LAB-RPT-10-00011
Rev. 0

RESULTS OF THE EXAMINATION OF ELECTROCHEMICAL NOISE PROBE SPECIMENS REMOVED FROM TANK 241-AN-107, JUNE, 2010

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EXECUTIVE SUMMARY

An Integrated Multi-function Corrosion Probe (IMCP) was installed in Tank 241-AN-107 on September 20, 2006. A portion of the probe was retrieved on June 8, 2010 and the sections holding the detectors were delivered to the 222-S Laboratory for analysis. The examination and disassembly of the probe sections encountered a number of challenges. However, disassembly and relevant analyses were successfully completed. The following summarizes our observations.

Brittle failure of the fiberglass probe in the middle of detector 2 resulted in the recovery of only three vapor space C-rings and six supernatant bullet specimens. The design of the bullets and how they were attached to the probe made the recovery of the components more difficult. The use of glue/epoxy on the bullets and the attachment of the flat bottom of the bullets to the curved surface of the fiberglass probe body meant that weight loss on cleaning and surface area of the specimens could not be determined with acceptable accuracy. Macrophotography of all specimens reveals that corrosion was slight in the vapor space and extremely slight in the supernatant.

The one pre-cracked C-ring recovered from the vapor space still had the stress bulge visible on the polished surface, indicating that crack propagation had not occurred in the tank. No photographs were taken of the C-ring before deployment. No further analysis was conducted on this specimen. A detailed discussion and photographic documentation are provided in this report.

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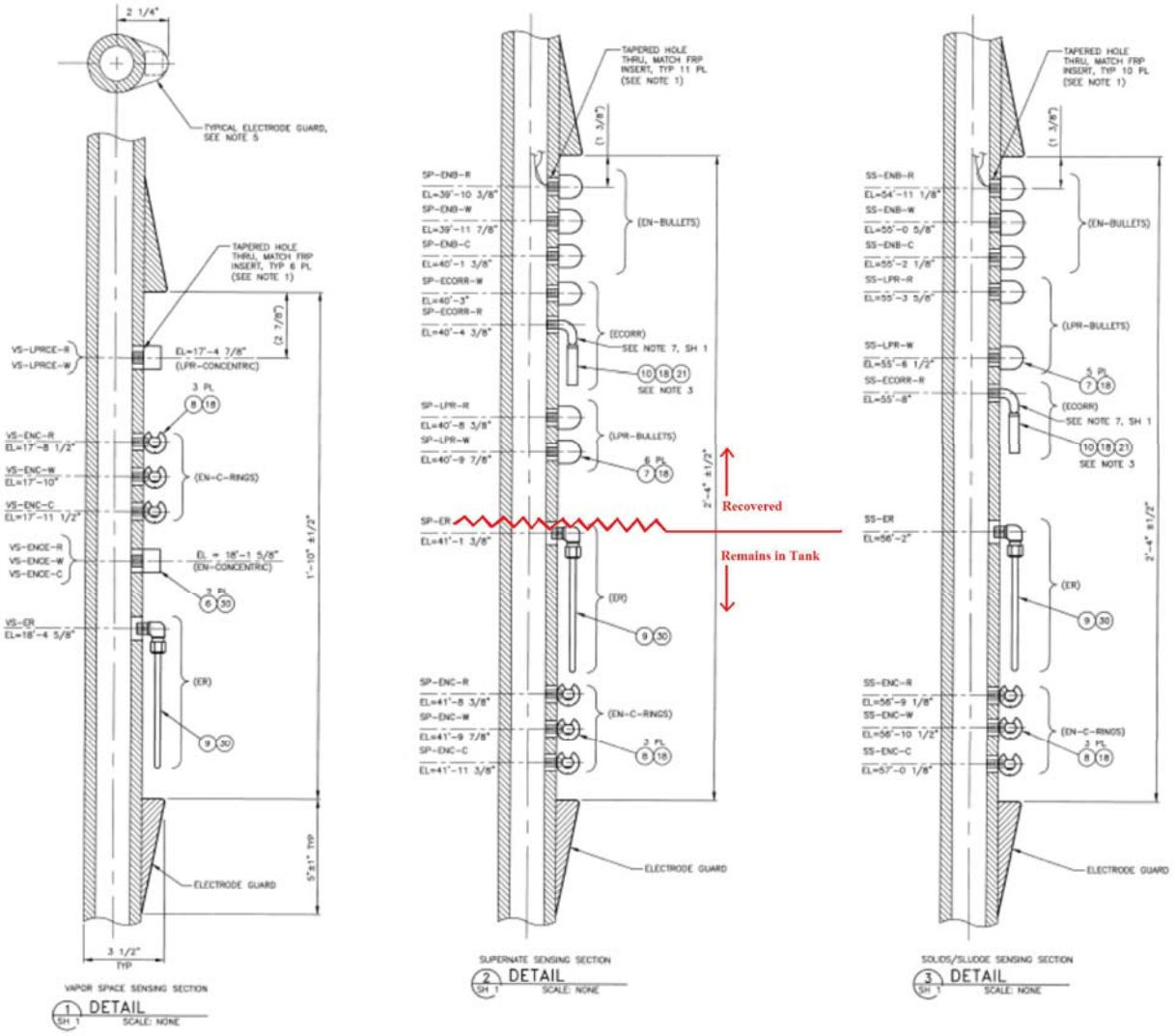
1.0 SAMPLE BREAKDOWN AND ANALYSIS

