Final Analytical Results from the Examination of Corrosion on Sections of Corrosion Probe Removed from Tank 241-AN-107 on August 10, 2006

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Abstract: Tank Farms Operations removed an electrochemical noise probe from Tank 241-AN-107. In the field, the probe was cut into four sections, wrapped, and placed in a 55-gallon drum. This drum was delivered to the 222-S Laboratory. The 222 S Laboratory unpackaged the sections of the AN-107 electrochemical noise probe and examined the material for evidence of corrosion. Each of the four sections contained three C-ring and three bullet specimens. The specimens were examined for pitting corrosion, crevice corrosion, and stress corrosion cracking. No evidence of stress corrosion cracking was found in the stressed C-ring specimens. Minor pitting was evident on some surfaces. Crevice corrosion was the dominant type of corrosion observed.

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1. SUMMARY

Tank Farms Operations removed an electrochemical noise probe from Tank 241-AN-107 (AN-107) on August 10, 2006. In the field, the probe was cut into four sections, wrapped, and placed in a 55-gallon drum. This drum was delivered to the 222-S Laboratory on August 17, 2006. The 222-S Laboratory unpackaged the sections of the AN-107 electrochemical noise probe and examined the material for evidence of corrosion.

Each of the four sections contained three C-ring and three bullet specimens. Eight of these 24 specimens were removed and cleaned and examined to determine the extent of surface corrosion. The specimens were examined for pitting corrosion, crevice corrosion, and stress corrosion cracking. Macrophotography, optical microscopy (OM), and scanning electron microscopy (SEM) were used to document the disassembly process and to determine the extent of corrosion on each of these eight specimens.

No evidence of stress corrosion cracking was found in the stressed C-ring specimens. Minor pitting was evident on some surfaces. Crevice corrosion was the dominant type of corrosion observed.

Crevice corrosion, as a result of crevices created by poor probe design, was found at the top of the C-rings (where the threaded bolt met the C-ring), at the base of the C-ring (where the bolt contacted the C-ring), and beneath the C-ring and bullet specimens, where vapors and liquids penetrated behind the O-ring seals and caused crevice corrosion between the detector elements and the O-rings. Pitting corrosion was found in isolated patches on the surfaces of some of the C-rings and bullets. Both crevice and pitting corrosion were more noticeable on the specimens that had been suspended in the vapor space of the tank (section 1), but were also present on some of the other specimens recovered from the sections submerged in the waste.

Cleaned, cut, and polished sections revealed that pitting was not very well developed in the corroded areas. Pit depths from cross-section specimens were always less than 100 μm. Polished and/or freeze-fractured surfaces of the stressed C-rings showed no evidence for stress corrosion cracking.

2. INTRODUCTION

This report describes the final results of the disassembly and examination of electrochemical noise probe specimens removed from AN-107 on August 10, 2006. Preparation and analysis of these detectors were conducted at the 222-S Laboratory using internal letter 7S110-GAC-06-079 Reissue, "Transmit the Test Procedure for the Examination of Electrochemical Noise Probe Specimens to be Removed from Tank 241-AN-107, August 2006" (7S110-GAC-06-079 Reissue). The original laboratory test procedure was revised to address radiation dose issues that were discovered during the breakdown of the sample drum.

The specimens were delivered to the 222-S Laboratory on August 17, 2006, as four detector sections containing six specimens each. The locations of the detectors and the three C-ring and three bullet specimens on each detector are identified in Table 1.

Table 1. Tank 241-AN-107 Electrochemical Noise Coupon Identification.

Specimen Type	Location	Probe Section	Lab ID	Field ID
Bullet	Vapor space	Detector 1	S06R001023	a
Bullet			S06R001024	Z[a]
Bullet			S06R001025	Y
C-ring			S06R001026	X
Stressed C-ring			S06R001027	W[a]
C-ring			S06R001028	V[a]
Bullet	Supernatant	Detector 2	S06R001029	U
Bullet			S06R001030	T
Bullet			S06R001031	S
C-ring			S06R001032	R
Stressed C-ring			S06R001033	P[a]
C-ring			S06R001034	N
Bullet	Supernatant	Detector 3	S06R001035	M
Bullet			S06R001036	L[a]
Bullet			S06R001037	K
C-ring			S06R001038	J
Stressed C-ring			S06R001039	H[a]
C-ring			S06R001040	G
Bullet	Saltcake	Detector 4	S06R001041	F
Bullet			S06R001042	E[a]
Bullet			S06R001043	D
C-ring			S06R001044	C
Stressed C-ring			S06R001045	B[a]
C-ring			S06R001046	A

[a] Specimens recovered for cleaning and analysis.

The specimens from Detector 1 (Figure 1), from the vapor space, were recovered in a fume hood using padded extension tools to avoid damaging the specimens. Detector 1 was removed from the drum, unwrapped in a hood, and all eight specimens from the detector arm were rinsed with inhibited water and placed in a dessicator.

Disassembly of the remaining sections in the hood was not possible due to high dose rates associated with the sections that had been submerged in the tank waste. These sections were loaded into a hot cell using step-by-step instructions (7S110-GAC-06-079 Reissue) that allowed the oversized sections to be passed through the airlock with both airlock doors open and a fiber-reinforced bag taped to the outer wall of the hot cell to provide contamination control. In the hot cell, a rotary cutting tool was used to remove the metal bar covering the specimens to allow for removal with the hot cell manipulators (Figure 2). The detectors were rinsed with tap water followed by inhibited water. Figure 3 through Figure 5 show the other three detector assemblies during the hot cell breakdown.

Figure 1. General View of Detector 1 During Disassembly in Hood.

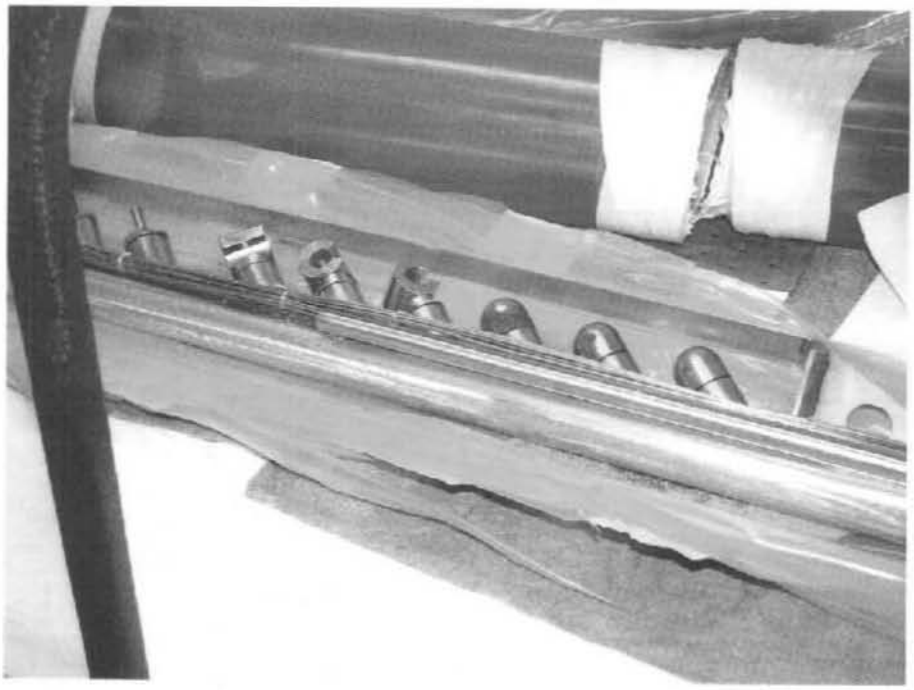
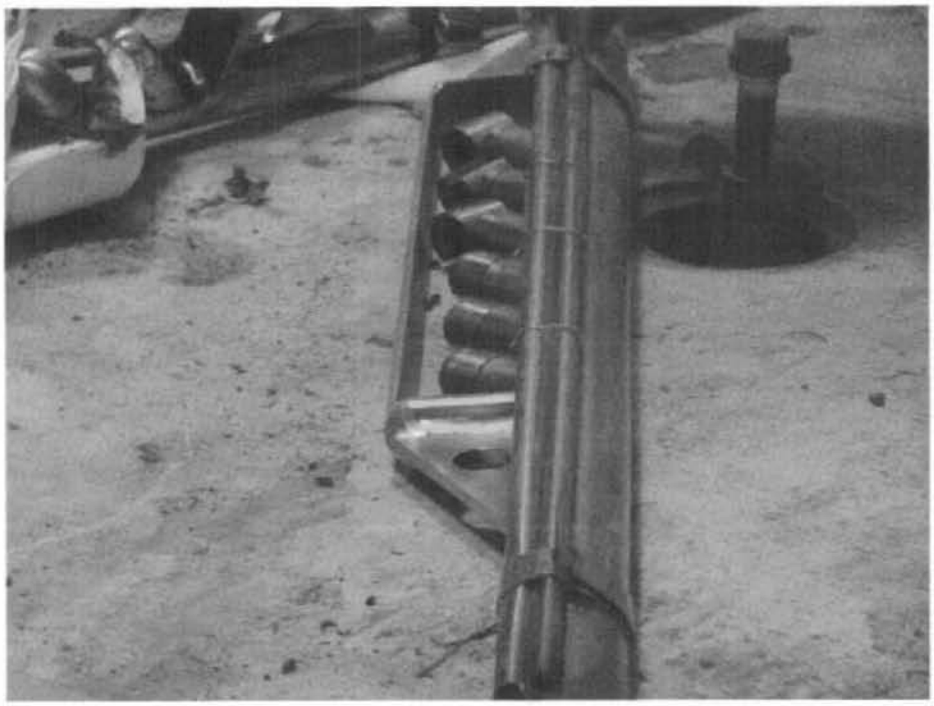


Figure 2. Removal of Cross Bar from Detector 4 in Hot Cell.

