LABORATORY NOTEBOOK

NOTEBOOK NO. 796

CONTINUED FROM NOTEBOOK NO. CONTINUED TO NOTEBOOK NO.

ASSIGNED TO: Hundal (Andy) Jung
Brian Derby - Brian Derby - BKD
Blair Brettmann - Blair Brettmann - BB

NAME Xihua He X.H

SIGNATURE He DATE 5/28/06

DATE ISSUED BY

PHONE EMAIL

ORGANISATION

DEPARTMENT

ADDRESS

CITY PROVINCE/REGION

COUNTRY POSTAL CODE

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NOTES:

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TITLE PROJECT

Continued From Page

Initial Scientific Notebook Entry for the Effects of Test Methods on Alloy 22 Crevice Corrosion Repassivation Potential

Title: Effects of test methods on Alloy 22 crevice corrosion repassivation potential

Tests Performed by: Hundal (Andy) Jung, Div. 20; Xihua He, Div. 20; Brian Derby, Div. 18

Objectives: Determine and compare the crevice corrosion repassivation potentials of mill-annealed, as-welded, and welded plus solution annealed Alloy 22 by two different test methods, i.e., DOE (ASTM G61, reference 1) and CNWRA (reference 2) methods

Proposed approach or procedure for achieving the objectives: Tests are conducted in a glass test cell using a multiple crevice assembly consisting of a number of grooves and plateaus in accordance with ASTM G61 as well as CNWRA methods. In this assembly, the serrated polytetrafluoroethylene or ceramic crevice former contacts with the crevice specimen to form an artificial crevice with 24 crevice sites. Then immerse the crevice assembly in N_2 deaerated solution to perform cyclic polarization or potentiodynamic polarization + potentiostatic hold to obtain crevice corrosion repassivation potential (see reference 1 and 2 below). The crevice specimens tested are mill-annealed, as-welded, and welded + solution annealed Alloy 22.

Equipment: Electrochemical test cell with multiple crevice assembly, Solartron 1287 and 1480 multi-channel potentiostats, temperature controller, thermometer, pH mater, balance, torque screwdriver. Calibration and due dates are provided in data sheet for each test.

Materials: Mill-annealed Alloy 22, welded Alloy 22, and welded plus solution annealed Alloy 22. Material heats to be added prior to testing

Specimen Specifications: crevice specimens CNWRA drawing #20.06002.01.322.002

Measurement Parameters: Temperature, open circuit potential, potential and current of specimen during polarization.

Required Level of Accuracy: Temperature ±2°C, Potentials ±1 mV, Current ±1 microamp.

Uncertainty and Sources of Error: Open circuit potential changes with time. Current measurement error can occur for localized corrosion processes because the actively corroding area is not the same as the surface area of the test specimen.

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1. Bechtel SAIC Company, LLC. "General Corrosion and Localized Corrosion of Waste Package Outer Barrier." Rev. 2. Las Vegas, Nevada: Bechtel SAIC Company, LLC. 2004. (Appendix I, p. I5-I6)
2. D.S. Dunn, Y.-M. Pan, K. Chiang, L. Yang, G.A. Cragnolino, X. He, "The localized corrosion resistance and mechanical properties of alloy 22 waste package outer containers", *Journal of Metals*, 57 (2005) 49-55.

TITLE **PROJECT**

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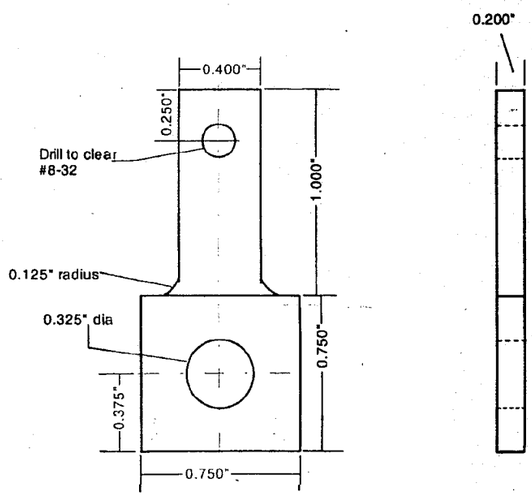
Darrell S. Dunn
SwRI-CNWRA
Phone: (210) 522-6090
Fax: (210) 522-5184
e-mail: ddunn@swri.org

CNWRA Drawing 20-06002-01-322-002
Dimensional tolerances +/- 0.005"

To be completed at time of order:
Material: Alloy 22
Heat: 2277-3-3266
Specimen Orientation: Normal to rolling direction
Other:



Initiated by. D. Dunn 3/11/05 Date

Reviewed by V. Jain 3/11/05 Date

QA Approval B. Brient for 3/11/05 Date

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TITLE **PROJECT**

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11411 East Coker Loop
San Antonio, Texas 78216
Phone: (210) 494-3651
Fax: (210) 494-6139
www.texastoolmakers.com

TEXAS TOOL MAKERS INC.

A8306
ISO 9001:2000

CERTIFICATE OF CONFORMANCE

TO: Southwest Research Institute
6220 Culebra Road
San Antonio, Tx. 78238-5166

CUSTOMER P.O. 656855D

TTI JOB #: 38019/2

DESCRIPTION 24 EA.; P/N 20-06002-01-322-002 Alloy 22 Specimen

WE CERTIFY THAT THE ITEM(S) ON THE ABOVE REFERENCED PURCHASE ORDER HAVE BEEN PROCESSED AND/OR MANUFACTURED IN ACCORDANCE WITH:

Drawing 3/11/05

RECORDS ARE ON FILE AT THIS FACILITY, WHICH VERIFY OUR PROCESS CONTROLS, AND AVAILABLE FOR REVIEW UPON REQUEST. TEST RESULTS ARE AS FOLLOWS:

Accepted

TEXAS TOOLMAKERS,

BY : (Casey Ridgway)

TITLE: Q.A. Manager

DATE : 5-30-06

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SIGNATURE DATE 5/30/06

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TITLE PROJECT

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DIMENSIONAL INSPECTION REPORT

TEXAS TOOLMAKERS, INC.

Job No.:	Part No.:	Rev. No.:	P.O. No.:
38019/2	20-06002-01-322-002		6568550

Customer:	Part Name:	Log No.:
S.W.R.I.	Alloy 22 Specimen	6125001-C A

Inspection Plan:	Quantity:	Sample Size:	Accept No.:	Reject No.:	NR No.:
[X] 100 % [ ] Specified Dim. [ ] 1st Article	24	24	24	0	0

Zone	Dim. / Char.	Tolerance*	Actual	Equipment S/N	Comments
1.	.400		.398-.403	TM-102	
2.	.250		.248-.253	TM-102	
3.	8-32 clear		.169	TM-102	
4.	R.125		R.125	TM-024	
5.	ϕ.325		.324	TM-102	
6.	.375		.373-.377	TM-102	
7.	.750		.748-.749	TM-102	
8.	.750		.747-.750	TM-102	
9.	1.000		1.000-1.004	TM-102	
10.	.200		.200-.203	TM-102	

* Recorded if not affected by tolerance block. Sheet 1 of 2

Inspection Performed by: [signature] Date 5-30-06 Customer (as applicable) _____ Date _____