The Tank 241-AN-107 corrosion probe specimens were delivered to the lab June 10, 2010 as two detector sections with a total of three C-rings and six bullet specimens attached. The detector sections were exposed to the tank environment for almost four years, since September 20, 2006. Examination was attempted using directions contained in LAB-PLAN-09-00005, *Test Plan and Procedure for the Examination of Tank 241-AN-107 Integrated Multi-Function Corrosion Probe*. The locations of the detectors and the three C-ring and three bullet specimens on each detector are identified in Table 1. The drawing in Figure 1 (from H-14-107244, Sheet 2, *IMCP System Active Probe Details*) identifies the recovered section of the probe and the section that remains in the tank. The supernatant liquid level was between the sections shown as detail 1 and detail 2. Attachment A contains the sample breakdown diagrams.

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

Specimen Type	Location	Probe Section	Identification	Laboratory I. D.
C-Ring	Vapor space	Detector 1	VS-ENC-R	S10R000239
C-Ring			VS-ENC-W	S10R000240
C-Ring			VS-ENC-C	S10R000241
Bullet	Supernatant	Detector 2	SP-ENB-R	S10R000242
Bullet			SP-ENB-W	S10R000243
Bullet			SP-ENB-C	S10R000244
Bullet			SP-ECORR-W	S10R000245
Bullet			SP-LPR-R	S10R000246
Bullet			SP-LPR-W	S10R000247

Figure 1. Mechanical Drawing of the Corrosion Probe 241-AN-107.



The two detector sections were loaded into hot cell 1 in Room 1-E at the 222-S Laboratory on June 14 without any difficulties (Figure 2). The package was placed in the airlock after removing the end cap that was closest to the door between the airlock and the hot cell (Figure 3). The manipulators were used to pull the inner package into the hot cell (Figure 4), leaving the outer polycarbonate package in the airlock. The outer packaging was disposed.

Figure 2. Detector Sections 1 and 2 with Outer Bags Removed.

Figure 3. Detector Section 1 in Hot Cell Airlock.

Figure 4. Detector Sections in Hot Cell 1E1 with Outer Container Removed.

On June 17, we stripped the outer packaging with a little difficulty as the two probe sections were packaged slightly differently and neither was packaged the same way as the mock-up we observed in May 2010. The exposed detector section 1 (Figure 5) and detector section 2 (Figure 6) were rinsed and the manipulators were used to attempt removal of the individual components. However, the bullets were impossible to remove, as the manipulators were unable to deliver enough torque to turn the specimens. We could turn the C-rings with difficulty, but they would bind up after about ¼ turn. If worked back and forth many times, it would free up for another ¼ or ½ turn before binding again. After much effort, we were able to get one of the end C-rings (S10R000241) off and started on the middle one. We stopped shortly thereafter for fear that we would damage the stressed C-ring.

Figure 5. Detector Section 1, Unpackaged in Hot Cell 1E1.

Figure 6. Detector Section 2, Unpackaged in Hot Cell 1E1.

While formulating a new strategy, we were informed that the individual specimens were threaded directly into the body of the fiberglass probe and that glue had been applied to the threads.