Figure 3. General View of Detector 2 During Disassembly in Hot Cell.

Figure 4. General View of Detector 3 During Disassembly in Hot Cell.

Figure 5. General View of Detector 4 During Disassembly in Hot Cell.



Selected C-ring and bullet specimens were retrieved from the detectors in the hot cell and then they were loaded out of the hot cell for analysis. Photographs taken during sample breakdown are listed in Appendix A. Many of these photos were processed through image analysis software to achieve color balance and to sharpen the images.

3. SAMPLE PREPARATION AND ANALYSIS

The selected specimens (identified in Table 1) were photographed, cleaned, and prepared for examination by reflected-light OM or SEM at the 222-S Laboratory. Selected features of the specimens were documented before and after cleaning. Representative macro and microphotographs are presented in Figure 6 through Figure 13. All photographs are tabulated in Appendix A. The digital images are posted on the chardocs share drive and are available on compact disk (CD).

The standard size 40-µm grid measured approximately 10% too large under the operating conditions of the SEM (see Appendix A); therefore, all measurements recorded on SEM images and any measurements made using the image scale bars are approximately 10% too large.

Figure 6. Microphotograph (10 times) of Specimen S06R001024, Detector 1 Bullet, Uncleaned, Scale Bar = 1 mm.

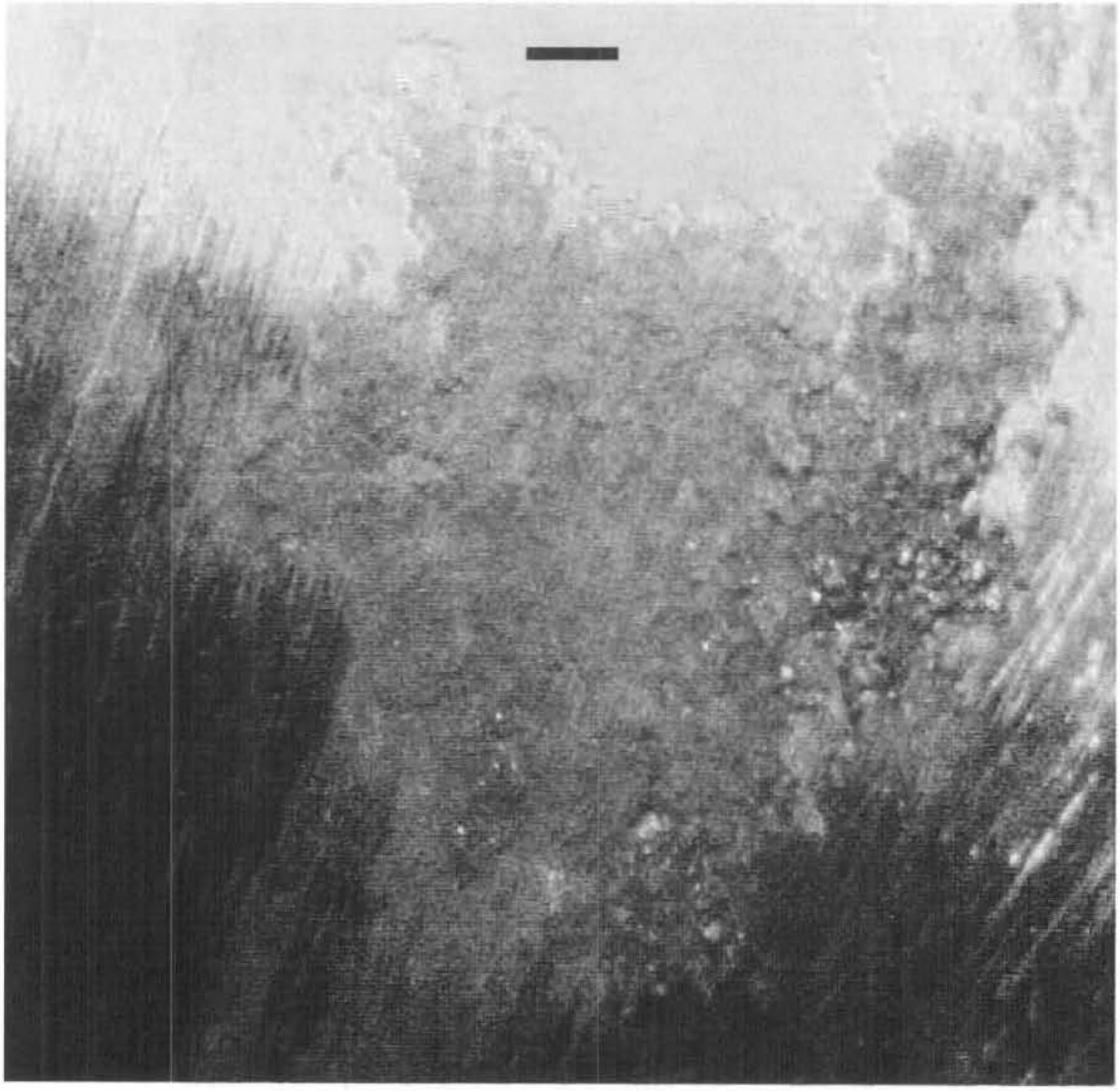


Figure 7. Macrophotograph Specimen S06R001027, Detector 1, Stressed C-Ring, Uncleaned.

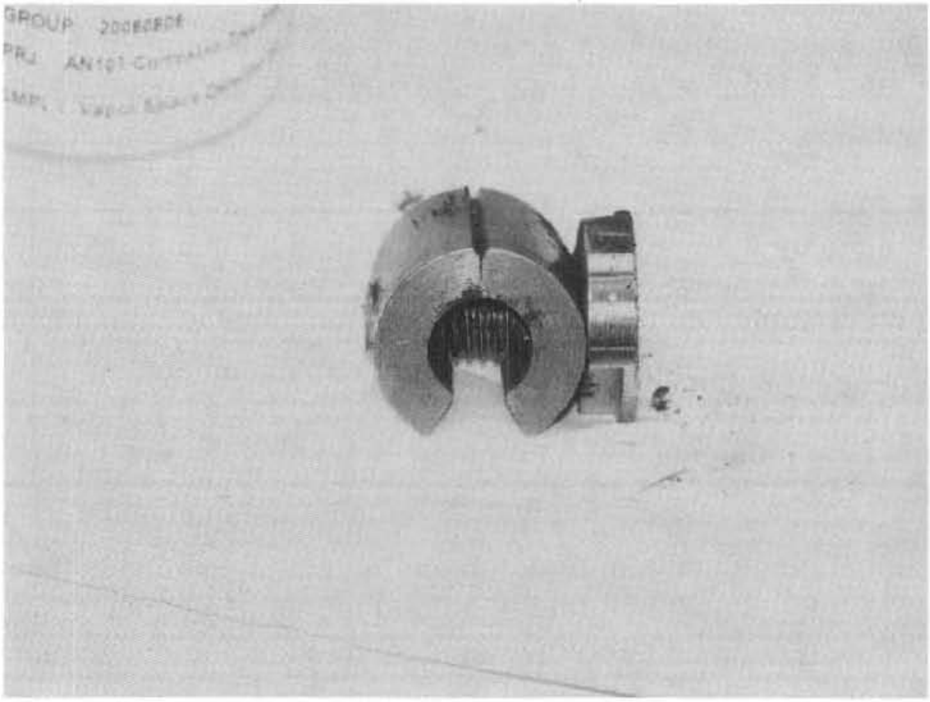


Figure 8. Macrophotograph Specimen S06R001033, Detector 2, Stressed C-Ring, Uncleaned.

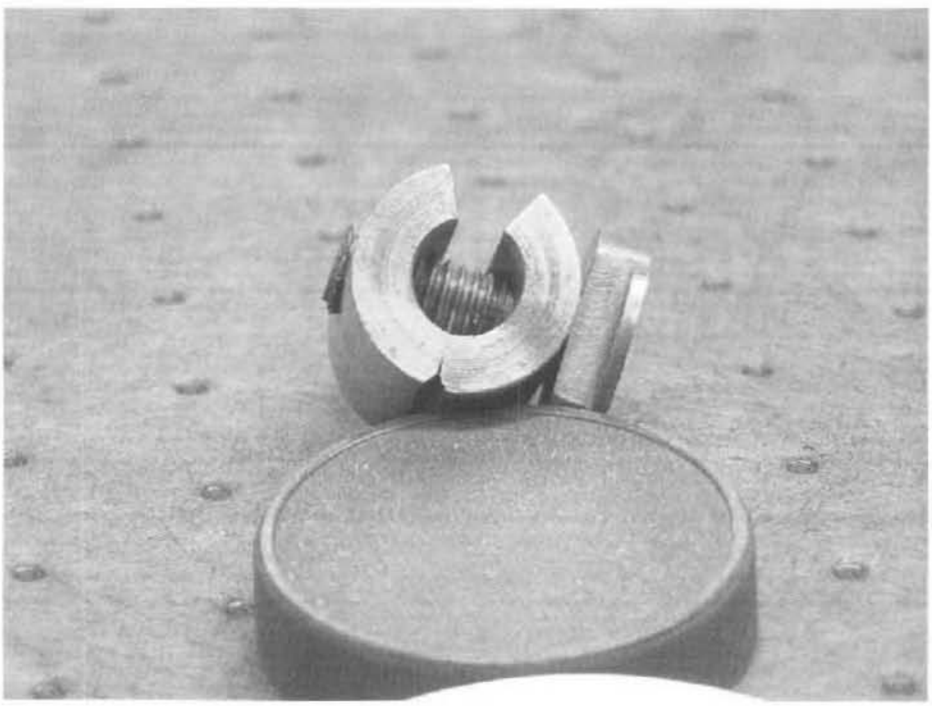


Figure 9. Macrophotograph Specimen S06R001036, Detector 3, Bullet, Uncleaned.