TTI Form QF-100201 Rev 2

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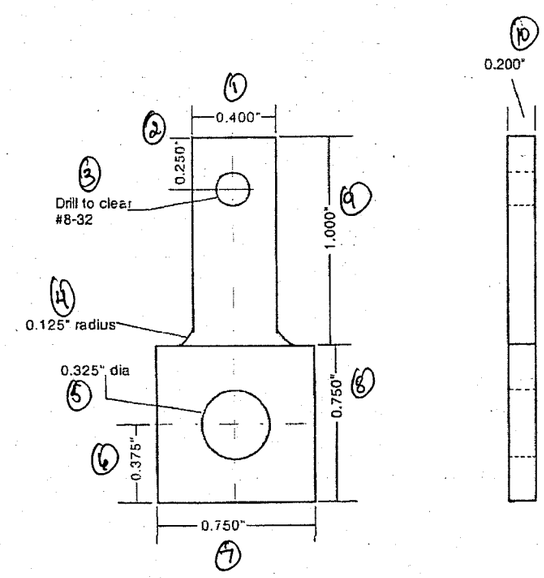
X.R. 7/14/08



Initiated by. D. Dunn 3/11/05 Date

Reviewed by V. Jain 3/11/05 Date

QA Approval B. Brient 3/4/05 Date

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5 10 15 20 25 30 35 40 45

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X-M

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ceramic crevice washers wrapped with Teflon tape

Torque Screwdriver: True Craft 70 In-lbs **SN:** 694000691 **Cal:** 7/22/05 **Due:** 7/21/06 X.H 8/15/06

Initial Weight: 24.28922g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 24.28053g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.0 m NaCl
116.94g NaCl Lot #052761
+ DI to 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 1/5/06 **Due:** 7/5/06

Initial pH: 4.83 **Model:** Orion **SN:** 2330
Final pH: 5.93 **CAL:** 7/25/05 **DUE:** 7/25/06
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** 4084 **Cal:** 7/25/05 **Due:** 7/25/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 3328225

Gas: 99.999% Nitrogen
Ecorr: −152 mV SCE **Model:** Keithley 614 **SN:** 0704934
Ept: +401 mV SCE **Cal:** 7/12/05 **Due:** 7/12/06
Eapplied (vs SCE): –

Potentiostat: Solartron 1287 **SN#** 60186634 **Cal:** 5/16/06 **Due** 11/16/06
Test ID: C22ERP01A

Specimen Examination: 11/24

11/24 Slight Crevice corrosion outer Edge of Ceramic Crevice washers - One Side Crevice washer Cracked - One Side of Specimen Has Small Minor In Dentions - At Time of Torque on washer Cracked on that Side - Gold tint Surface Staining on Specimen

SIGNATURE		DATE 6/1/06
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TITLE **PROJECT**

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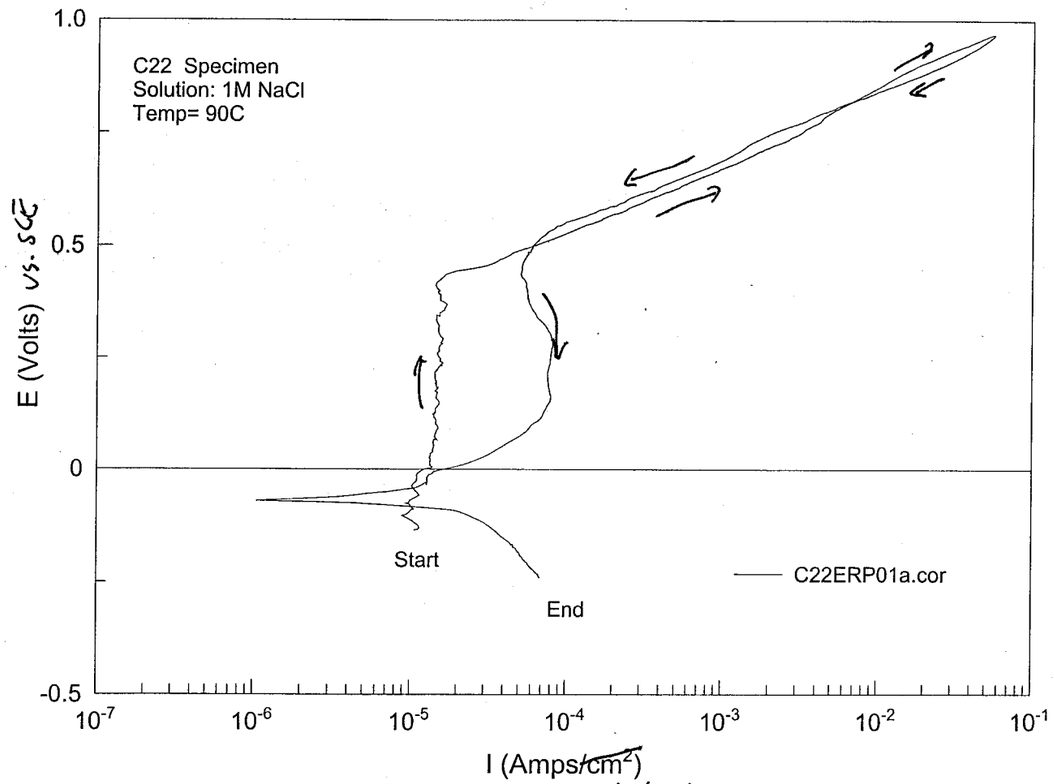
X.H 7/14/08



X.H 6/5/06

$E_{cross-over} = -41.9\ mV_{SCE}$ $E_{R1} = -41.9\ mV_{SCE}$ $E_{R2} = 14.7\ mV_{SCE}$
$= (-41.9 + 42)\ mV_{SSC}$
$= +0.1\ mV_{SSC}$

X.H 7/14/08

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ceramic crevice washers wrapped with Teflon tape X.H 8/15/06

Torque Screwdriver: True Craft 70 In-lbs. **SN:** 694000691 **Cal:** **Due:** 7/21/06

Initial Weight: 24.25151g **Final Weight:** 24.24170g **Model:** Sartorius Genius **SN:** 12809099 **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.0 m NaCl
116.90g NaCl # 052761 lot
+ DI To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 1/5/06 **Due:** 7/5/06

Initial pH: 4.76 **Final pH:** 6.79 **Model:** Orion **SN:** 2330 **CAL:** 7/25/05 **DUE:** 7/25/06 **pH Probe:** #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-170 **Cal:** 4/7/06 **Due:** 4/6/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: -391 mV Vs SCE **Ept:** +247 mV Vs SCE **Model:** Keithley 614 **SN:** 0704934 **Cal:** 7/12/05 **Due:** 7/12/06

Eapplied (vs SCE): —

Potentiostat: Solartron 1287 **SN#** 00148500 cal: 5/15/06 Due: 11/15/06

Test ID: C22ERP01B

Specimen Examination: 21/24

21/24 feet of Crevice Washer Have Corrosion mainly on Inner And Outer Edge of Ceramic Crevice Washers Both Crevice Washers Cracked. One Side of Specimen Shows Minor In Dentions Also. Gold tint Staining on All Surfaces

SIGNATURE	DATE 6/1/06
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TITLE **PROJECT**