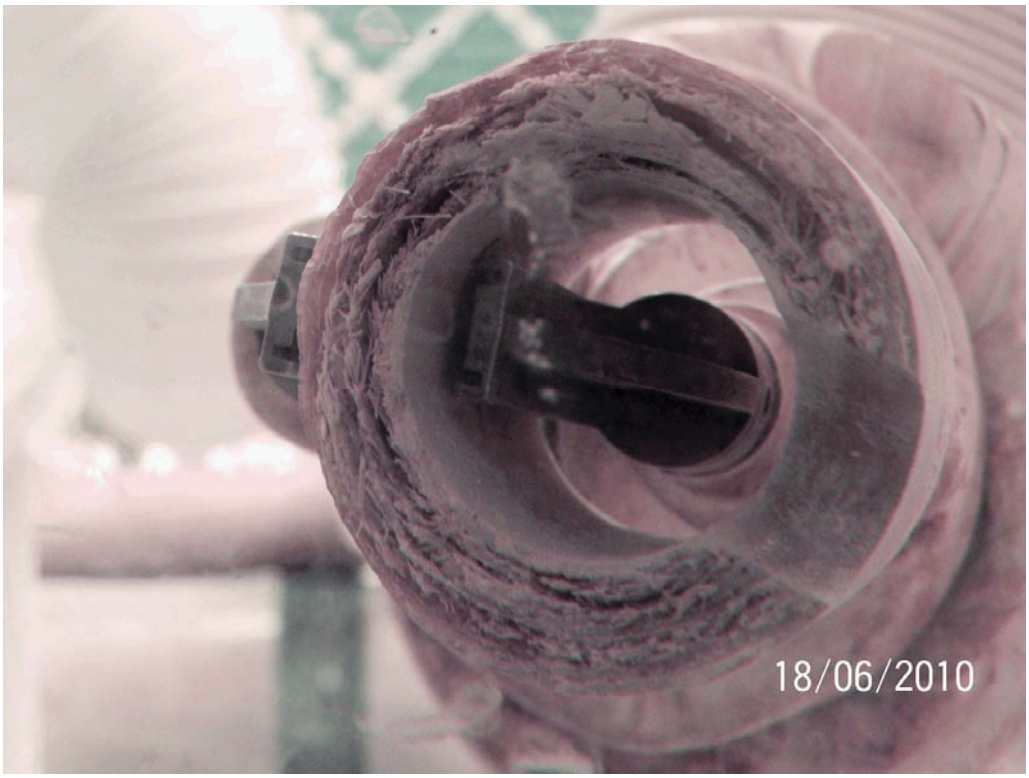
On June 18, we loaded a rotary cut-off grinder into the 1E-1 hot cell and sliced the probe sections into several smaller pieces. On June 21, we rinsed, inspected, and photographed the pieces to be loaded out. These include the pieces shown in the following figures (Figures 7 – 10).

Figure 7. The Half-Foot Long Section of Detector 1 with 2 C-Rings Attached.

Figure 8. The Foot- Long Section of Detector 2 with the Supernatant Probe Section Bullets.

Figure 9. The One C-Ring that was Successfully Removed in Hot Cell 1E1.

Figure 10. The Inch-Thick Piece of Fiberglass from the Failed End.



On June 22, we loaded the pieces out of the hot cell and placed them in Hood 1, Room 1E. The rest of the day was spent with wrenches, vise grips, and a breaker bar removing the C-rings and bullets from the probe sections. This was done with great difficulty, since glue had been applied to the specimen's threads, and each piece was threaded directly into the fiberglass body rather than into a metal-threaded seat. The removed specimens were rinsed with inhibited water, photographed, and placed in a 75 °C oven overnight. After drying, the specimens were placed in jars and stored in a dessicator on a shelf in Room 2B.

After drying and cooling, each specimen was weighed, photographed, and returned to the dessicator. The weights, both original (H-14-107244, Sheet 1, *IMCP System Active Probe Assembly*) and recovered from the rinsed, dried specimens, are included as Attachment B along with the difference in grams.

There are several things to note:

1) All specimens gained about 0.3 grams (range 0.282 – 0.336 grams). The only other time we had both before-deployment and after-deployment (before cleaning) weights was in RPP-8920, *Tank 241-AN-107 Corrosion Coupon Laboratory Analysis*. There, similar C-rings and a lighter "pin" showed slight (less than 0.1 grams) weight losses before and after deployment. The source of the weight gain seen this time is uncertain. The slight corrosion should lead to weight gains as Fe is converted to Fe-oxyhydroxides. However, there is an indeterminate amount of glue and/or epoxy adhering to the threads and, for some of the specimens, filling a small hole on the bottom of the threaded sections where