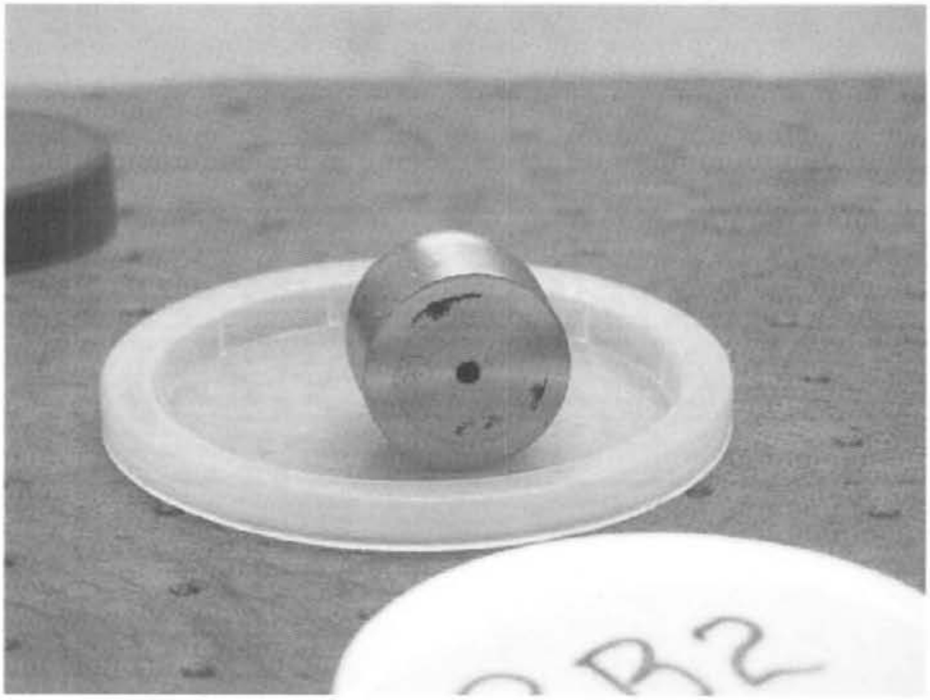


Figure 10. Macrophotograph Specimen S06R001038, Detector 3, Nonstressed C-Ring, Uncleaned.

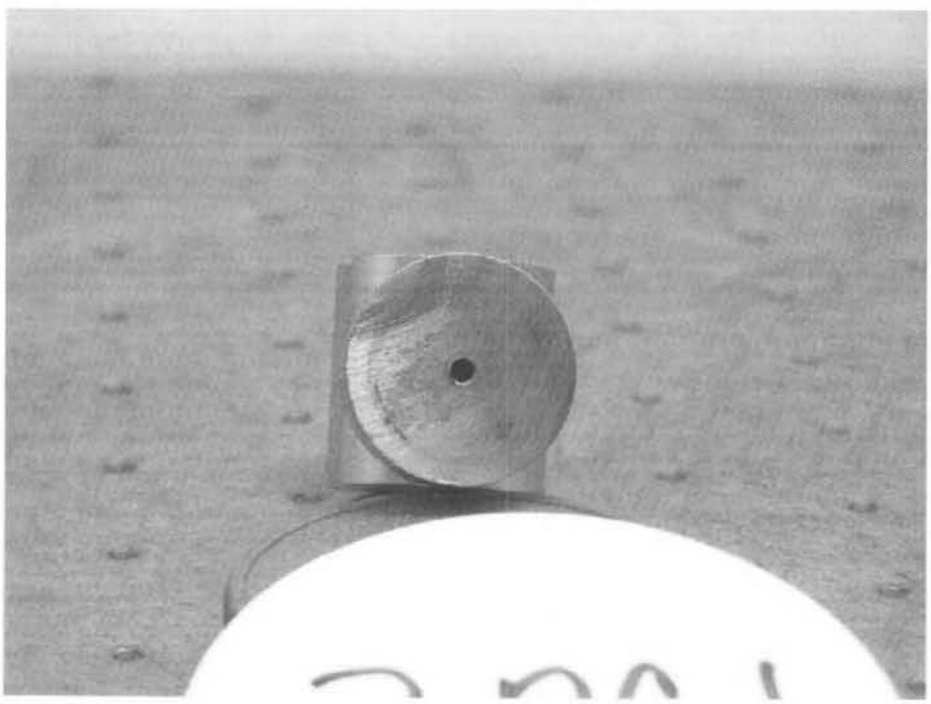


Figure 11. Macrophotograph Specimen S06R001039, Detector 3, Stressed C-Ring, Uncleaned.

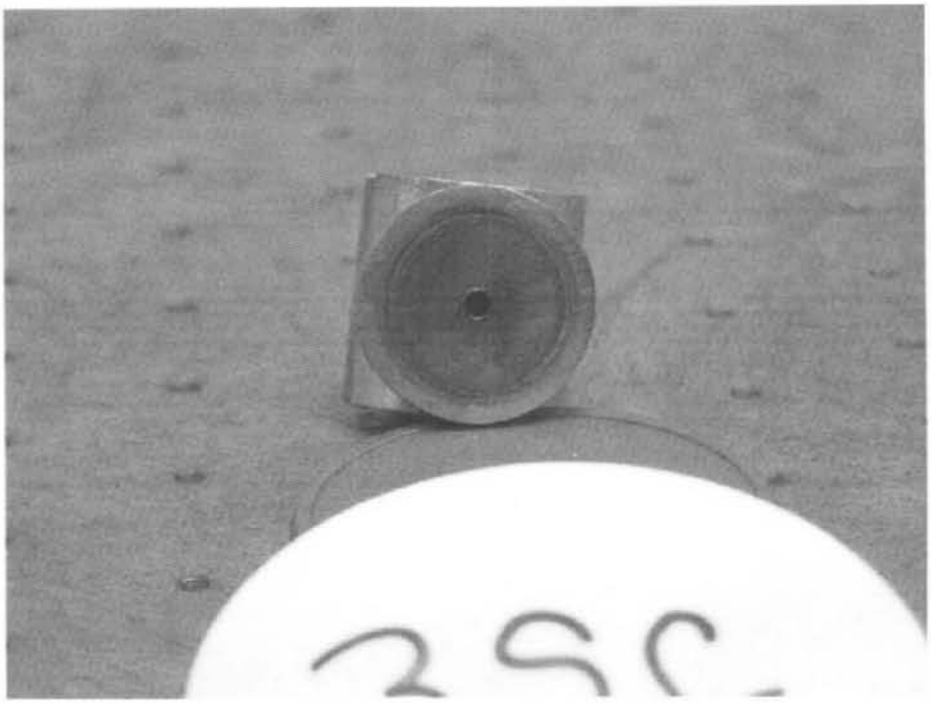


Figure 12. Macrophotograph Specimen S06R001042, Detector 4, Uncleaned.

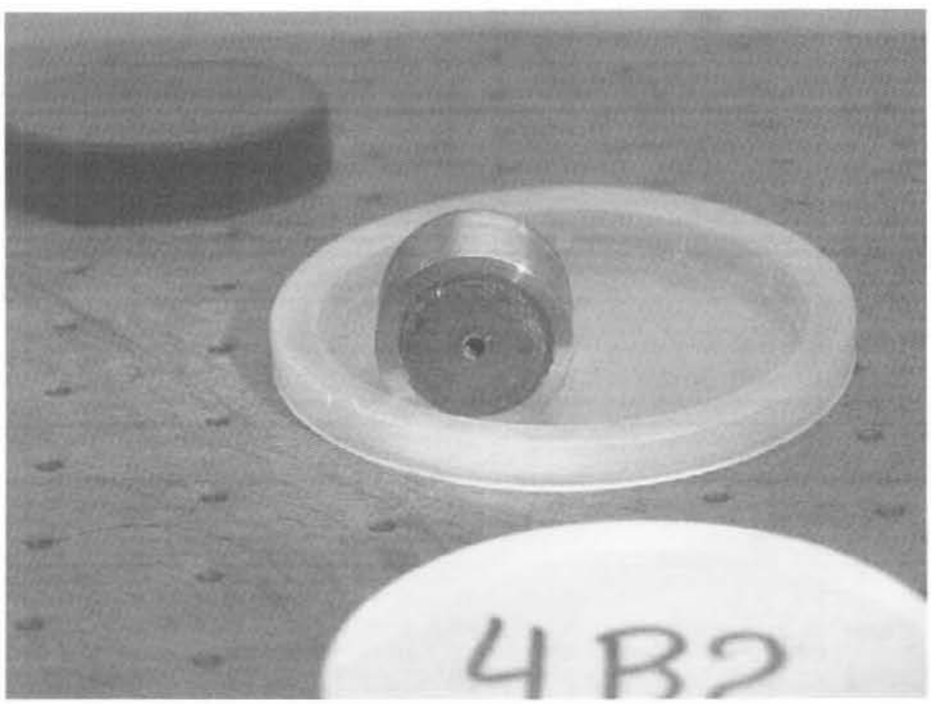
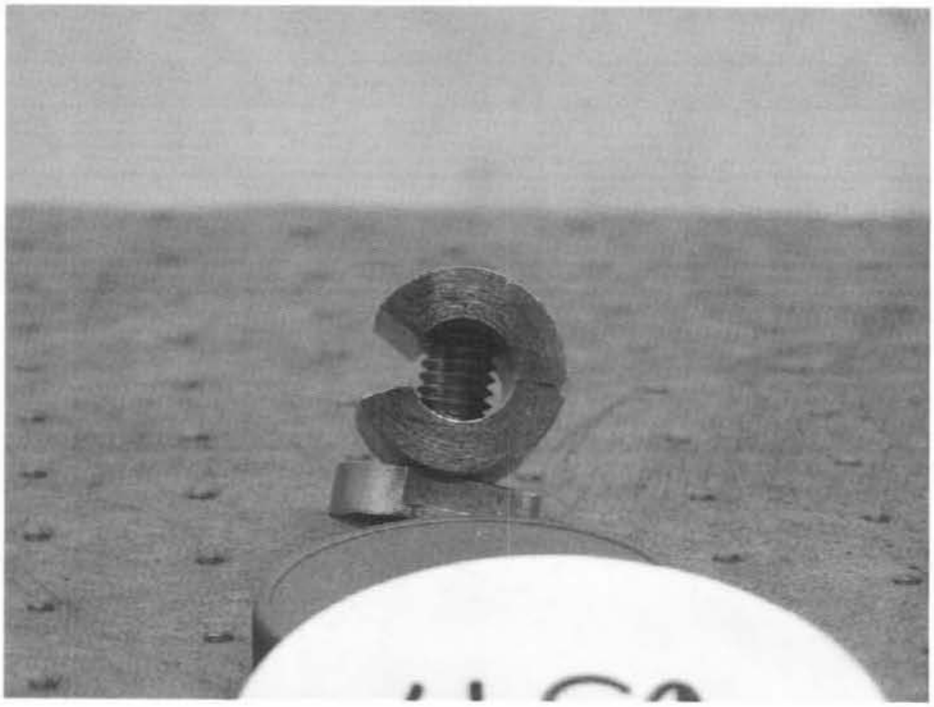


Figure 13. Macrophotograph Specimen S06R001045, Detector 4, Stressed C-Ring, Uncleaned.