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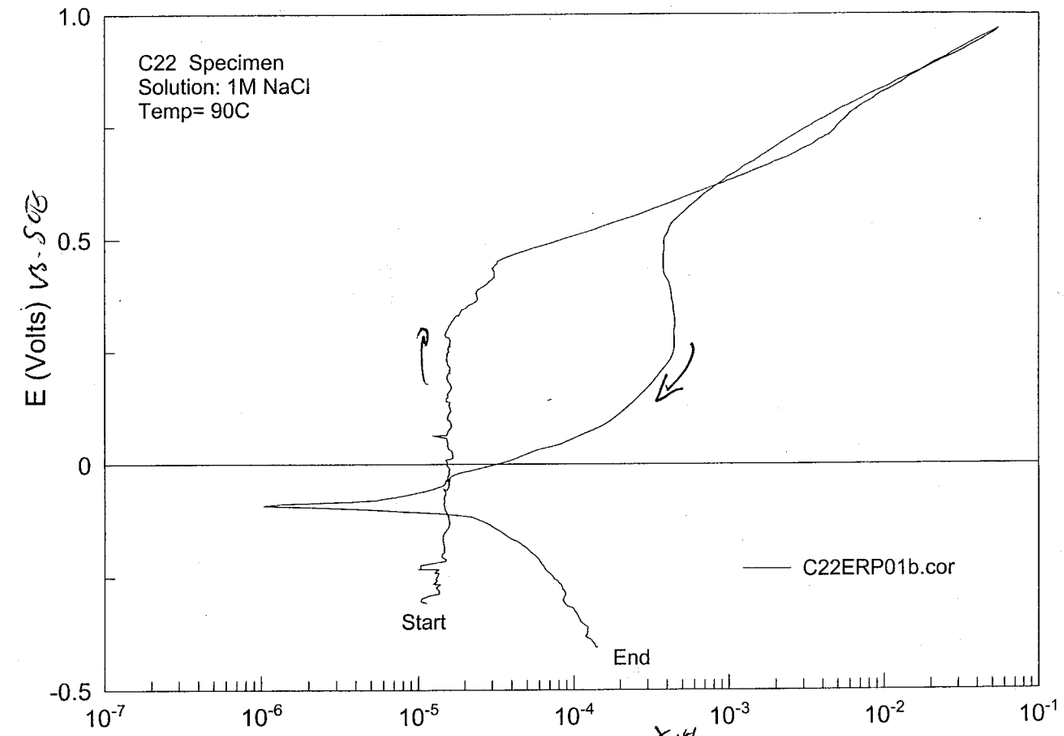
X.H 7/14/08



X.H 7/6/06

$E_{cross\text{-}over} = -37.9\ mV_{SCE}$ $E_{R_1} = -59.4\ mV_{SCE}$ $E_{R_2} = -11.2\ mV_{SCE}$

$= 4.1\ mV_{SCE}$ SSC

X.H 7/25/06

X.H 7/14/08

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SIGNATURE	DATE 6/2/06
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TITLE **PROJECT**

POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X.H 8/15/06

Torque Screwdriver: Proto 6104 50 In-oz. **SN:** 139072
Cal: 4/4/06 **Due:** 10/4/06

Initial Weight: 23.79275 **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.79181 g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.0 m NaCl
116.88g NaCl Lot# 052761
+ DI

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/5/06 **Due:** 1/5/07

Initial pH: 5.19 **Model:** Orion **SN:** 2330
Final pH: 5.74 **CAL:** 7/25/05 **DUE:** 7/25/06
pH Probe: #13-620-296 **SN:** 5003695

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-179
Cal: 5/11/06 **Due:** 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 3328225

Gas: 99.999% Nitrogen
Ecorr: − 388 mV SCE **Model:** Keithley 614 **SN:** 467374
Ept: + 125 mV SCE **Cal:** 6/12/06 **Due:** 1/12/07
Eapplied (vs SCE): –

Potentiostat: Solartron 1287 **SN#** 00186634
Test ID: C22ERP02A-1 & -2 & -3 Cal: 5/16/06 Due: 11/16/06

Specimen Examination: 0/24

No Corrosion 0/24 feet of Crevice Washers (PTFE)
Mild Surface staining on Specimen

* Note: Specimen Repolished for further Testing

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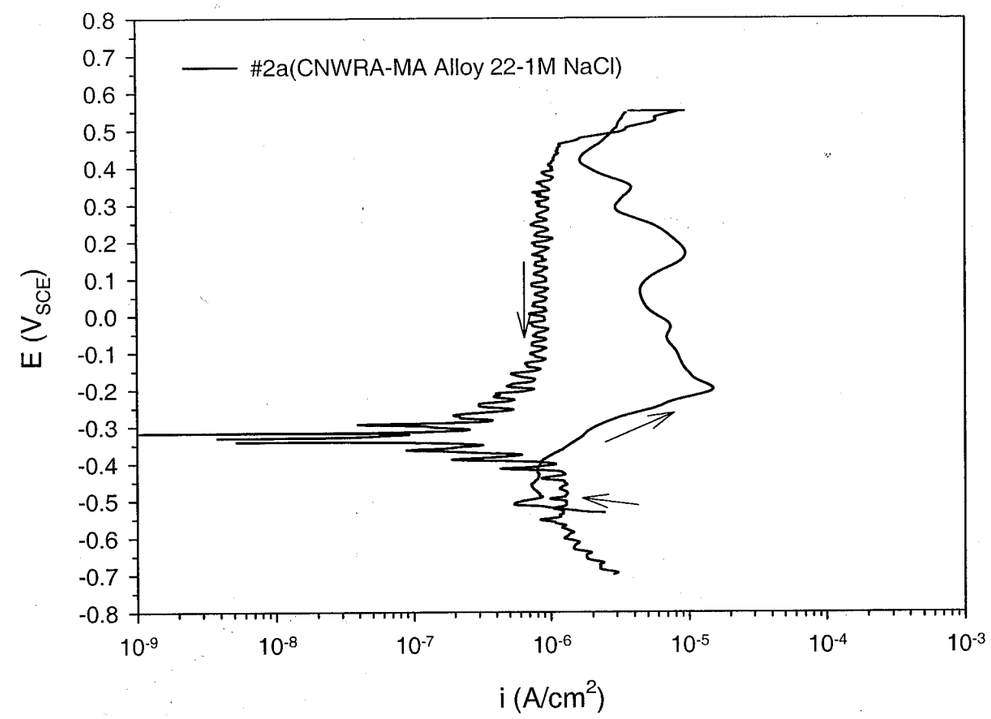
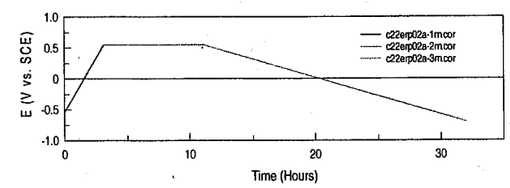
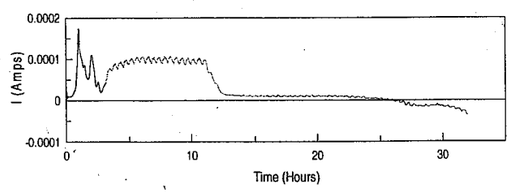


Figure 3. CPP curve for Mill-annealed Alloy 22 (#2a) obtained by CNWRA method in 1 M NaCl at 90°C





Mill-annealed C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 482 mV_{SCE};
$i < 10^{-6}$ A/cm² at 452 mV_{SCE}

Xihua Hu 7/25/06

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X.H 8/15/06

Torque Screwdriver: Proto 6104 50 In-oz **Cal:** 4/4/06 **SN:** 135072 **Due:** 10/4/06

Initial Weight: 23.61410g **Final Weight:** 23.61268g **Model:** Sartorius Genius **Cal:** 5/9/06 **SN:** 12809099 **Due:** 11/9/06

SOLUTION: 1.0 m NaCl
116.89g NaCl Lot # 052761
+ DI To 2000 ml

Reagents measured with **Model:** OHAUS **Cal:** 7/5/06 **SN:** 2883 **Due:** 1/5/07

Initial pH: 5.45 **Final pH:** 6.37 **Model:** Orion **CAL:** 07/25/06 **pH Probe:** #13-620-296 **SN:** 2330 **DUE:** 7/25/06 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-170 **Cal:** 4/7/06 **Due:** 4/6/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: -322mV SCE **Ept:** +210 mV SCE **Model:** Keithley 614 **Cal:** 6/12/06 **SN:** 467374 **Due:** 1/12/07

