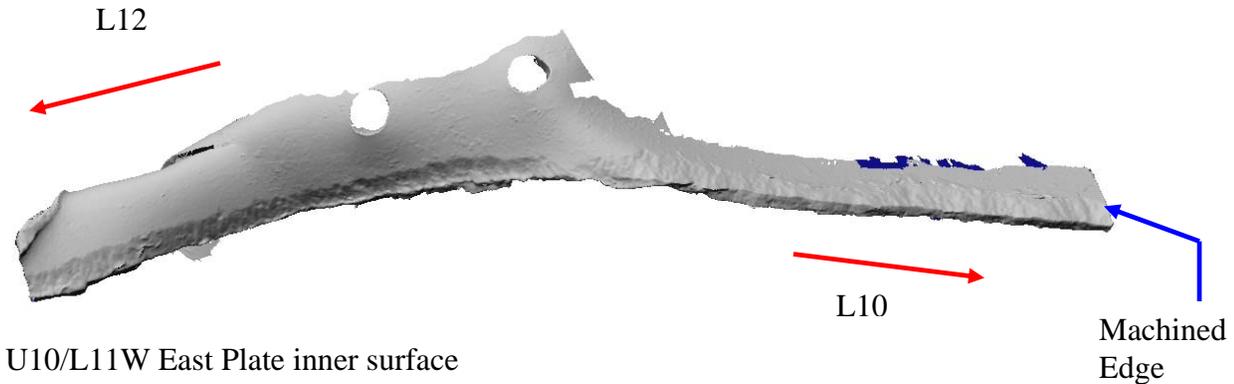
Distance (in) (from S Edge of Plate)	Node L11W. East Gusset Plate.							
	Laser Scan							
	L11W E PL Data			U10/L11W E PL		U11-L11W E PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Section @ Corrosion	Corrosion Width	Nominal Thickness
87.0								
87.5								
88.0								
88.5								
89.0								
89.5								
90.0								
90.5								
91.0								
91.5								
92.0								
92.5			0.554					
93.0								
93.5								
94.0								
94.5			0.511					
95.0								
95.5								
96.0								
96.5			0.506					
97.0								
97.5								
98.0								



L11W East Plate inner surface



L11W East Plate outer surface



Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
0.0				0.506		
0.5				0.512		
1.0				0.439		
1.5				0.462		
2.0				0.501		
2.5				0.505		
3.0				0.506		
3.5				0.507		
4.0				0.517		
4.5				0.481		
5.0				0.496		
5.5				0.511		
6.0				0.507		
6.5				0.514		
7.0				0.506		
7.5				0.517		
8.0				0.517		
8.5				0.515		
9.0				0.518		
9.5				0.521		
10.0				0.521		
10.5				0.522		
11.0				0.524		
11.5				0.497		
12.0				0.519		
12.5				0.502		
13.0				0.524		
13.5				0.519		
14.0				0.516		
14.5				0.518		
15.0				0.511		
15.5				0.509		
16.0				0.507		
16.5				0.477		
17.0				0.501		

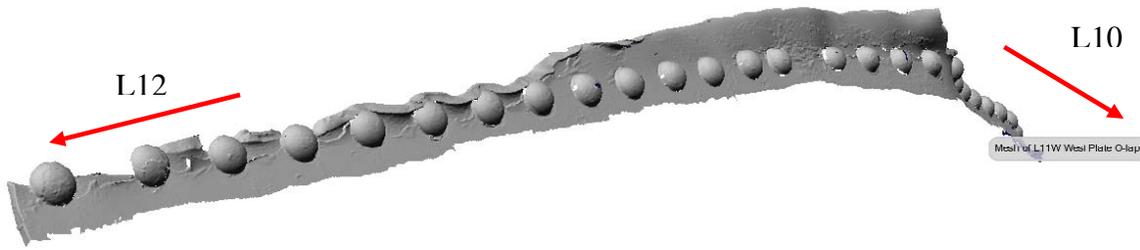
Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
17.5				0.503		
18.0				0.514		
18.5				0.492		
19.0				0.455		
19.5				0.5		
20.0				0.486		
20.5				0.499		
21.0				0.494		
21.5			0.5			0.5
22.0						
22.5			0.463			0.463
23.0						
23.5						
24.0						
24.5						
25.0						
25.5						
26.0				0.524		
26.5				0.494		
27.0			0.535	0.435		0.535
27.5				0.446		
28.0				0.508		
28.5				0.477		
29.0				0.458		
29.5				0.456		
30.0				0.447		
30.5				0.518		
31.0	0.434			0.45		
31.5	0.409			0.445		
32.0	0.417		0.517	0.379		0.517
32.5	0.423			0.456		
33.0	0.421			0.474		
33.5	0.422			0.42		
34.0	0.467			0.436		
34.5	0.443			0.408		
35.0	0.421			0.423		

Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
35.5	0.402			0.413		
36.0	0.469	1.139		0.457		
36.5	0.423			0.404		
37.0	0.442		0.493	0.374		0.493
37.5	0.425			0.421		
38.0	0.459			0.379		
38.5	0.429			0.375		
39.0	0.422			0.388		
39.5	0.424			0.501		
40.0	0.41			0.492		
40.5	0.391			0.42		
41.0	0.412			0.372		
41.5	0.439			0.358		
42.0	0.402		0.53	0.4		0.53
42.5	0.392			0.38		
43.0	0.394			0.383		
43.5	0.414			0.38		
44.0	0.449			0.431		
44.5	0.392			0.403		
45.0	0.358			0.433		
45.5	0.346			0.391		
46.0	0.372			0.493		
46.5	0.382			0.531		
47.0	0.388		0.519			0.519
47.5	0.397			0.533		
48.0	0.356					
48.5	0.38		0.527	0.534		
49.0	0.409					
49.5	0.415			0.525		
50.0	0.423					
50.5	0.415			0.514		
51.0	0.34		0.553			
51.5	0.378			0.511		
52.0	0.39		0.526			
52.5	0.404			0.501		
53.0	0.41					

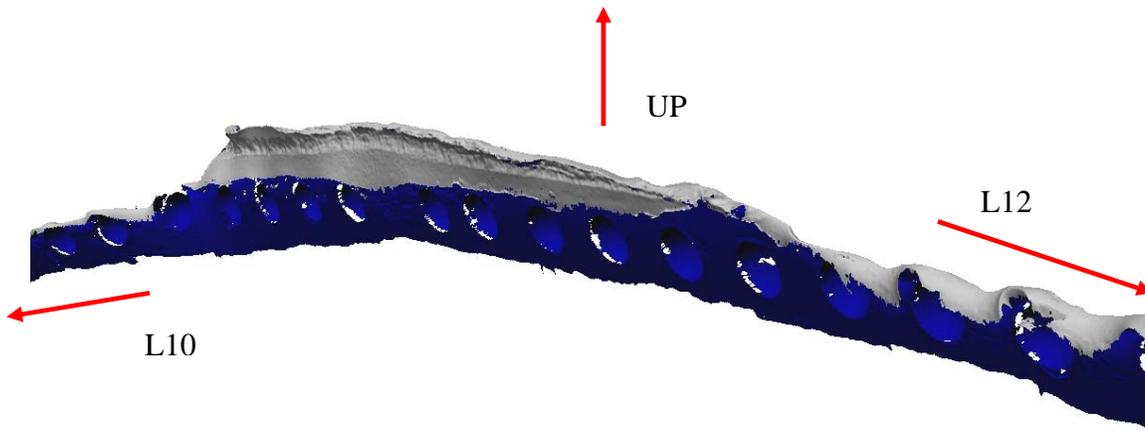
Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
53.5	0.417		0.519	0.515		
54.0	0.414					
54.5	0.414			0.518		
55.0	0.401					
55.5	0.387			0.522		
56.0	0.4		0.542			
56.5	0.438			0.518		
57.0	0.473					
57.5	0.341					
58.0	0.402					
58.5	0.409		0.525			
59.0	0.451					
59.5	0.471					
60.0	0.452					
60.5	0.461					
61.0	0.53		0.518			
61.5	0.486					
62.0	0.527					
62.5	0.545					
63.0	0.529					
63.5	0.52		0.541			
64.0	0.521					
64.5						
65.0						
65.5						
66.0						
66.5						
67.0						
67.5						
68.0						
68.5						
69.0						
69.5						
70.0						
70.5						
71.0						

Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
71.5						
72.0						
72.5						
73.0						
73.5						
74.0						
74.5						
75.0						
75.5						
76.0						
76.5						
77.0						
77.5						
78.0						
78.5						
79.0						
79.5						
80.0						
80.5						
81.0						
81.5						
82.0						
82.5						
83.0						
83.5						
84.0						
84.5						
85.0						
85.5						
86.0						
86.5						
87.0						
87.5						
88.0						
88.5						
89.0						

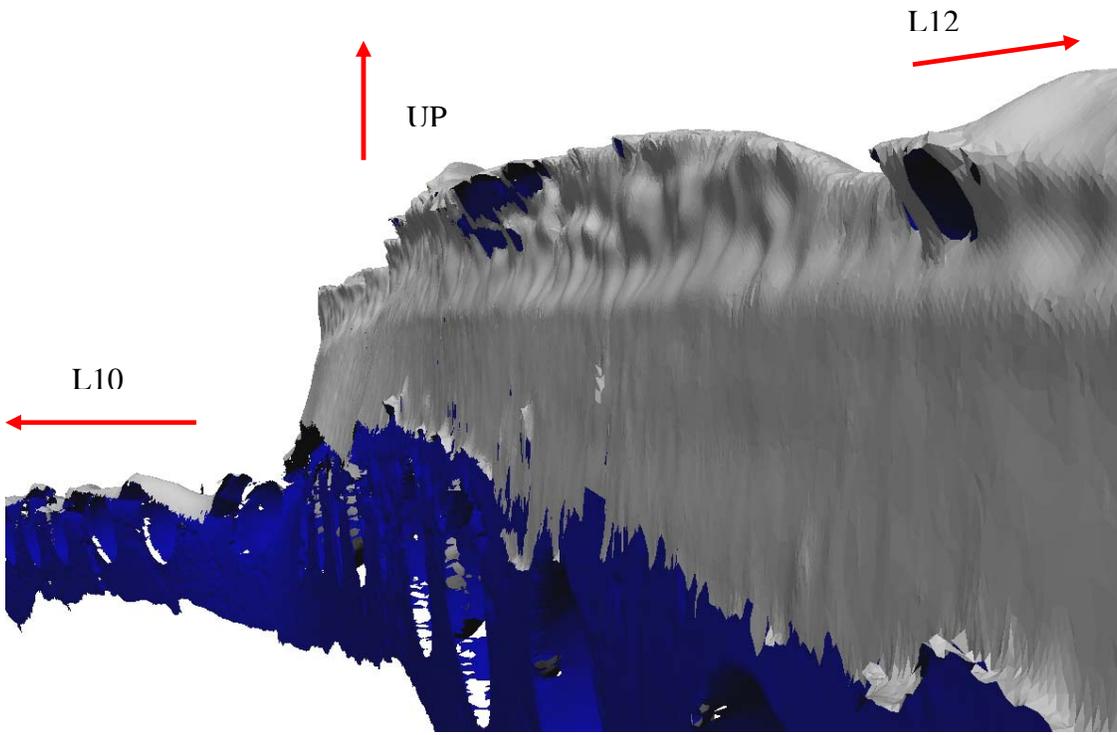
Distance (in) (from S Edge of Plate)	Node L11W. West Gusset Plate					
	Laser Scan					
	L11W W PL			U10/L11W West PL		
	Section @ Corrosion	Corrosion Width	Nominal Thickness	Section @ Corrosion	Corrosion Width	Nominal Thickness
89.5						
90.0						
90.5						
91.0						
91.5						
92.0						
92.5						
93.0						
93.5						
94.0						
94.5						
95.0						
95.5						
96.0						
96.5						
97.0						
97.5						
98.0						