Specimen preparation followed the test procedures in 7S110-GAC-06-079 Reissue. Cleaning was performed with single or multiple washings with hot ammonium citrate in accordance with ASTM G46–94, *Standard Guide for Examination and Evaluation of Pitting Corrosion.* Table 2 compiles the weight loss data for the several washes necessary to achieve a minimal weight change after the initial wash (<0.1% total weight loss) or between successive washes (<10.0% cumulative weight loss).

Cleaned specimens were examined by OM and SEM. Several features of note were documented before any further preparation. Specimen S06R001028, a nonstressed C-ring from detector 1 (in the vapor space) showed significant corrosion where the threads of the bolt came through the top of the C-ring (Figure 14). After cleaning, SEM examination of that region revealed that only a portion of the corrosion-covered area had significant pitting (Figure 15).

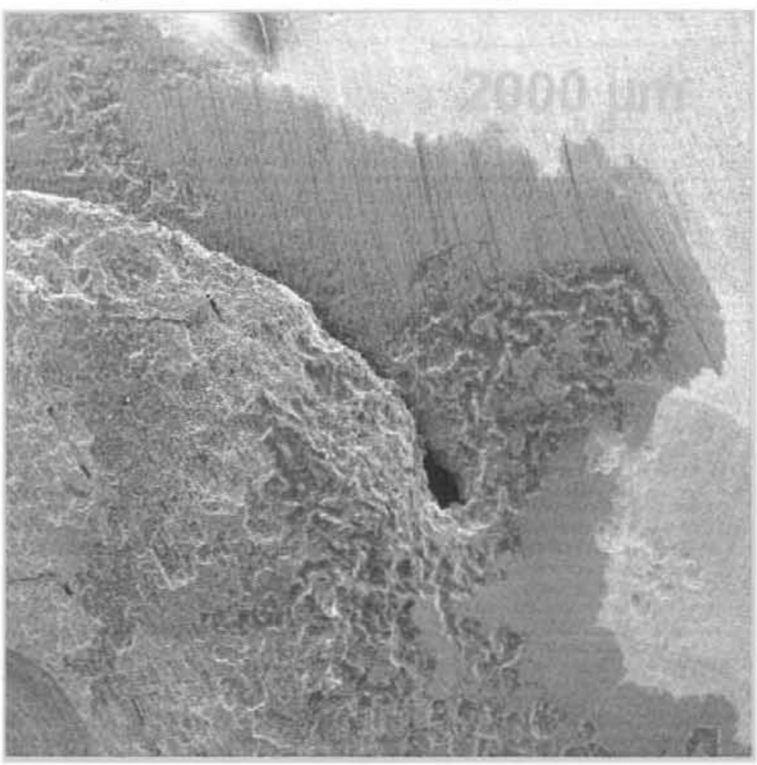
Table 2. Weight Loss during Ammonium Citrate Cleaning.

Specimen Identification 1	Laboratory Sample Number 2	Weight before Solution Soak (grams) 3	Weight after Solution Soak (grams) 4	Cumulative Weight Loss (grams) 5	Cleaning Number	Weight Delta %[a] 6
Detector 1 B2 (Z)	S06R001024	82.345	82.270	0.075	1	0.091
Detector 1 B2 (Z)	S06R001024	82.270	82.242	0.103	2	27.184
Detector 1 B2 (Z)	S06R001024	82.242	82.209	0.136	3	24.265
Detector 1 B2 (Z)	S06R001024	82.209	82.214	0.131	4	[3.81]
Detector 1 SC (W)	S06R001027	86.895	86.683	0.212	1	0.243
Detector 1 SC (W)	S06R001027	86.683	86.608	0.287	2	26.132
Detector 1 SC (W)	S06R001027	86.608	86.510	0.385	3	25.454
Detector 1 SC (W)	S06R001027	86.510	86.515	0.380	4	[1.31]
Detector 1 RC2 (V)	S06R001028	87.427	87.197	0.230	1	0.263
Detector 1 RC2 (V)	S06R001028	87.197	87.072	0.355	2	35.211
Detector 1 RC2 (V)	S06R001028	87.072	87.019	0.408	3	12.990
Detector 1 RC2 (V)	S06R001028	87.019	86.946	0.481	4	15.177
Detector 1 RC2 (V)	S06R001028	86.946	86.943	0.484	5	0.620
Detector 2 SC (P)	S06R001033	86.684	86.661	0.023	1	0.027
Detector 3 B2 (L)	S06R001036	82.512	82.511	0.001	1	0.001
Detector 3 SC (H)	S06R001039	88.426	88.411	0.015	1	0.017
Detector 4 B2 (E)	S06R001042	82.260	82.247	0.013	1	0.016
Detector 4 SC (B)	S06R001035	87.499	87.483	0.016	1	0.018
Centering Post	Blank	47.798	47.770	0.028	1	0.059
Centering Post	Blank	47.770	47.766	0.032	2	12.5

[a] Weight delta % is the weight loss [gain] as a percentage of the total sample for the first cleaning. For successive cleaning, it is the percentage weight loss as a percentage of the cumulative weight loss from all cleanings.

Figure 14. Macrophotograph of the Top of Vapor Space Nonstressed C-Ring S06R001028.

Figure 15. SEM Microphotograph of the Top of Vapor Space Nonstressed C-Ring S06R001028.



Following cleaning, the selected specimens were prepared for examination in several ways. Cross sections of the specimens were sliced using a low-speed saw with a diamond-impregnated blade. The stressed C-rings were prepared for examination of the stress-cracked section by slicing a thin section of the C-ring. The thin (about 4-mm thick) portion of the stressed C-rings was submerged in liquid nitrogen (LN2) and then struck lightly, on edge, with a mallet, to complete the fracture into two pieces. These two pieces were mounted side-by-side for OM and SEM examination of the fractured surfaces. Figure 16 is an SEM photomicrograph of one of the fractured surfaces from S06R001027, the vapor space stressed C-ring. All measurements in Figure 16 start at the top where the v-notch ends and the pre-crack begins. The entire length of the pre-crack after recovery and preparation is 3720 μm. The region from 3720 μm to 5230 μm is the LN2 fractured surface. Figure 17 through Figure 19 show example SEM photomicrographs of the three stressed C-ring LN2 fractured surfaces. In these three figures, the right-hand image is a magnified view of the area in the yellow box of the left hand image and the LN2 fractured portion is toward the bottom of the images. These right-hand images are all taken from the region where the pre-crack ends and the LN2 fracture surface begins.

Figure 16. SEM Photomicrograph of the Face of Pre-stressed Crack, Specimen S06R001027.

(V-notch is toward the top and the LN2 cracked area is toward bottom.)

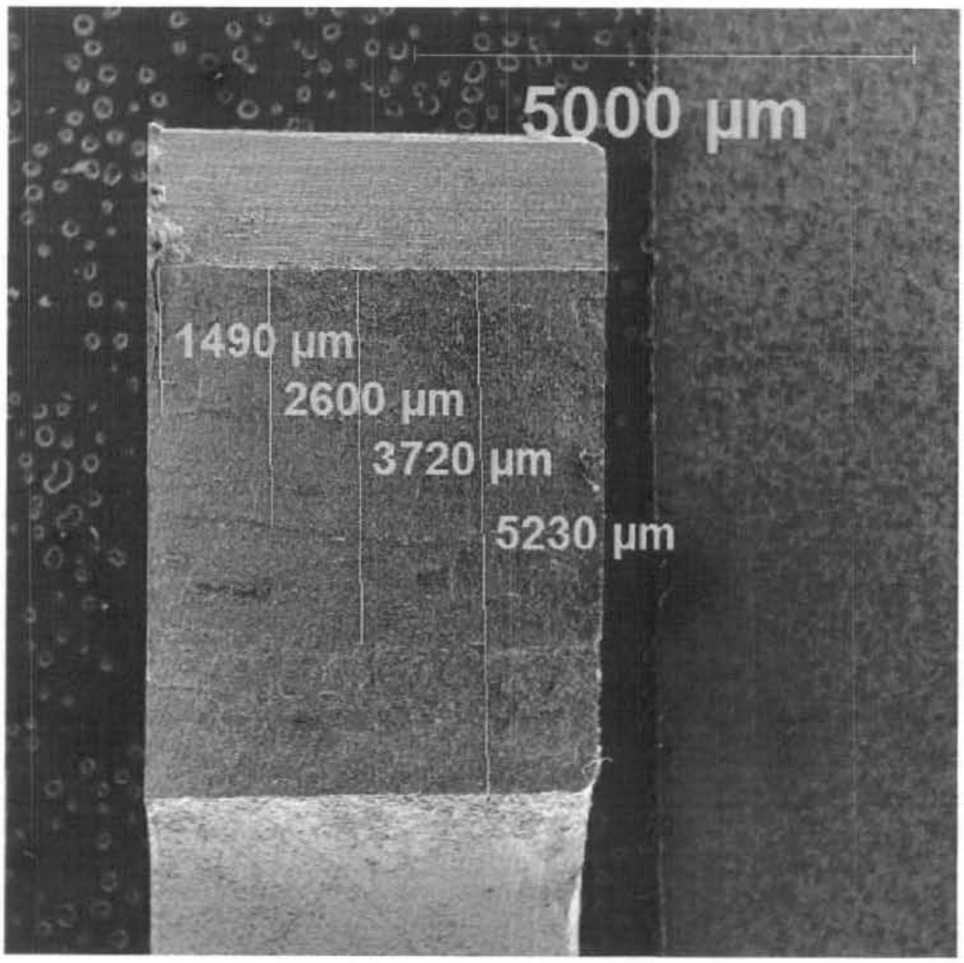


Figure 17. SEM Photomicrograph of the Face of Pre-stressed Crack, Specimen S06R001027.