Eapplied (vs SCE): —

Potentiostat: Solartron **SN#** 001405000 **cal:** 5/15/06 **Due:** 11/15/06

Test ID: C22ERP028-1 & -2 & -3

Specimen Examination: 0/24

No Crevice Corrosion 0/24 feet of PTFE Crevice washers

Mild Gold tint surface staining

* Note: Specimen Repolished for further Testing

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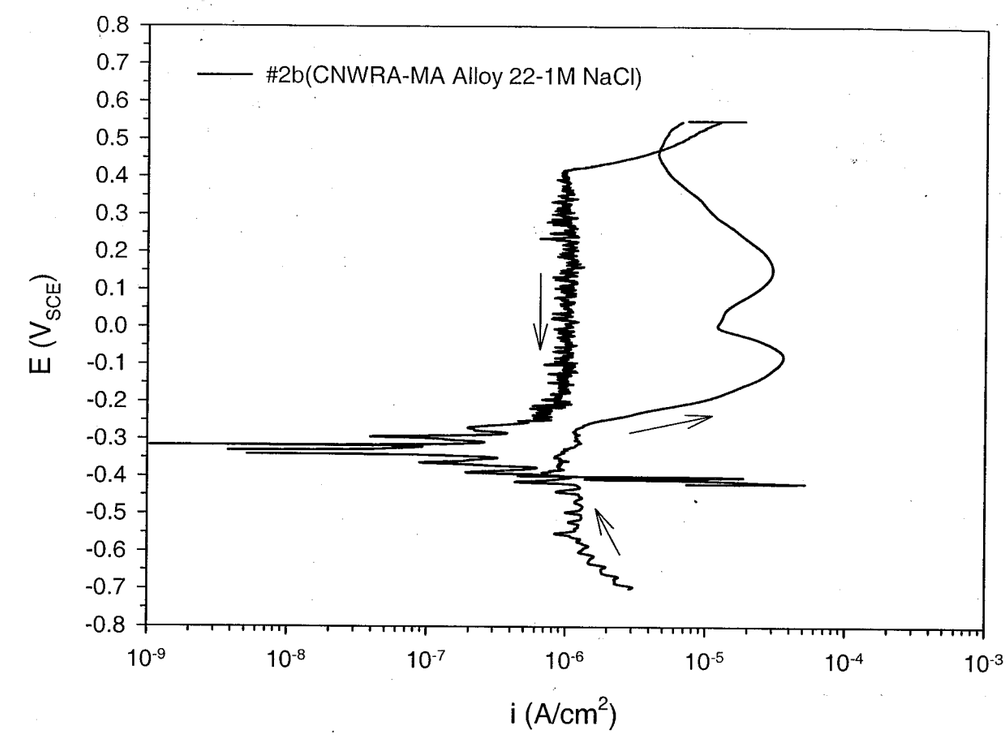
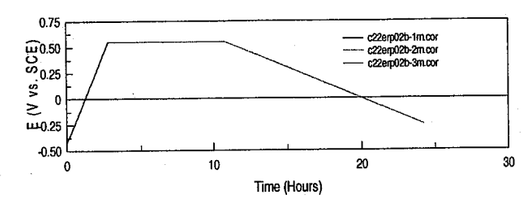
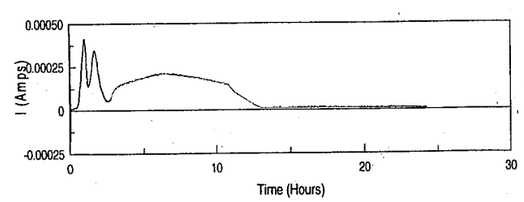


Figure 4. CPP curve for Mill-annealed Alloy 22 (#2b) obtained by CNWRA method in 1 M NaCl at 90°C





Mill-annealed C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 534 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 438 mV_{SCE};
$i < 10^{-6}$ A/cm² at 419mV_{SCE}

X. Huerta 7/25/06

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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# ~~2277-3-3266~~ 2277-3-3292 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers

Torque Screwdriver: Proto 6104 50 In-02 Cal: 4/4/06 SN: 139072 Due: 10/4/06

Initial Weight: 23.17562g **Final Weight:** 23.17329g Model: Sartorius Genius Cal: 5/9/06 SN: 12809099 Due: 11/9/06

SOLUTION: 1.0 m NaCl; 166.88g NaCl Lot # 052761 + DI To 2000mls

Reagents measured with Model: OHAUS Cal: 7/5/06 SN: 2883 Due: 1/5/07

Initial pH: 5.13 **Final pH:** 7.02 Model: Orion CAL: 7/6/06 SN: 2330 DUE: 7/6/07 pH Probe: #13-620-296 SN: 5603095

TEST TEMPERATURE: 90°C Measured with Hg Thermometer SN: H 98-179 Cal: 5/11/06 Due: 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE SN: 3328225

Gas: 99.999% Nitrogen

Ecorr: -503 mV Vs SCE **Ept:** +239 mV Vs SCE **Eapplied (vs SCE):** — Model: Keithley 614 Cal: 6/12/06 SN: 467324 Due: 1/12/07

Potentiostat: Solartron 1287 SN# 00186634 cal 5/16/06 Due 11/16/06

Test ID: C22ERP03B

Specimen Examination: 1/24

Crevice Corrosion on 1/24 feet of PTFE Crevice washers. m/o Surface staining on Specimen

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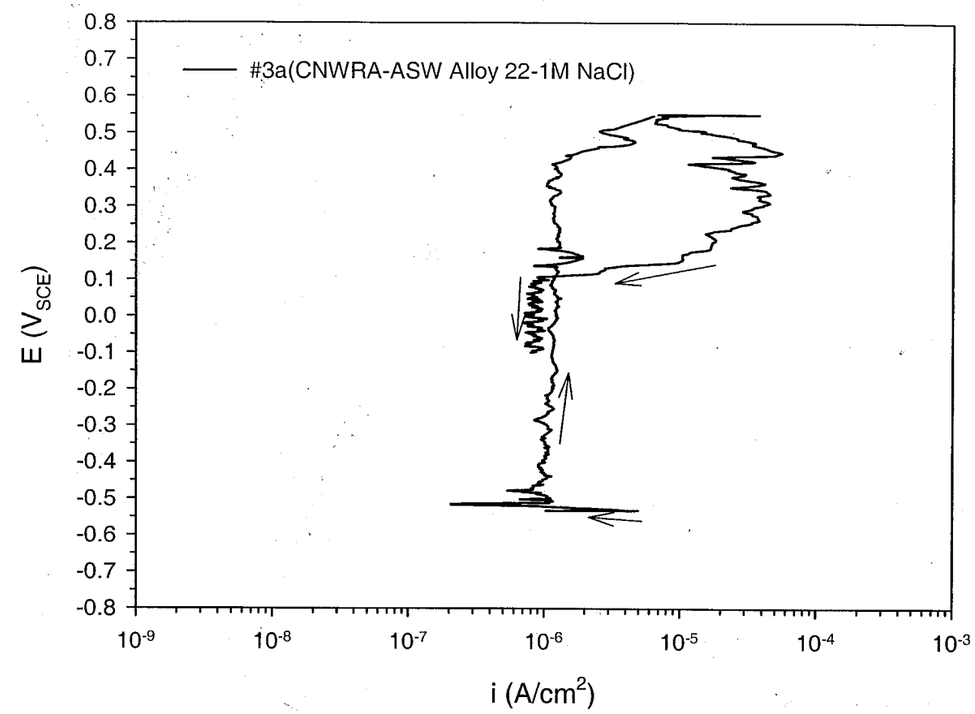
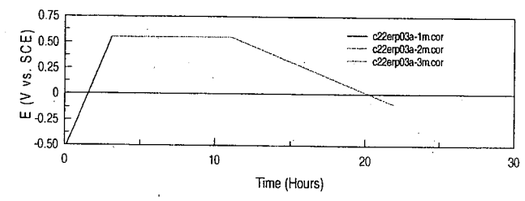
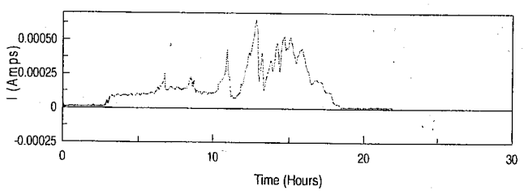