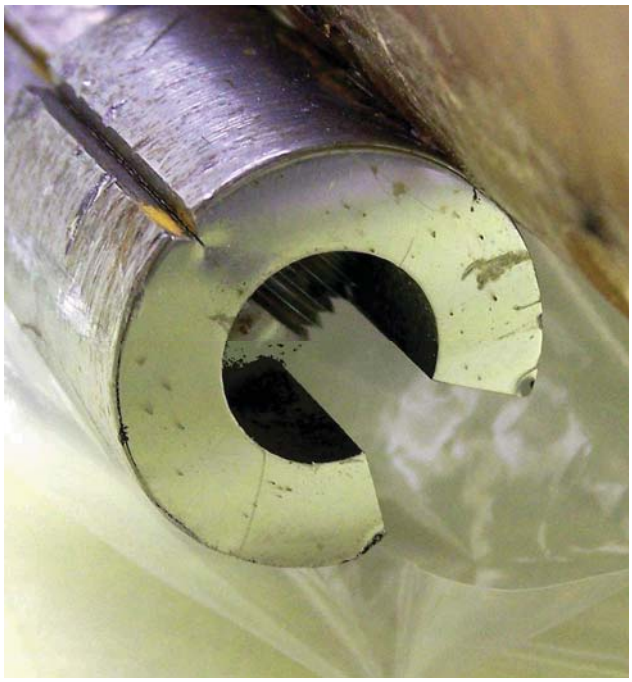
wires were inserted. These wires were cut off with wire cutters. But the epoxy and a portion of the wire remain, recessed in the small hole.

2) The design of the "bullets" makes the determination of a surface area problematic. How do we account for the area at the base of the bullets, where they made only partial contact with the curved surface of the fiberglass? The design of these bullets, with the male threads as part of the cleaned and weighed specimen means that the glue/epoxy is now part of the specimen.

3) The process of retrieval of the coupons from the probe was quite forceful, involving padded channel locks, vise grips, and a substantial amount of force. This was required because of the glue used on the threads and the tapping of threads directly into the fiberglass, instead of metal. It would be difficult to say how much corrosion and how much metal might have been removed in this process. In cross-section, it would be difficult to discriminate between cleaned corrosion pits and scars caused by the removal.

4) The C-rings recovered from the vapor space show the slight corrosion (dominantly crevice corrosion) that has been seen in the past (RPP-RPT-32425, *Final Analytical Results from the Examination of Corrosion on Sections of Corrosion Probe Removed from Tank 241-AN-107 on August 10, 2006* and 7S110-GAC-06-087, "Results of the Examination of Electrochemical Noise Probe Specimens Removed from Tank 241-AN-107"). The one stressed C-ring still shows the characteristic bulge in the polished surface indicating that the stress that was imparted during pre-cracking has not been relieved by further cracking (Figure 11). We do not have pictures of the crack before deployment, but every indication is that the crack has not progressed any further.

Figure 11. Pre-Stressed C-Ring VS-ENC-W (S10R000240) Showing Stress Bulge is Undisturbed.



Metrology of the bullets has been corrupted by the use of glue and by the design of the bullets prohibiting the measurement of an exposed surface area. Macrophotography shows an overall low level of corrosion. Visible evidence for corrosion is slightly more evident on the vapor section C-rings than on the bullets suspended in the supernatant of Tank AN-107. These observations are consistent with previous studies, referenced above. The macrophotographs also demonstrate that the pre-cracked C-ring still retains its stress bulge at the tip of the crack, on the polished end of the C-ring (Figure 11).

For these reasons, it was agreed that there was little to be gained from revising the test plan to account for some of the issues identified above and to continue with the cleaning and specimen preparation for micro analysis as detailed in LAB-PLAN-09-00005. Additional analysis was cancelled.

Attachment A consists of the project breakdown diagram. This diagram provides the cross reference between the specimen identification letters in Table 1 and the 222-S Laboratory sample numbers.

Attachment B is a compilation of the weights of the specimens before and after deployment.

Attachment C consists of the macrophotographs taken of all nine specimens.

2.0 REFERENCES

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.

H-14-107244, Sheet 1, 2006, *IMCP System Active Probe Assembly*, Rev 2, US Department of Energy, Office of River Protection, Richland Washington.

H-14-107244, Sheet 2, 2006, *IMCP System Active Probe Details*, Rev. 3, U.S. Department of Energy, Office of River Protection, Richland Washington.

LAB-PLAN-09-00005, 2010, *Test Plan and Procedure for the Examination of Tank 241-AN-107 Integrated Multi-function Corrosion Probe*, Rev. 1, Washington River Protection Solutions LLC, Richland Washington.