(Image to the right is a blow-up of the area within the box in the left-hand image.)

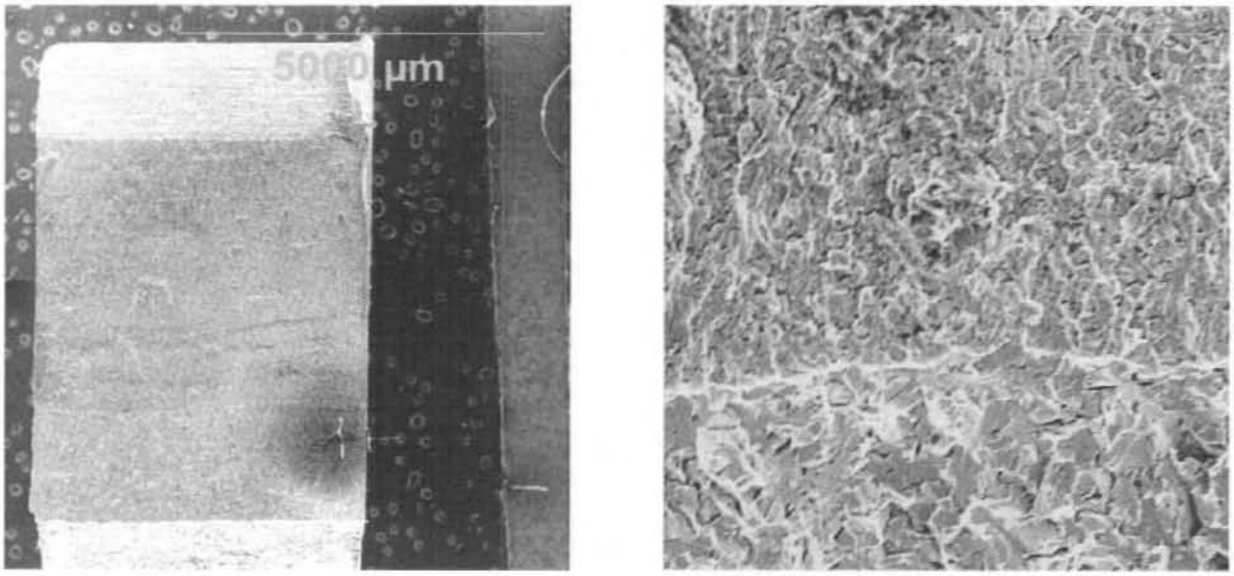


Figure 18. SEM Photomicrograph of the Face of Pre-stressed Crack, Specimen S06R001033.

(Image to the right is a blow-up of the area within the box in the left-hand image.)

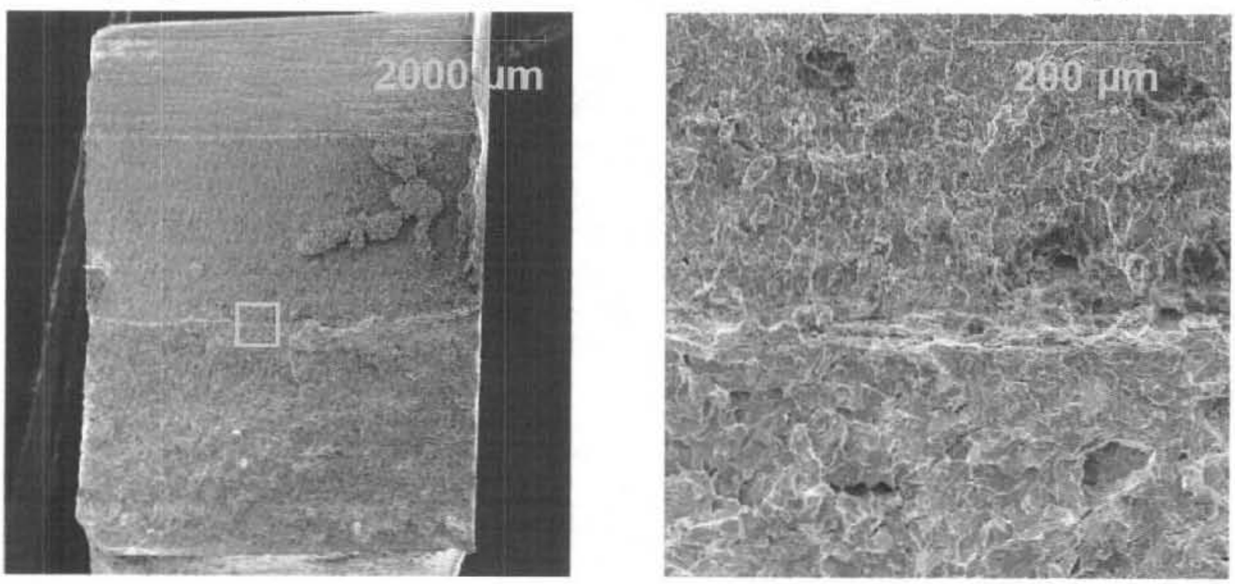
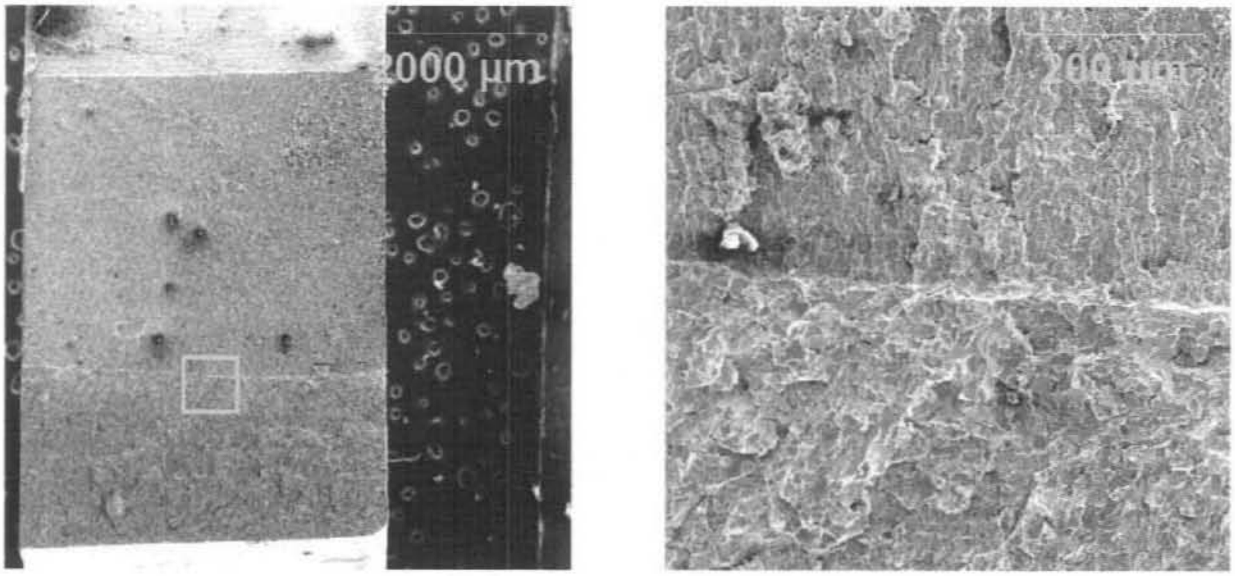


Figure 19. SEM Photomicrograph of the Face of Pre-stressed Crack, Specimen S06R001045.

(Image to the right is a blow-up of the area within the box in the left-hand image.)



The larger cut sections of two of the pre-stressed C-rings were polished with successively finer polishing grits with a 10-µm final polish. The cut and polished surfaces were then etched with 3% nitric acid in methanol (ASTM E-407-99, *Standard Practice for Microetching Metals and Alloys*). The polished and etched surfaces of the pre-cracks were again examined by OM and SEM. Figure 20 and Figure 21 show SEM photomicrographs of the polished and etched surfaces at the tips of each of the pre-cracks in the two stressed C-rings that were examined.

Finally, a number of specimens were examined for corrosion pit size, depth, and shape. These samples were prepared by cutting cross-sections using the low-speed saw and polishing the surfaces to 600 grit. The resulting specimens were examined by OM and SEM. Representative images of the largest pits observed in these samples are shown in Figure 22 through Figure 26.

Figure 20. SEM Photomicrograph of the Polished and Etched Surface of Pre-stressed Crack, Specimen S06R001027.

(Image to the right is a blow-up of the area within the box in the left-hand image.)