Figure 5. CPP curve for As-welded Alloy 22 (#3a) obtained by CNWRA method in 1 M NaCl at 90°C





As-welded C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 151 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 114 mV_{SCE};
$i < 10^{-6}$ A/cm² at 109 mV_{SCE}

Xihua He 7/25/06

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TITLE **PROJECT**

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POTENTIODYNAMIC TEST

Objective: see page #1

BWS 8/15/06

2277-3-3292 WN813

Specimen: C22 specimen Heat# ~~2277-3-3266~~ CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ crevice washers

Torque Screwdriver: Proto 6104 50 In-oz Teflon X-H 8/15/06 **SN:** 139072
Cal: 4/4/06 **Due:** 10/4/06

Initial Weight: 23.41184 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.41108 g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.0 M NaCl
166.89 g NaCl, Lot # 052761
+ DI To 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/5/06 **Due:** 1/5/07

Initial pH: 5.17 **Model:** Orion **SN:** 2330
Final pH: 7.18 **CAL:** 07/06/06 **DUE:** 07/06/07
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-170
Cal: 4/7/06 **Due:** 4/6/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: -0.337 VSCE **Model:** Keithley 614 **SN:** 467374
Ept: +0.198 VSCE **Cal:** 6/12/06 **Due:** 1/12/07
Eapplied (vs SCE): —

Potentiostat: Solatron 1287 **SN#** 0014 8500
Test ID: C22ERP03A-1 & 2 & 3 Cal: 5/15/06, Due: 1/15/06.

Specimen Examination: 0/24

No Crevice Corrosion 0/24 feet of PTFE Crevice washer - mild Surface Staining on Specimen

Note: Specimen repolished for further testing.

7/13/06

~~PROPRIETARY INFORMATION~~ 9/3/08 MP

TITLE **PROJECT**

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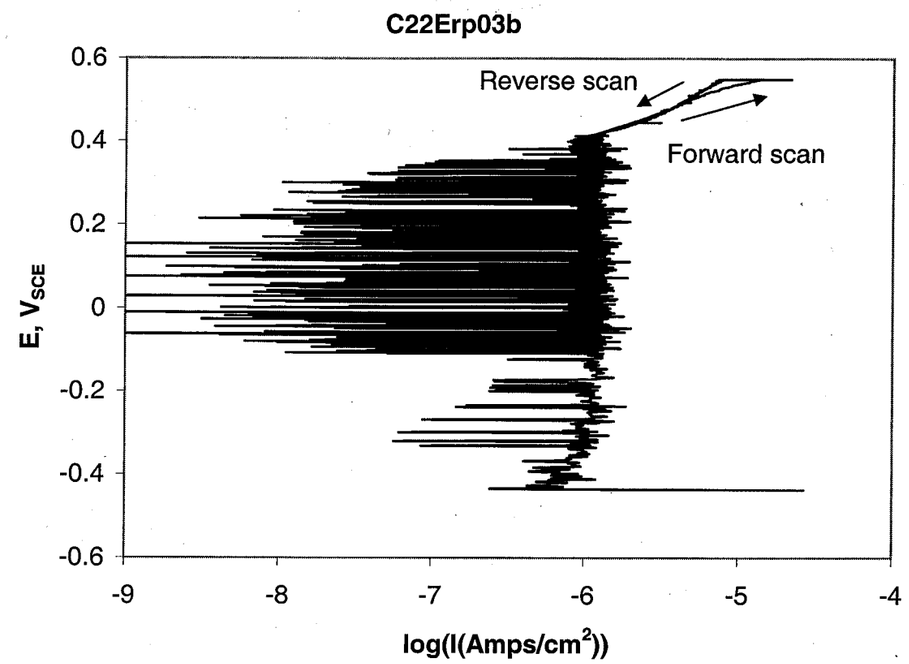
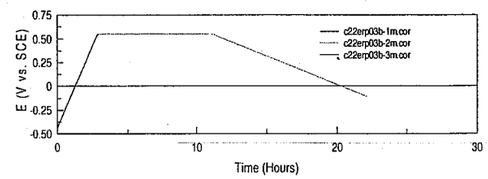
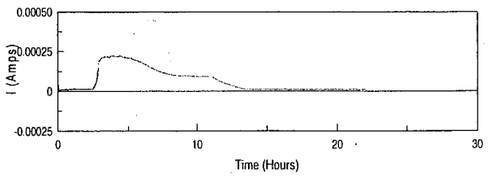


As-welded C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 440 mV_{SCE};
$i < 10^{-6}$ A/cm² at 414 mV_{SCE}





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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X.H 8/15/06

Torque Screwdriver: Proto 6104 50 In-Oz Cal: 04/04/06 SN: 139072 Due: 10/4/06

Initial Weight: 24.37186 g Model: Sartorius Genius SN: 12809099

Final Weight: 24.3647 g Cal: 05/09/06 Due: 11/09/06

SOLUTION: 1.0 M NaCl
116.89 g NaCl Lot # 052761
+ DI To 2000 mls

Reagents measured with Model: OHAUS SN: 2883
Cal: 07/05/06 Due: 1/5/07

Initial pH: 4.79 Model: Orion SN: 2330

Final pH: 6.92 CAL: 07/06/06 DUE: 07/06/07

pH Probe: #13-620-296 SN: 5003095

TEST TEMPERATURE: 90°C Measured with Hg Thermometer SN: H98-179
Cal: 5/11/06 Due: 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE SN: 4028036

Gas: 99.999% Nitrogen

Ecorr: −0.345 V_{SCE} Model: Keithley 614 SN: 0579628

Ept: +0.188 V_{SCE} Cal: 09/14/05 Due: 09/14/06

Eapplied (vs SCE): —

Potentiostat: Solartron 1287 SN# 00148500

Test ID: C22ERP04A Cal: 05/15/06 Due: 1/15/06

Specimen Examination: 0/24

No Crevice Corrosion on Specimen 0/24 feet of Crevice washer. Gold tint staining on All Surfaces of Specimen