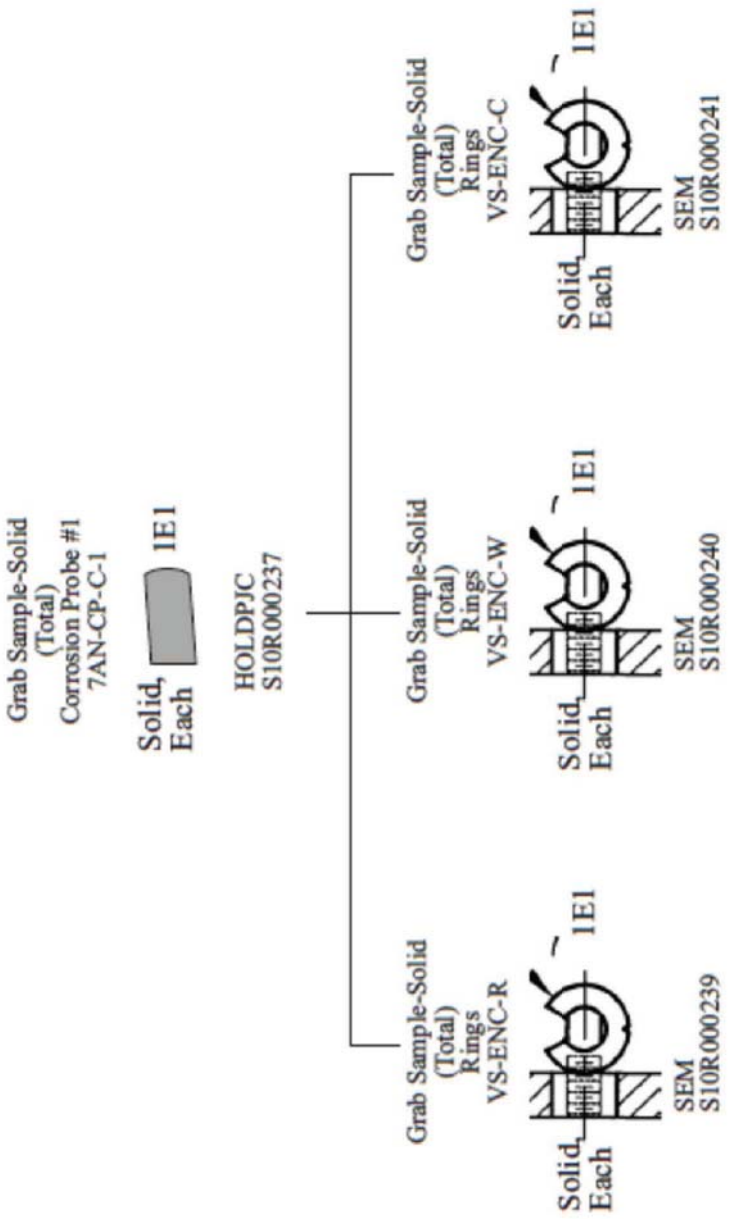
RPP-8920, 2001, *Tank 241-AN-107 Corrosion Coupon Laboratory Analysis*, Rev. 0, CH2M HILL Hanford Group, Inc., Richland, Washington.

RPP-RPT-32425, 2007, *Final Analytical Results from the Examination of Corrosion on Sections of Corrosion Probe Removed from Tank 241-AN-107 on August 10, 2006*, CH2M HILL Hanford Group, Inc., Richland, Washington.