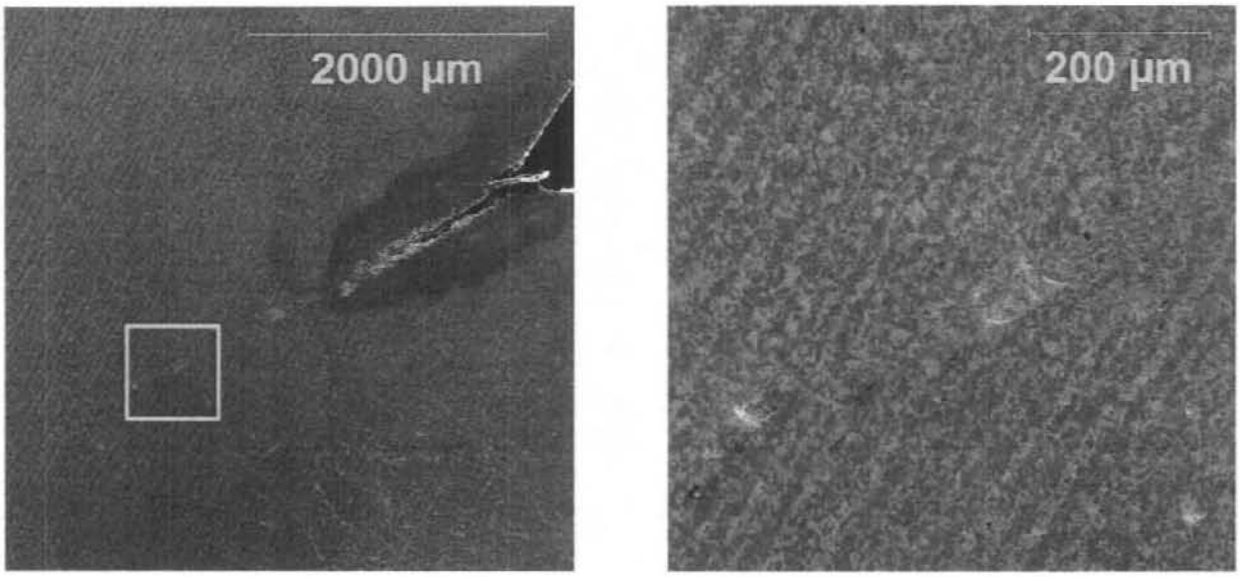


Figure 21. SEM Photomicrograph of the Polished and Etched Surface of Pre-stressed Crack, Specimen S06R001045.

(Image to the right is a blow-up of the area within the box in the left-hand image.)

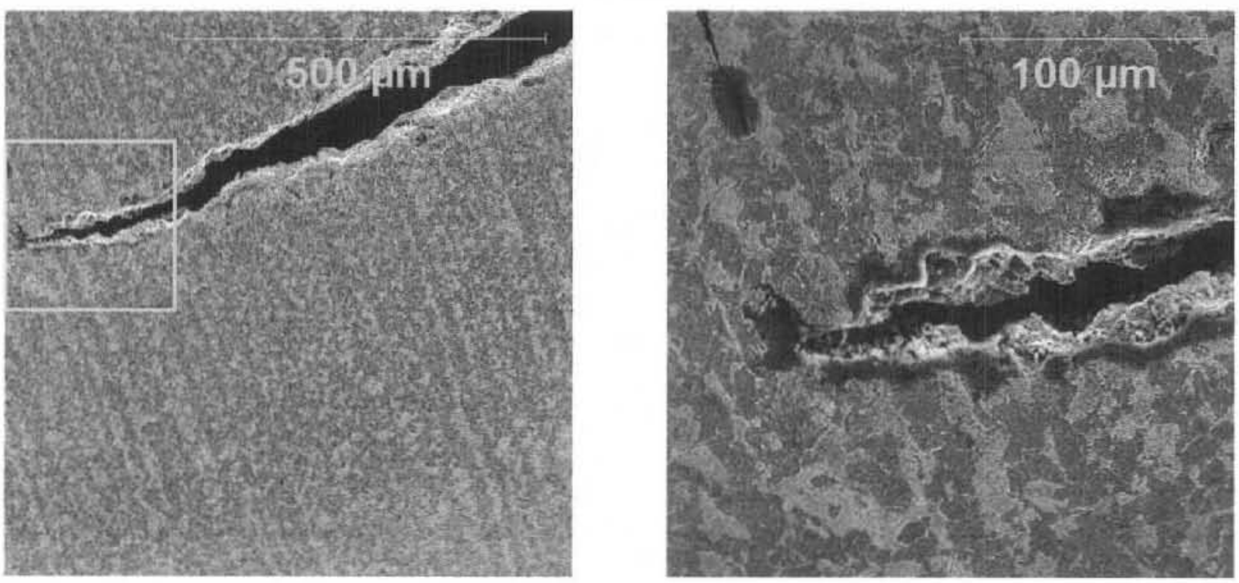


Figure 22. SEM Image of Pitted Area on Outer Surface of Sample S06R001024.

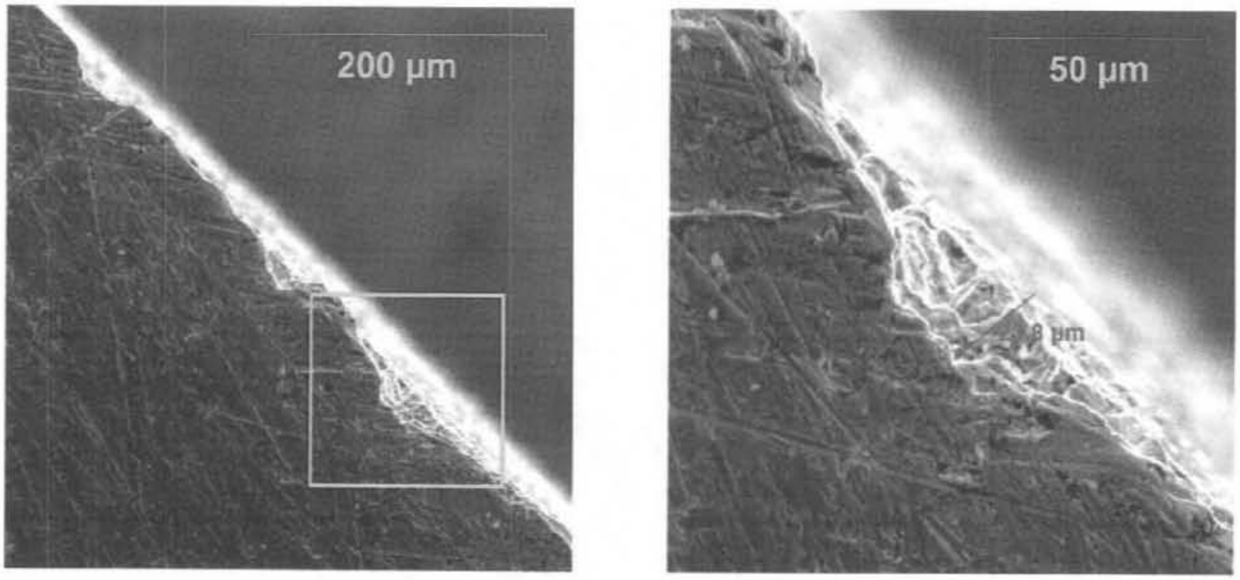


Figure 23. SEM Image of Pitted Area Near Crevice Between C-Ring and Bolt Head on Sample S06R001027.

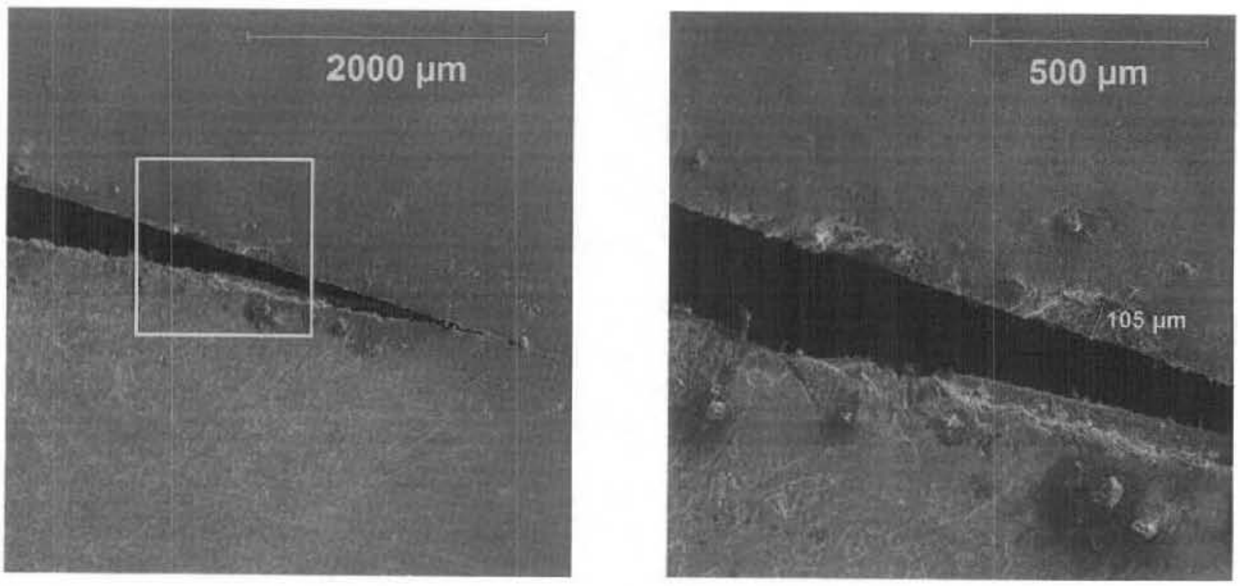


Figure 24. SEM Image of Pitted Area from End of Bolt on Sample S06R001028.