* Note: Specimen Repolished for Further Testing

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SIGNATURE DATE 8/2/06

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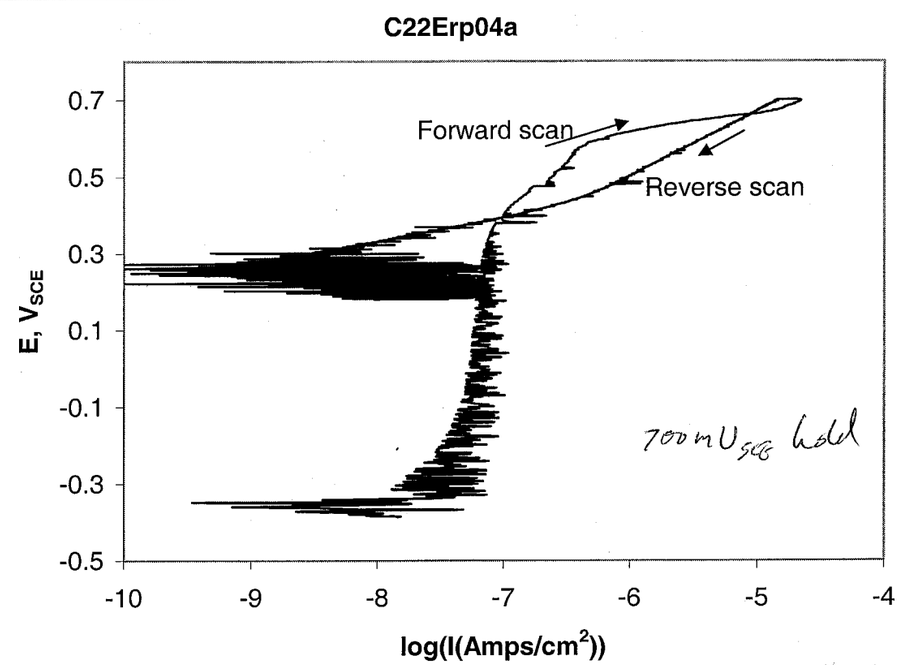

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SIGNATURE DATE 8/2/06

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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X·M 8/15/06

Torque Screwdriver: Proto 6104 50 In-Oz. **SN:** 139072 **Cal:** 4/4/06 **Due:** 10/4/06

Initial Weight: 24.00605g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 24.00442g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.0 m NaCl
116.88g NaCl Lot# 052761
+ DI To 2000mL

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 7/5/06 **Due:** 1/5/07

Initial pH: 5.12 **Model:** Orion **SN:** 2330
Final pH: 7.25 **CAL:** 7/6/06 **DUE:** 7/6/07
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°c **Measured with Hg Thermometer SN:** H98-179 **Cal:** 5/11/06 **Due:** 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen
Ecorr: −428 mV Vs SCE **Model:** Keithley 614 **SN:** 0579628
Ept: +398 mV Vs SCE **Cal:** 9/14/05 **Due:** 9/14/06
Eapplied (vs SCE): —

Potentiostat: Solartron 1287 **SN#** 00148500 **Cal:** 5/15/06 **Due:** 11/15/06
Test ID: C22 ERP04b

Specimen Examination: 2/24

Crevice Corrosion on 2/24 feet of Crevice Washer
One Location Just Initiation · One Location Deeper
Mild Gold tint Surface Staining

*Note: Specimen Repolished for further testing - Not Repolished

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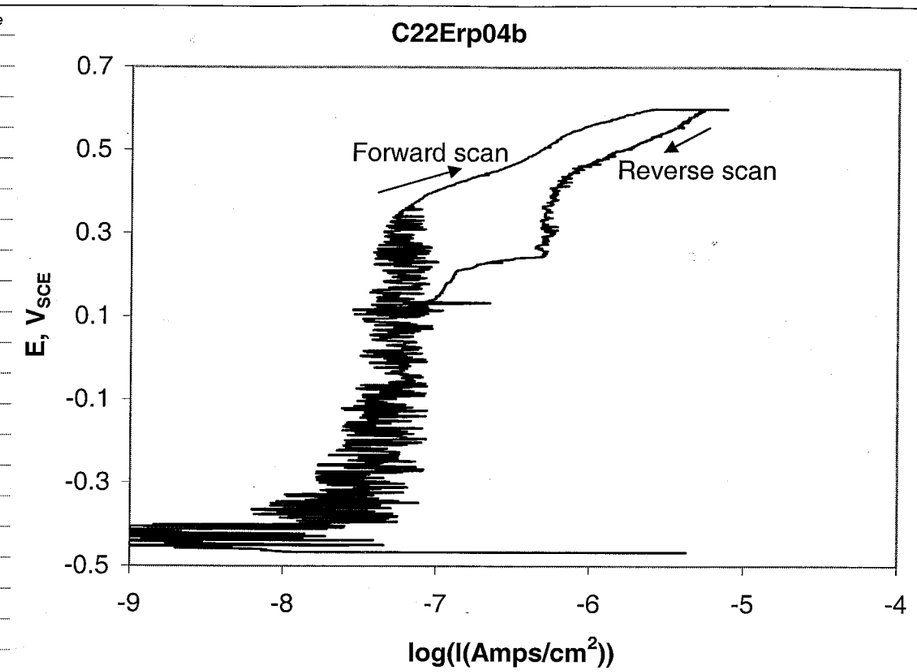

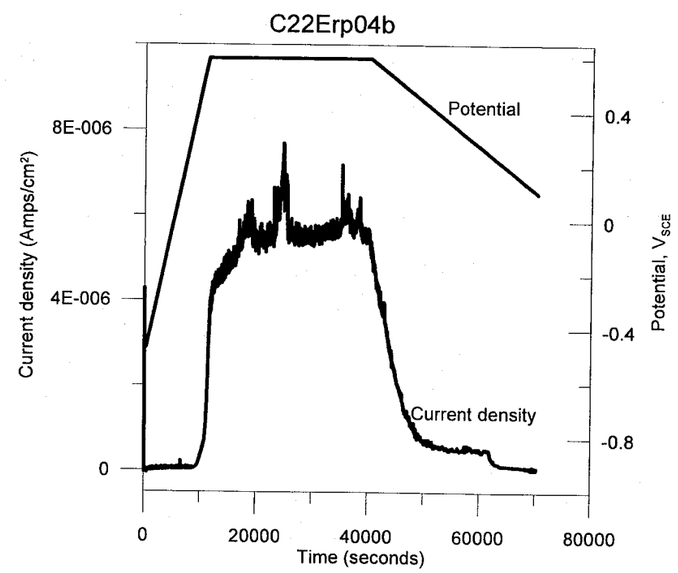

Mill-annealled C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 600 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 600 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 515 mV_{SCE};
$i < 10^{-6}$ A/cm² at 469 mV_{SCE}

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SIGNATURE DATE 8/2/06
DISCLOSED TO AND UNDERSTOOD BY DATE
~~PROPRIETARY INFORMATION~~ 9/3/08 MP

TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers x.H 8/15/06

Torque Screwdriver: Proto 6104 50 In.-oz **SN:** 139072 **Cal:** 4/4/06 **Due:** 10/4/06

Initial Weight: 23.48916g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.47735g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 1.25 M $CaCl_2 \cdot 2H_2O$
367.59g $CaCl_2 \cdot 2H_2O$ Lot#025259
+ DI To 2000mls

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 7/5/06 **Due:** 1/5/07

Initial pH: 3.45 **Model:** Orion **SN:** 2330
Final pH: 7.71 **CAL:** 7/6/06 **DUE:** 7/6/07
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H 98-179 **Cal:** 5/11/06 **Due:** 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: -487 mV Vs SCE **Model:** Keithley 614 **SN:** 0579628
Ept: +15 mV Vs SCE **Cal:** 9/14/05 **Due:** 9/14/06
Eapplied (vs SCE): –

Potentiostat: Solartron 1287 **SN#** 00148500 cal: 5/15/06 due 11/15/06

Test ID: ~~C22Erp05b~~ x.H 8/4/06 C22Erp05b

Specimen Examination: 2/24

Crevice Corrosion on 2/24 feet of Crevice Washer
M/o surface staining on Specimen