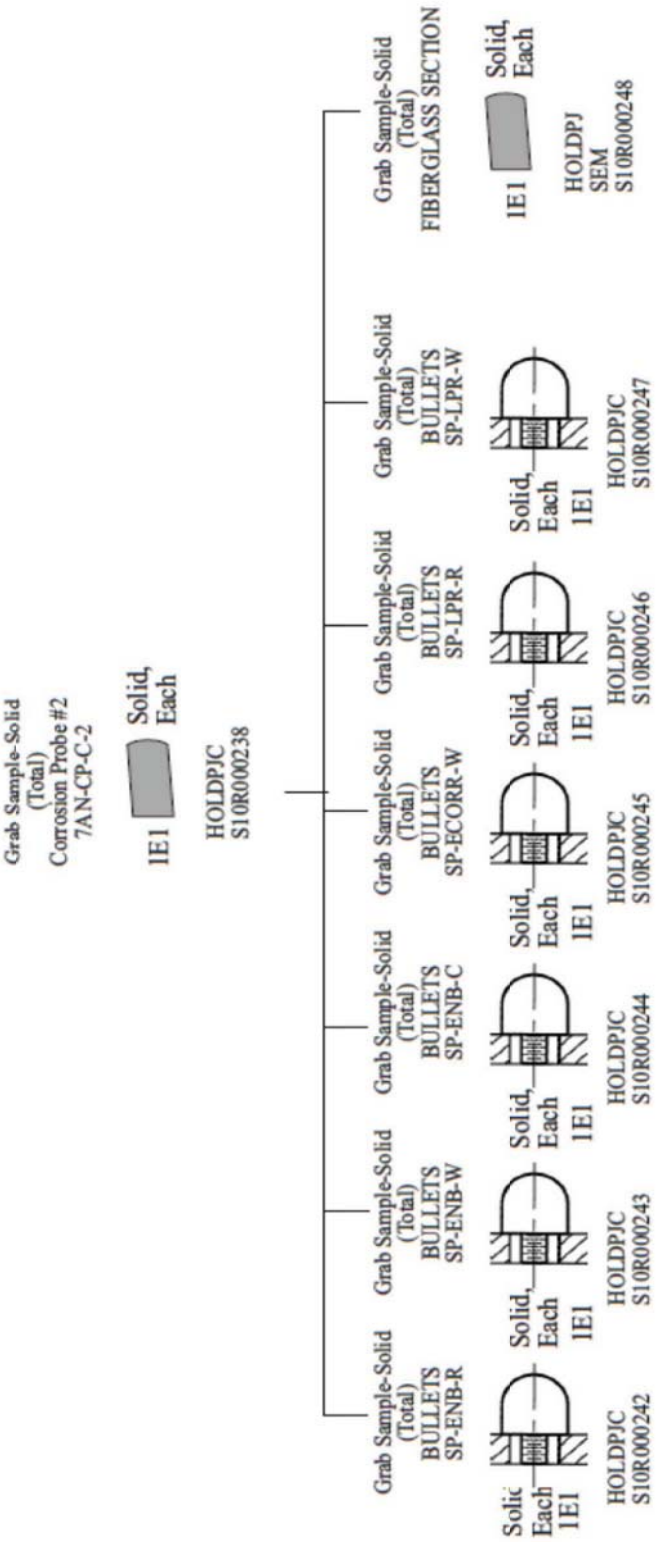
ATTACHMENT A – SAMPLE BREAKDOWN DIAGRAM, 241-AN-107 ELECTROCHEMICAL NOISE PROBE

Consisting of 3 pages, including coversheet

AN107 CORROSION PROBE
Group 20100469



AN107 CORROSION PROBE
Group 20100469



ATTACHMENT B – WEIGHTS OF 241-AN-107 ELECTROCHEMICAL NOISE PROBE SPECIMENS

Consisting of 2 pages, including coversheet

COUPON DATA SHEET--7S110-GAC-06-087
(Original weights from H-14-107244, Sheet 1)

Specimen Identification	Laboratory Sample Number	Original Weight in grams	Recovered Weight in grams	Weight Gain in grams
VS-ENC-R	S10R000239	72.408	72.744	0.336
VS-ENC-W	S06R000240	72.208	72.508	0.300
VS-ENC-C	S06R000241	72.412	72.701	0.289
SP-ENB-R	S06R000242	89.982	90.283	0.301
SP-ENB-W	S06R000243	89.988	90.286	0.298
SP-ENB-C	S06R000244	90.039	90.328	0.288
SP-ECORR-W	S06R000245	90.008	90.347	0.339
SP-LPR-R	S06R000246	90.043	90.325	0.282
SP-LPR-W	S06R000247	90.028	90.346	0.318

ATTACHMENT C – MACROPHOTOGRAPHS TAKEN DURING DISASSEMBLY AND STABILIZATION OF AN-107 ELECTROCHEMICAL NOISE PROBE SPECIMENS

Consisting of 11 pages, including cover sheet

NOTE: Images have been loaded into a folder in IDMS and are also located on the Hanford Chardocs share drive in the directory;
AN107 Corrosion Probe/2010/Photos

Plate I. Sample VS-ENC-R (S10R000239).

Plate IIa. Sample VS-ENC-W (S10R000240).

Plate IIb. Sample VS-ENC-W (S10R000240).

Plate III. Sample VS-ENC-C (S10R000241).