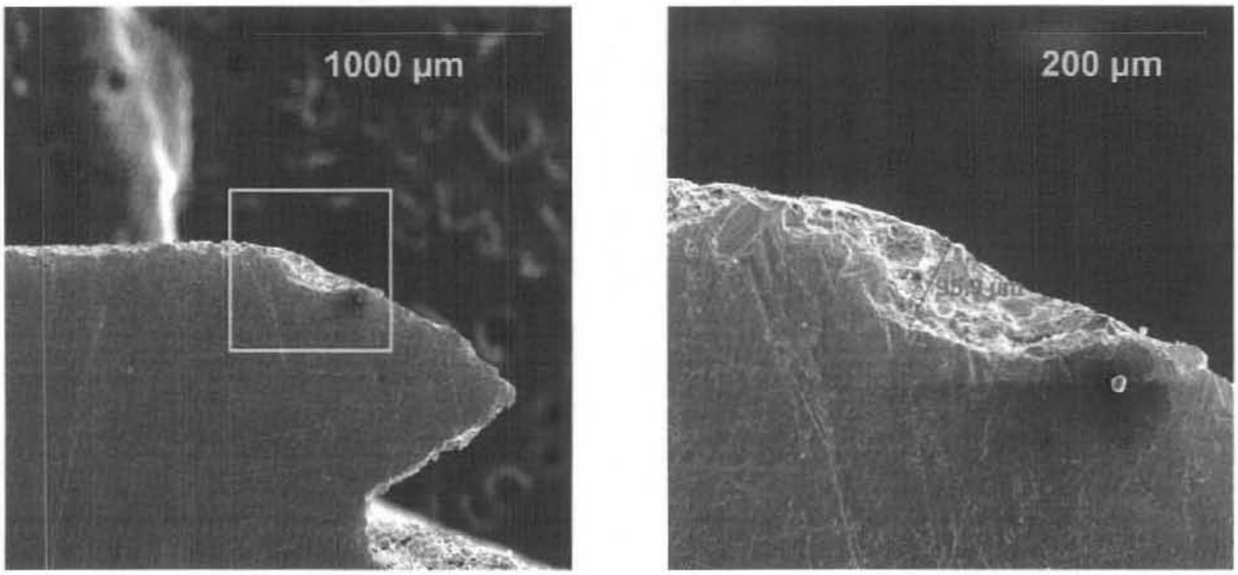


Figure 25. SEM Image of Pitted Area on Base of Sample S06R001042.

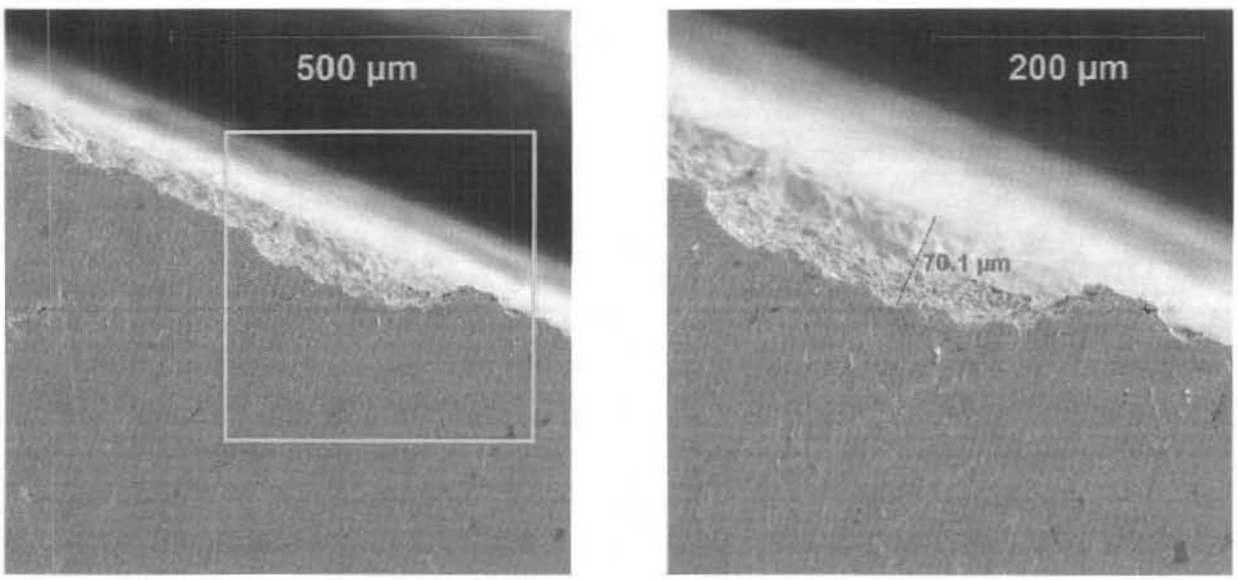
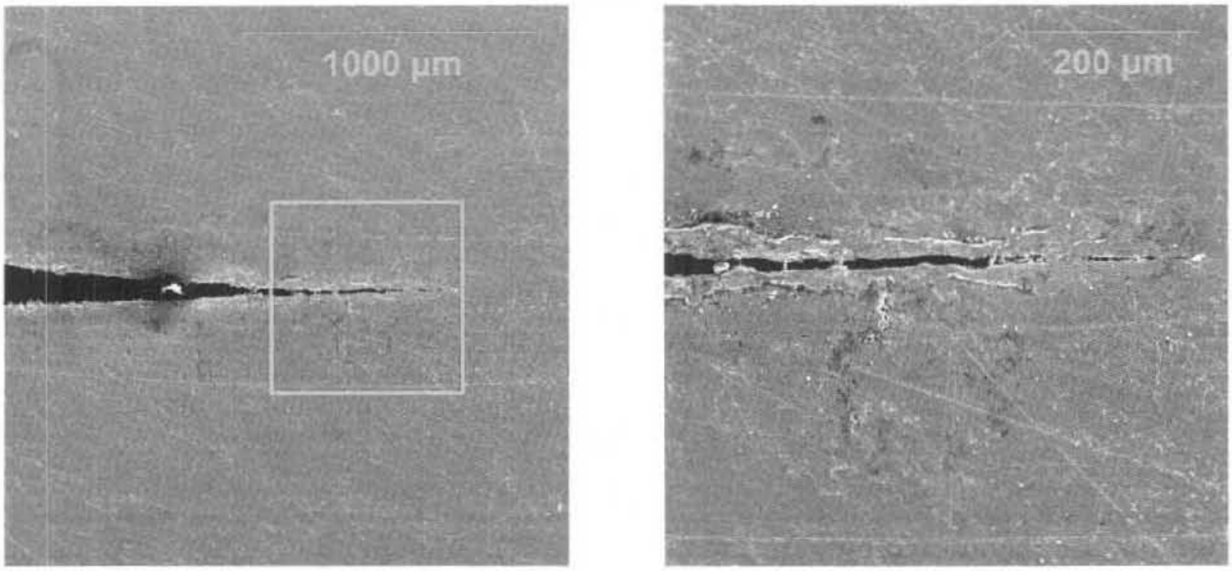


Figure 26. SEM Image of Pitted Area on Sample S06R001045.



4. DISCUSSION

The AN-107 electrochemical noise probe was removed from AN-107 on August 10, 2006, cut into four sections, wrapped, placed in a 55-gallon drum and delivered to the 222-S Laboratory on August 17, 2006. The 222-S Laboratory unpackaged the sections of the AN-107 electrochemical noise probe and examined the material for evidence of corrosion.

The electrochemical noise probe consisted of four detector sections, each containing three C-ring specimens and three bullets. Detector 1 was deployed in the head space or vapor space of the tank. Detector 2 and Detector 3 were submerged in the supernate liquid. Detector 4 was imbedded in the saltcake waste. One of the three C-ring specimens on each detector was pre-stressed to investigate the potential for stress corrosion cracking in the tank waste.

Detector 1 was disassembled in a fume hood and all six specimens were removed and examined during rinsing and transfer to the dessicator. During this process, it was noted that the pre-stressed C-ring S06R001027 had a noticeable crack extending from the tip of the v-notch (Figure 7). In addition, significant patches of corrosion were seen on several of the other specimens on detector 1. Of note were a patch of surface corrosion on bullets S06R001024 and S06R001025 (Figure 1 and Figure 6) and a large patch of corrosion on the top of nonstressed C-ring S06R001028 where the bolt extended through the C-ring (Figure 14). It was also noted that all of the specimens removed from detector 1 had significant corrosion on the underside, beneath, and behind the region that was protected by the O-ring (Figure 27).

Figure 27. Bullet Sample S06R001023. (Bottom region, behind O-ring.)

During discussions with Glenn Edgemon of ARES Corporation about observations made during the Detector 1 breakdown, it was learned that the stressed C-rings were not stressed to just below the point of cracking, as specified in ASTM G38-01, *Standard Practice for Making and Using C-Ring Stress Corrosion Test Specimens*. Rather, they were stressed beyond failure to "pre-crack" the stressed C-rings. Therefore, the observation of cracks in the v-notch of specimen S06R001027 was to be expected. Unfortunately, no pictures of the pre-cracked specimens were available. Therefore, the extent to which cracking occurred in the tank becomes more difficult to determine and the physical evidence from analysis of the C-rings provides the only basis, other than analysis of the electrochemical signals, for determining if stress corrosion cracking has occurred. Edgemon also indicated (personal communication) that the observation of corrosion product beneath the Detector 1 specimens and behind the O-rings was not unexpected since the electrical signal from Detector 1 failed early during deployment.

Disassembly of the remaining detectors revealed that the other three pre-stressed C-rings were also cracked in the v-notch, as was now expected. It also showed that the submerged detector section specimens were coated with significantly less corrosion product. Corrosion apparently proceeded at a greater rate in the vapor space of the tank.

During disassembly of all four detectors, the sections were photographed and eight specimens were selected for microscopic evaluation of corrosion. These were the four pre-stressed C-rings (all of which showed evidence of pre-cracking) and four additional samples (see Table 1). The additional samples were, in general, selected because they showed some evidence for surface pitting or crevice corrosion.