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TITLE PROJECT

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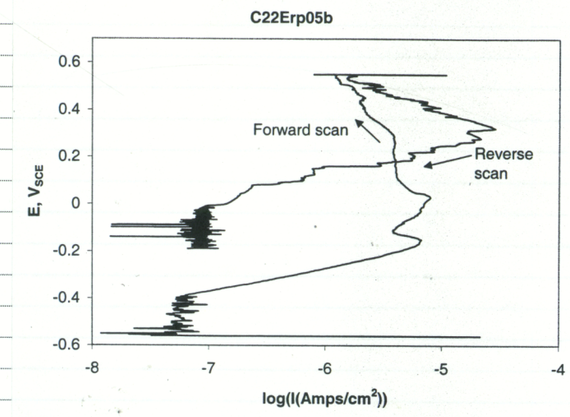

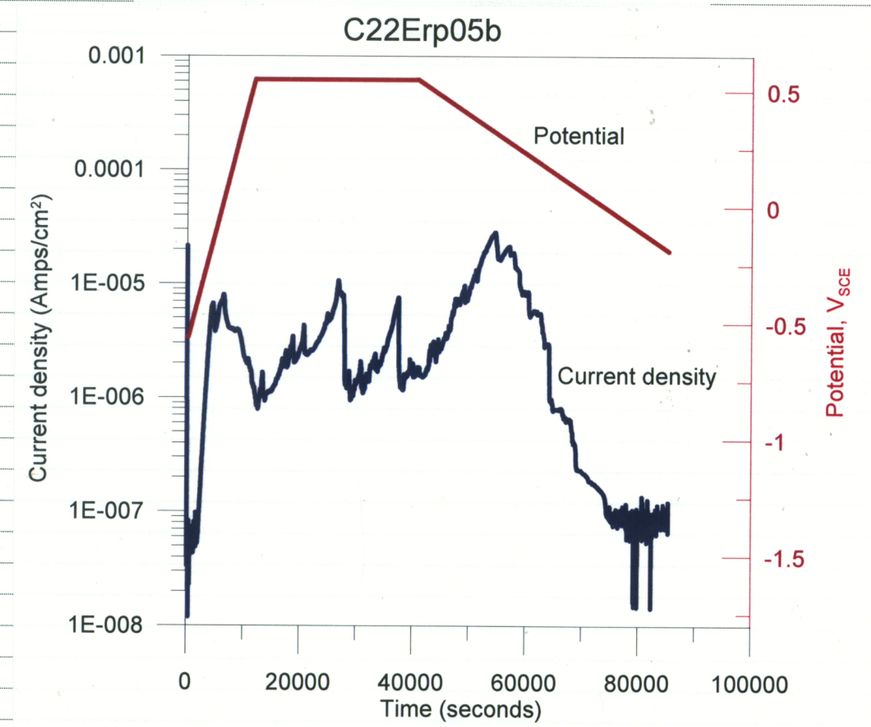

Mill-annealled C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1.25 M $CaCl_2$ solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 249 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 162 mV_{SCE};
$i < 10^{-6}$ A/cm² at 160 mV_{SCE}

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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X.H 8/15/06

Torque Screwdriver: Proto 6104 50 in-oz **Cal:** 4/4/06 **SN:** 139072 **Due:** 10/4/06

Initial Weight: 23.42792g **Final Weight:** 23.42928g **Model:** Sartorius Genius **Cal:** 5/9/06 **SN:** 12809099 **Due:** 11/9/06

SOLUTION: 1.25 m $CaCl_2 \cdot 2H_2O$
367.59g $CaCl_2 \cdot 2H_2O$ Lot 075259
+ DI To 2000 mls

Reagents measured with **Model:** OHAUS **Cal:** 7/5/06 **SN:** 2883 **Due:** 1/5/07

Initial pH: 3.67 **Final pH:** 6.52 **Model:** Orion **CAL:** 7/6/06 **SN:** 2330 **DUE:** 7/6/07
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-170 **Cal:** 4/7/06 **Due:** 4/6/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: -430 mV Vs SCE **Ept:** +31 mV Vs SCE **Model:** Keithley 614 **Cal:** 7/6/06 **SN:** 0704934 **Due:** 7/6/07

Eapplied (vs SCE):

Potentiostat: Solartron 1287 **SN#** 00186634 Cal: 5/16/06 Due: 11/16/06

Test ID: C22Erp05a

Specimen Examination: X.H 8/15/06 0/24

No Crevice Corrosion 0/24 feet of Crevice Washer
m/o Surface Staining

* Note: Specimen Repolished for Further Testing

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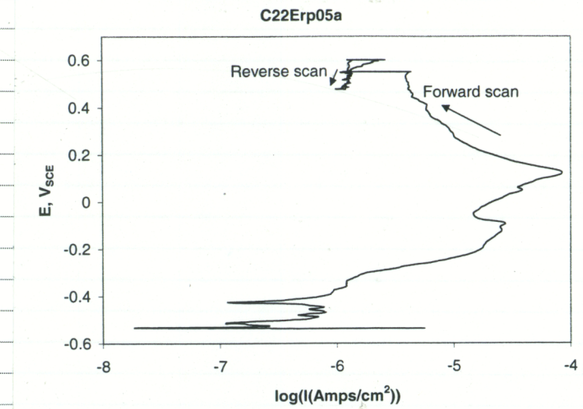

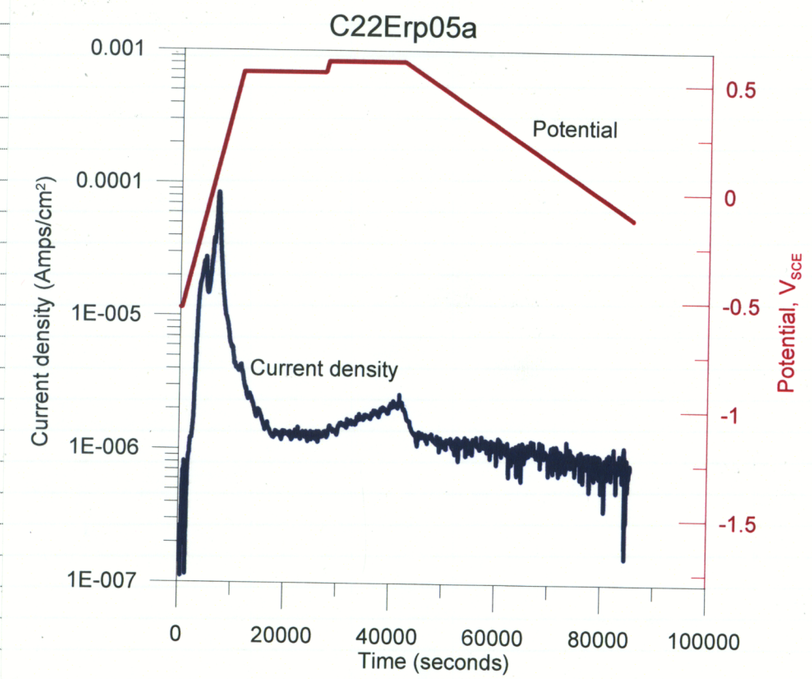

Mill-annealled C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 1.25 M $CaCl_2$ solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 4 hours and 600 mV_{SCE} for 4 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at 600 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 588 mV_{SCE};
$i < 10^{-6}$ A/cm² at 394 mV_{SCE}

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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers X.H 8/15/06

Torque Screwdriver: Proto 6104 50 In-oz **SN:** 139092
Cal: 4/4/06 **Due:** 10/4/06

Initial Weight: 23.67691 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.54207 g **Cal:** 5/9/06 **Due:** 11/9/06

SOLUTION: 5 M $CaCl_2 \cdot 2H_2O$
1470.2 g $CaCl_2 \cdot 2H_2O$ Lot 025259
+ DI to 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/5/06 **Due:** 1/5/07