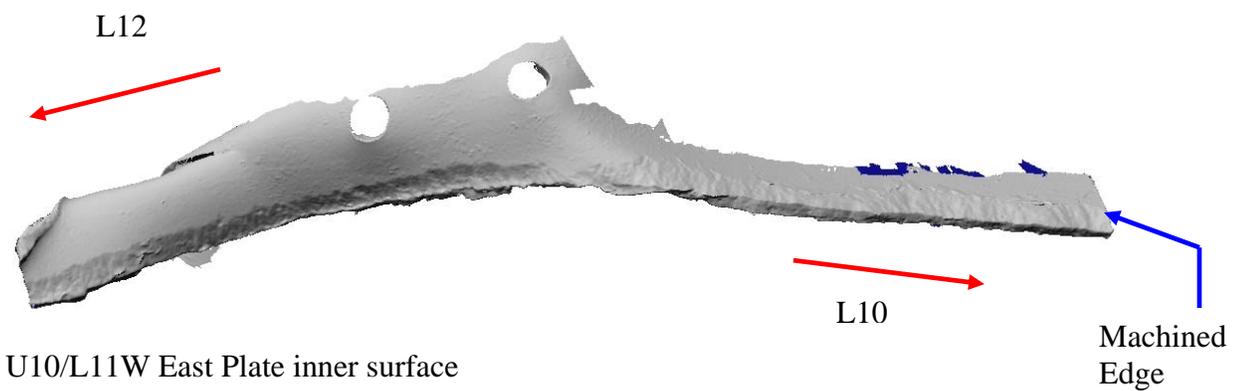
L11W West Plate outer surface



L11W West Plate inner surface



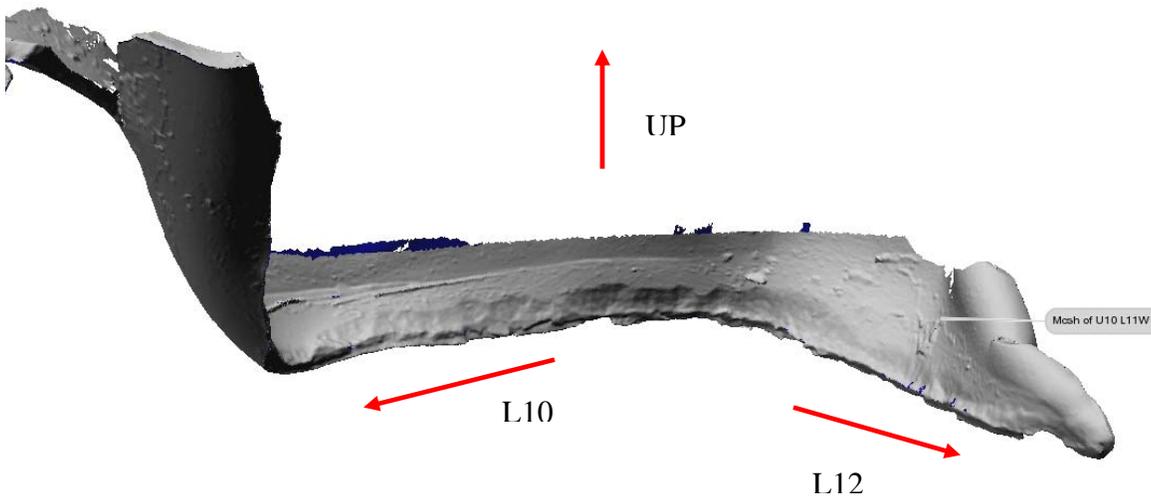
L11W West Plate inner surface



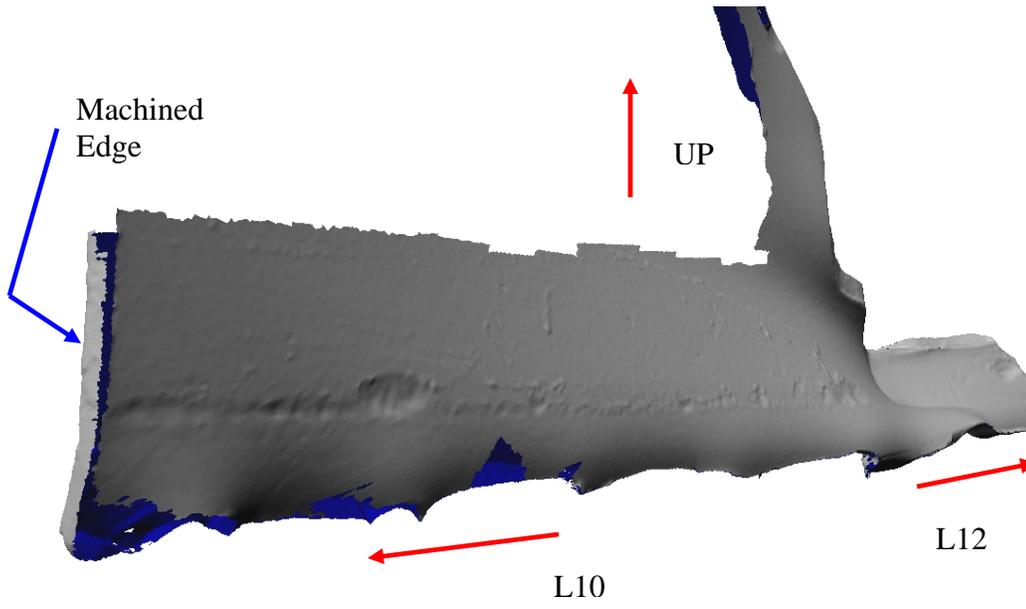
U10/L11W East Plate inner surface



U10/L11W West Plate overview with detail views to follow



U10/L11W West Plate inner surface



U10/L11W West Plate inner surface

Calibration Certificate

Part Description: Platinum Certification Date: 10/18/07 Serial#: P08-05-07-05240
 Single Point 2 Sigma: P08-05 +/--030mm (+/--0012") Certificate#: P0524039373
 Linear Displacement 2 Sigma: P08-05 +/--043mm (+/--0017") Temperature: See attached data

Measurement Standards Traceability

Ball Bar Kit Asset Number: 1107 Calibration Date: 08/22/07 *SI Traceability: METAS-L20070822MG4
Thermometer Asset Number: TQ025 Calibration Date: 03/12/07 *SI Traceability: NVLAP-A7314003

*The artifact above has been calibrated with a device traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or through an ISO17025 Accredited Laboratory. Expanded measurement uncertainty is 3.6 + 5.8X micrometers, where X=measured value in meters. Uncertainty is expressed at approximately a 95% Level of Confidence using k=2.00.

Certification Results

- 3 Single Point Articulation Tests at <=20%, 20%-80% and >=80% range. **PASSED**
- 1 Effective diameter sphere test. **PASSED**
- 20 Volumetric ball bar tests in 4 quadrants and 2 orientations. **PASSED**

Calibration and certification conforms to procedures developed in accordance with ASME B89.4.22-2004.