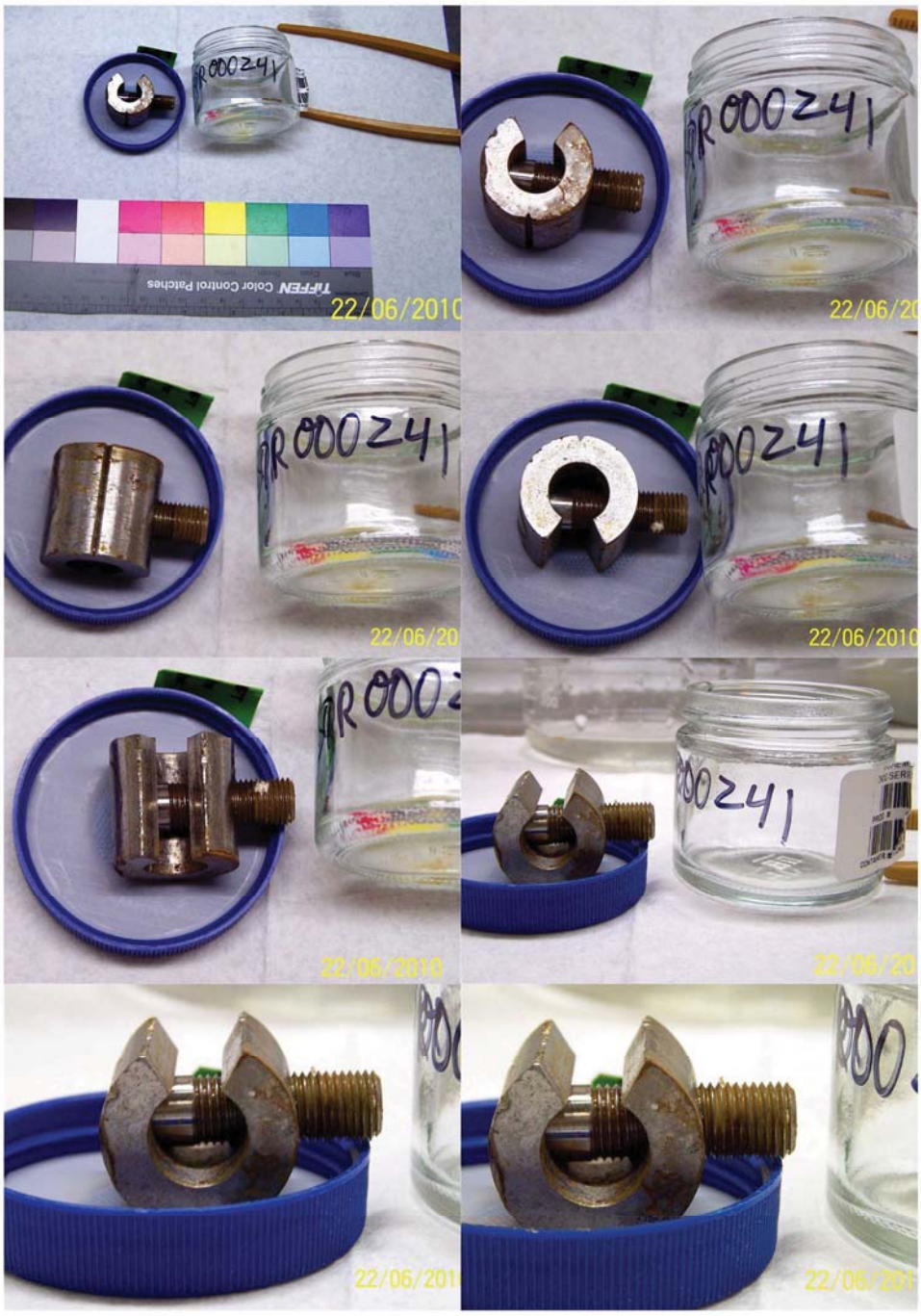


Plate IV. Sample SP-ENB-R (S10R000242).