The cleaning of these specimens in accordance with ASTM G1-90, *Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens*, serves two purposes. It removes corrosion to expose the metal surface to examine for the extent and type of corrosive attack, and it provides weight loss data for the estimation of corrosion rates. None of the C-rings or bullet specimens were preweighed prior to deployment in the tank; therefore, there is no basis for conversion of weight loss data from specimen preparation to a corrosion rate. The data obtained during cleaning confirmed more corrosion product had built up on the vapor space specimens than on the specimens from the other three detectors (Table 2). Weight losses during cleaning for the three specimens in the vapor space were 0.131 g, 0.380 g, and 0.484 g. None of the weight losses during cleaning for the other five specimens exceeded 0.03 g.

The specimens were examined for pitting corrosion, crevice corrosion, and stress corrosion cracking, as discussed in the ASM Handbook, *Corrosion*, Volume 13. Macrophotography, OM, and SEM were used to document the disassembly process and to determine the extent of corrosion on each of the eight specimens.

No evidence of stress corrosion cracking was found in the stressed C-ring specimens. These examination results were reported in internal letter 7S110-GAC-06-087, "Results of the Examination of Electrochemical Noise Probe Specimens Removed from Tank 241-AN-107 August 10, 2006" (7S110-GAC-06-087). Minor pitting was evident on some surfaces. Crevice corrosion was the dominant type of corrosion observed.

Crevice corrosion was found at the top of the C-rings (where the threaded bolt met the C-ring), at the base of the C-ring (where the bolt contacted the C-ring), and beneath the C-ring and bullet specimens, where vapors and liquids penetrated behind the O-ring seals and caused crevice corrosion between the detector elements and the O-rings. Pitting corrosion was found in isolated patches on the surfaces of some of the C-rings and bullets. Both crevice and pitting corrosion were more noticeable on the specimens that had been suspended in the vapor space of the tank (Detector 1) but evidence of crevice and pitting corrosion was also present on some of the other specimens recovered from the detectors submerged in the waste.

Cleaned, cut, and polished sections revealed that pitting was not very well developed in the corroded areas. Pit depths from the cross-sectioned specimens were always less than 100 µm. Polished and/or freeze-fractured surfaces of the stressed C-rings showed no evidence of stress corrosion cracking.

5. REFERENCES

7S110-GAC-06-079 Reissue, 2006, "Transmit the Test Procedure for the Examination of Electrochemical Noise Probe Specimens to be Removed from Tank 241-AN-107, August 2006" (internal letter from G. A. Cooke to K. G. Carothers, September 20), CH2M HILL Hanford Group, Inc., Richland, Washington.

7S110-GAC-06-087, 2006, "Results of the Examination of Electrochemical Noise Probe Specimens Removed from Tank 241-AN-107 August 10, 2006" (internal letter from G. A. Cooke and J. B. Duncan to K. G. Carothers, September 27), CH2M HILL Hanford Group, Inc., Richland, Washington.

ASM Handbook, 1987, Volume 13, *Corrosion*, ASM International, Materials Park, Ohio.

ASTM G1-90, 1990 (Reapproved 1999), *Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens*, ASTM International, West Conshohocken, Pennsylvania.

ASTM G38-01, 2001, *Standard Practice for Making and Using C-Ring Stress-Corrosion Test Specimens*, ASTM International, West Conshohocken, Pennsylvania.

ASTM G46–94, 1994 (Reapproved 1999), *Standard Guide for Examination and Evaluation of Pitting Corrosion*, ASTM International, West Conshohocken, Pennsylvania.

ASTM E-407-99, 1999, *Standard Practice for Microetching Metals and Alloys*, ASTM International, West Conshohocken, Pennsylvania.

APPENDIX A

IMAGE NAMES AND LOCATIONS FROM THE EXAMINATION OF 241-AN-107 ELECTROCHEMICAL NOISE PROBE SPECIMENS

NOTE: Images located on the Hanford Chardocs share drive in the directory; AN107 Corrosion Probe/Final Report

Chardocs:\AN107 Corrosion Probe\Final Report \
Detector Breakdown

Subdirectory Detector 1\September Breakdown
AN107 Segment 1 028.jpg
AN107 Segment 1 029.jpg
AN107 Segment 1 030.jpg
AN107 Segment 1 031.jpg
AN107 Segment 1 032.jpg
AN107 Segment 1 033.jpg
AN107 Segment 1 034.jpg
AN107 Segment 1 035.jpg
AN107 Segment 1 036.jpg
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AN107 Segment 1 042.jpg
AN107 Segment 1 043.jpg
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AN107 Segment 1 047.jpg
AN107 Segment 1 048.jpg
AN107 Segment 1 049.jpg
AN107 Segment 1 050.jpg
AN107 Segment 1 051.jpg
AN107 Segment 1 052.jpg
AN107 Segment 1 053.jpg
AN107 Segment 1 054.jpg

Subdirectory Detector 2\December Breakdown
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Section2B1HC2.JPG
Section2B2HC1.JPG
Section2B2HC2.JPG
Section2B3HC1.JPG
Section2B3HC2.JPG
Section2C1HC1.JPG
Section2C1HC2.JPG
Section2C3HC1.JPG
Section2C3HC2.JPG
Tree2-2.JPG
Tree2-3.JPG
Tree2-4.JPG

Tree2-5.JPG
Tree2-6.JPG
Tree2-7.JPG

Subdirectory Detector 2\September Breakdown

Processed

Segment 2 Sample tag.jpg
Segment 2-1.jpg

Raw

AN107 Segment 3 and 4 006.jpg
AN107 Segment 3 and 4 007.jpg
AN107 Segment 3 and 4 008.jpg
AN107 Segment 3 and 4 009.jpg
AN107 Segment 3 and 4 010.jpg
AN107 Segment 3 and 4 011.jpg
AN107 Segment 3 and 4 012.jpg
AN107 Segment 3 and 4 013.jpg
AN107 Segment 3 and 4 014.jpg
AN107 Segment 3 and 4 015.jpg
AN107 Segment 3 and 4 016.jpg

Subdirectory Detector 3\December Breakdown

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Section3B1HC2.JPG
Section3B3HC3.JPG
Section3B3HC4.JPG
Section3B3HC5.JPG
Section3C3HC1.JPG
Section3C3HC2.JPG
Tree3-1.JPG
Tree3-2.JPG
Tree3-3.JPG
Tree3-4.JPG
Tree3-5.JPG
Tree3-6.JPG
Tree3-7.JPG
Tree3-8.JPG
Tree3-9.JPG

Subdirectory Detector 3\September Breakdown

AN107 Segment 3 and 4 023.jpg
AN107 Segment 3 and 4 024.jpg
AN107 Segment 3 and 4 025.jpg
AN107 Segment 3 and 4 026.jpg
AN107 Segment 3 and 4 027.jpg
AN107 Segment 3 and 4 028.jpg

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AN107 Segment 3 and 4 062.jpg

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Section4B1HC2.JPG
Section4B3HC1.JPG
Section4B3HC2.JPG
Section4B3HC3.JPG
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Section4C1HC3.JPG
Section4C1HC4.JPG
Section4C1HC5.JPG
Section4C1HC6.JPG

Section4C1HC7.JPG
Section4C3HC1.JPG
Section4C3HC2.JPG
Section4C3HC3.JPG
Section4C3HC4.JPG
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Tree4-5.JPG
Tree4-6.JPG

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AN107 Segment 3 and 4 003.jpg
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AN107 Segment 3 and 4 064.jpg
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AN107 Segment 3 and 4 077.jpg
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AN107 Segment 3 and 4 079.jpg

Chardocs:\AN107 Corrosion Probe\Final Report \
Sample Analysis\Macrophotography

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AN107 Segment 1 002
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AN107 Segment 1 005
AN107 Segment 1 006
AN107 Segment 1 007
AN107 Segment 1 008

Subdirectory S06R001027B
AN107 Segment 1 base.jpg
AN107 Segment 1 C-Ring side A.jpg
AN107 Segment 1 C-Ring side B.jpg
AN107 Segment 1 top of C-ring crack.jpg

Subdirectory S06R001033
AN107 Segment 2 Stressed C-Ring notch.jpg
AN107 Segment 2 Stressed C-Ring notch 2.jpg
AN107 Segment 2 Stressed C-Ring side A.jpg
AN107 Segment 2 Stressed C-Ring bottom.jpd
AN107 Segment 2 Stressed C-Ring side B.jpg

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AN107 Segment 3 Bullet bottom.jpg
AN107 Segment 3 Bullet.jpg

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AN107 Segment 3 Unstressed C-Ring bottom.jpd

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AN107 Segment 3 Stressed C-Ring notch 1.jpg
AN107 Segment 3 Stressed C-Ring notch 2.jpg
AN107 Segment 3 Stressed C-Ring notch 3.jpg

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AN107 Segment 4 Bullet bottoom2.jpg
AN107 Segment 4 Bullet.jpg

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AN107 Segment 4 Stressed C-Ring bottom.jpg
AN107 Segment 4 Stressed C-Ring side A.jpg
AN107 Segment 4 Stressed C-Ring side B.jpg
AN107 Segment 4 Stressed C-Ring notch.jpg

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		ECN No. DRF

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K. D. Boomer	H6-19	X			
D. E. Bowers	R3-26	X			
K. C. Carothers	S5-08	X			
J. L. Castleberry	R3-26	X			
G. P. Duncan	R3-26	X			
K. M. Hall	T6-02	X			
N. W. Kirch	S5-08	X			
M. A. Knight	R2-58	X			
R. Ni	S5-07	X			
T. C. Oten	S5-07	X			
D. L. Renberger	T6-03	X			
C. M. Seidel	T6-14				X
J. R. Smith	T6-07	X			
R. W. Sosa	T6-02	X			
D. J. Washenfelder	R2-58	X			