Instrument condition as received:

Inoperative

Instrument condition outgoing:

Within specifications

Technician: [Redacted] Date: 10/18/07

Dan Kligtz

FARO Technologies, Inc.
 PH1:1-800-736-2771
 PH2:407-333-9911
 FAX:407-333-8056
 L-A-B Cert Number: L1147

125 Technology Park
 Lake Mary, FL 32746
 USA



Calibration Certificate

Part Description: FARO Laser Line Probe Certification Date: 06/19/08 Serial#: LLP000702705
 Accuracy Specification: 0.02mm (.0019 in.) Certificate#: L0270539618
 Measurement Standards Traceability Temperature: See attached data
 Laser Calibration Fixture Asset Number: 920 Calibration Date: 05/05/08 *SI Traceability: METAS-L20070403AB1

The artifact above has been calibrated with a device traceable to the International System of Units (SI) through a National Metrological Institute (NMI) or through an ISO17025 Accredited Laboratory.

Certification Results

Mean deviation of diameter throughout entire field of view. **PASSED**
 2 Sigma standard deviation of diameter throughout entire field of view. **PASSED**

Instrument condition as received:

Within specifications

This certificate shall not be reproduced, except in full, without permission of FARO Technologies, Inc.
 The results of this certificate relate only to the items calibrated or tested.

Instrument condition outgoing:

Within specifications

Technician: [Redacted] Date: 6/19/08
 Arnold Torres

FARO Technologies, Inc.
 PH1: 1-800-736-2771
 PH2: 407-333-9911
 FAX: 407-333-8056

125 Technology Park
 Lake Mary, FL 32746
 USA