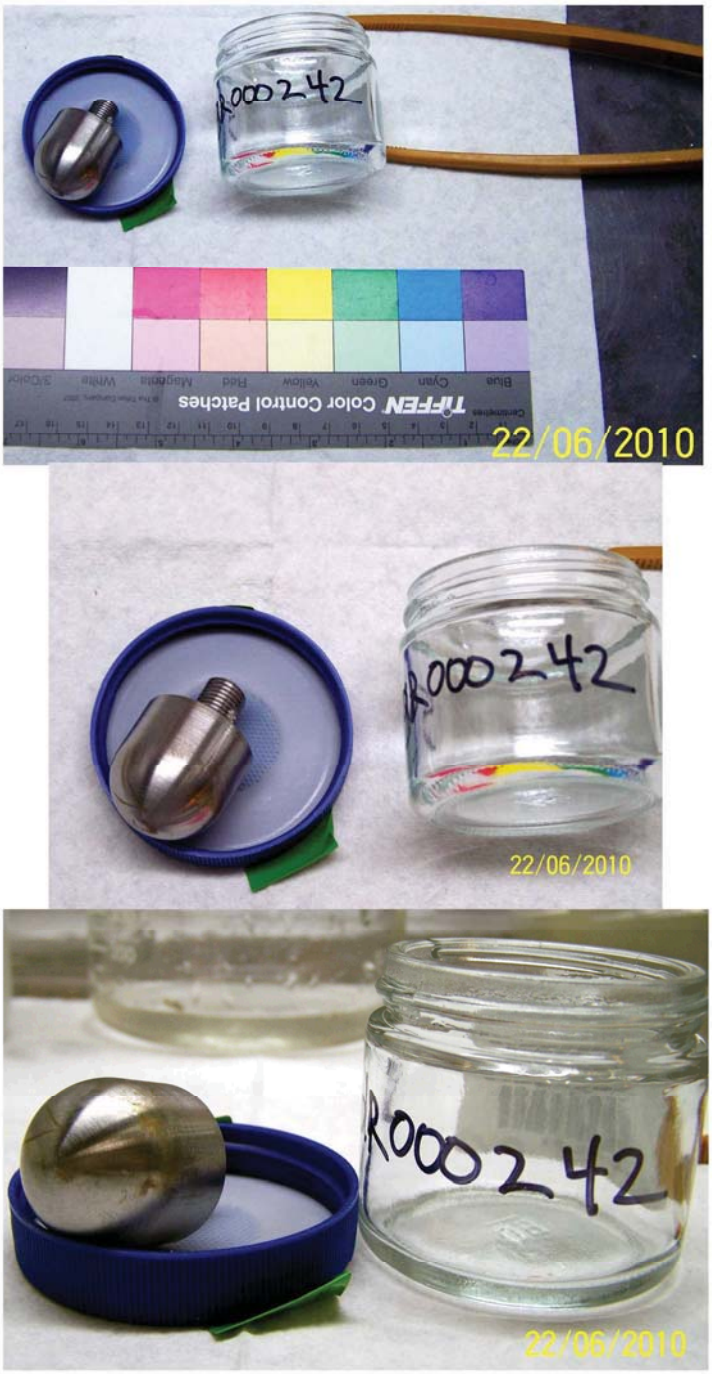


Plate V. Sample SP-ENB-W (S10R000243).

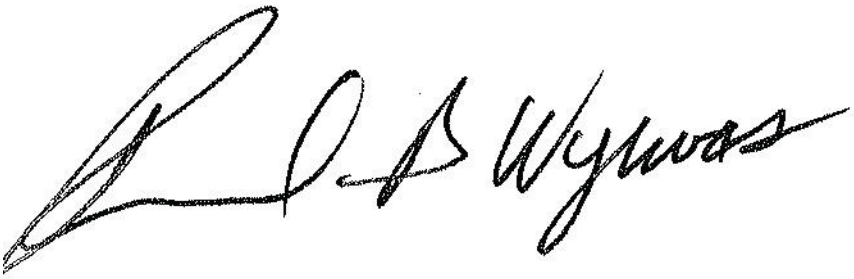
Plate VI. Sample SP-ENB-C (S10R000244).

Plate VII. Sample SP-ECORR-W (S10R000245).

Plate VIII. Sample SP-LPR-R (S10R000246).

Plate IX. Sample SP-LPR-W (S10R000247).

Electronically Approved by:



UserName: Wyrwas, Richard (h3390899)
Title: APD Chemist
Date: Monday, 25 October 2010, 01:04 PM Pacific Time
Meaning: Additional approval obtained
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UserName: Duncan, James (h0079048)
Title: APD Chemist
Date: Monday, 25 October 2010, 02:18 PM Pacific Time
Meaning: Additional approval obtained
==========

UserName: Carothers, Kelly (h0072896)
Title: Process Engineering
Date: Thursday, 28 October 2010, 09:19 AM Pacific Time
Meaning: Approved by the customer or delegate
==========

UserName: Hardy, Don (h0085161)
Title: Laboratory Facilities Manager
Date: Monday, 01 November 2010, 09:47 AM Pacific Time
Meaning: Approved by the Facility Manager or delegate
==========

Electronically Approved by:

UserName: Seidel, Cary (h0009079)
Title: APD Manager
Date: Monday, 01 November 2010, 10:30 AM Pacific Time
Meaning: Approved by the APD Manager or delegate
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