Initial pH: 6.13 **Model:** Orion **SN:** 2330
Final pH: 6.39 **CAL:** 7/6/06 **DUE:** 7/6/07
pH Probe: #13-620-296 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-179
Cal: 5/11/06 **Due:** 5/11/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4028036

Gas: 99.999% Nitrogen

Ecorr: −444 mV$_{SCE}$ **Model:** Keithley 614 **SN:** 0579828
Ept: +96 mV$_{SCE}$ **Cal:** 9/14/05 **Due:** 9/14/06
Eapplied (vs SCE):

Potentiostat: Solatron 1287 **SN#** 001 48500
Test ID: C22Erp06b Cal: 5/15/06 Due: 11/15/06

Specimen Examination: 19/24

Corrosion Around 19 Areas of Crevice Washer
M/o Surface Staining. Corrosion of specimen on
Exterior Surfaces Ano up to Crevice Contact.

cell #1

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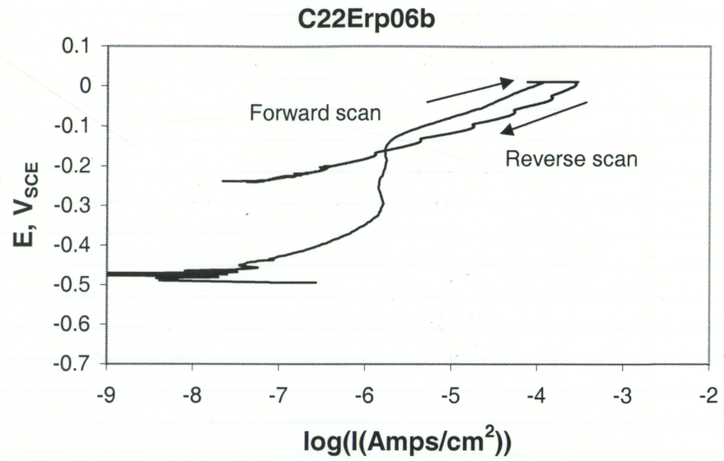

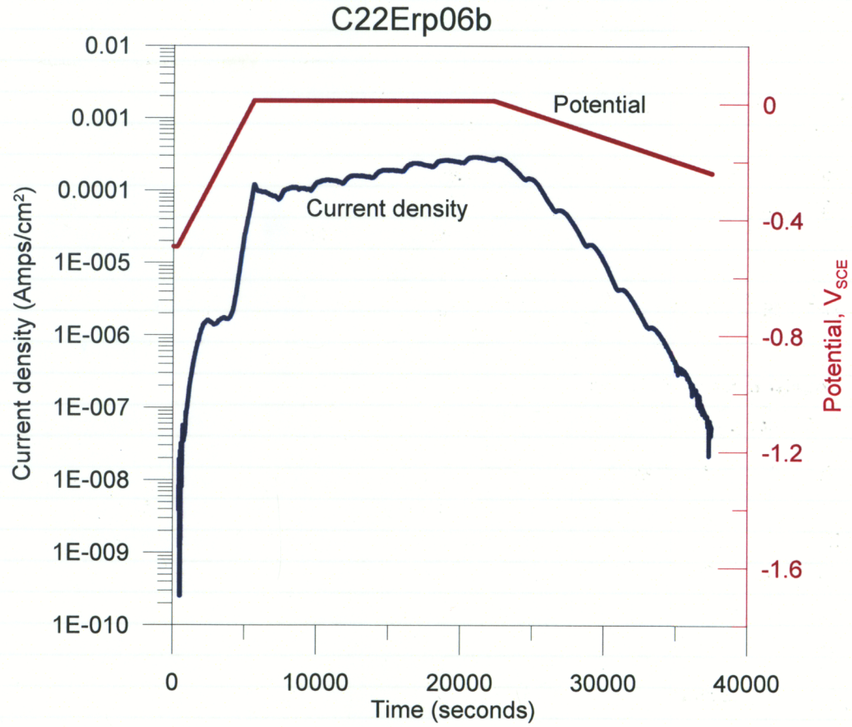

Mill-annealled C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 5 M $CaCl_2$ solution
Forward scan rate: 0.1 mV/s, Potential hold: 10 mV$_{SCE}$ for 5 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm^2 at -118 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm^2 at -158 mV$_{SCE}$;
$i < 10^{-6}$ A/cm^2 at -181 mV$_{SCE}$

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TITLE PROJECT

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POTENTIODYNAMIC TEST

Objective: see page #1

Specimen: C22 specimen Heat# 2277-3-3266 CNWRA Drawing 20.06002.01.322.002 polished to a 600 grit finish cleaned with Acetone then used ~~ceramic~~ Teflon crevice washers x.H 8/15/06

Torque Screwdriver: Proto 6104 50 In-oz **Cal:** 4/4/06 **SN:** 139072 **Due:** 10/4/06

Initial Weight: 23.11866 g **Final Weight:** 22.83175g **Model:** Sartorius Genius **Cal:** 5/9/06 **SN:** 12809099 **Due:** 11/9/06

SOLUTION: 5 m $CaCl_2 \cdot 2H_2O$
1470.2 g $CaCl_2 \cdot 2H_2O$ Lot 061720
+ D.I to 2000 mls

Reagents measured with **Model:** OHAUS **Cal:** 7/5/06 **SN:** 2883 **Due:** 1/5/07

Initial pH: 6.11 **Final pH:** 6.55 **Model:** Orion **CAL:** 7/6/06 **pH Probe:** #13-620-296 **SN:** 2330 **DUE:** 7/6/07 **SN:** 5003095

TEST TEMPERATURE: 90°C **Measured with Hg Thermometer SN:** H98-170 **Cal:** 4/7/06 **Due:** 4/6/07

Counter Electrode: Platinum Flag

Reference Electrode: Fisher SCE **SN:** 4025036

Gas: 99.999% Nitrogen

Ecorr: −127 mVSCE **Ept:** +282 mVSCE **Eapplied (vs SCE):** — **Model:** Keithley 614 **Cal:** 7/6/06 **SN:** 0704934 **Due:** 7/6/07

Potentiostat: Solatron 1287 **SN#** 00186634 **Cal:** 5/16/06 **Due:** 11/16/06

Test ID: C22 Erp 06a

Specimen Examination: 21/24

Corrosion Around 21 Areas of Crevice washer
Mild Surface Staining - Corrosion of Specimen on
Exterior Surfaces And Up to Crevice Contact.

Cell #2

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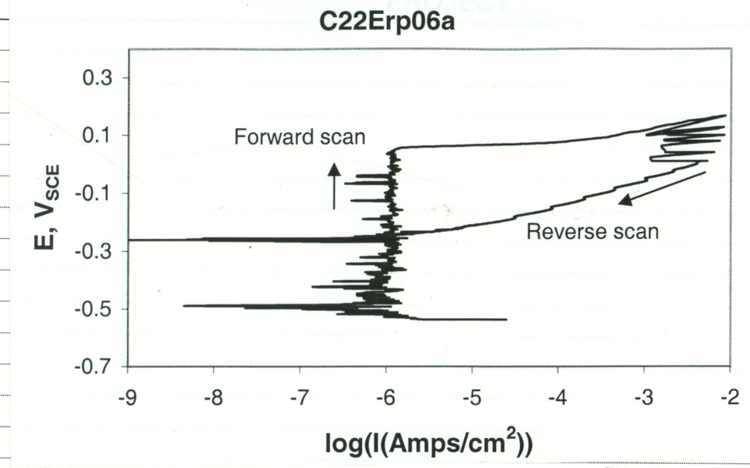

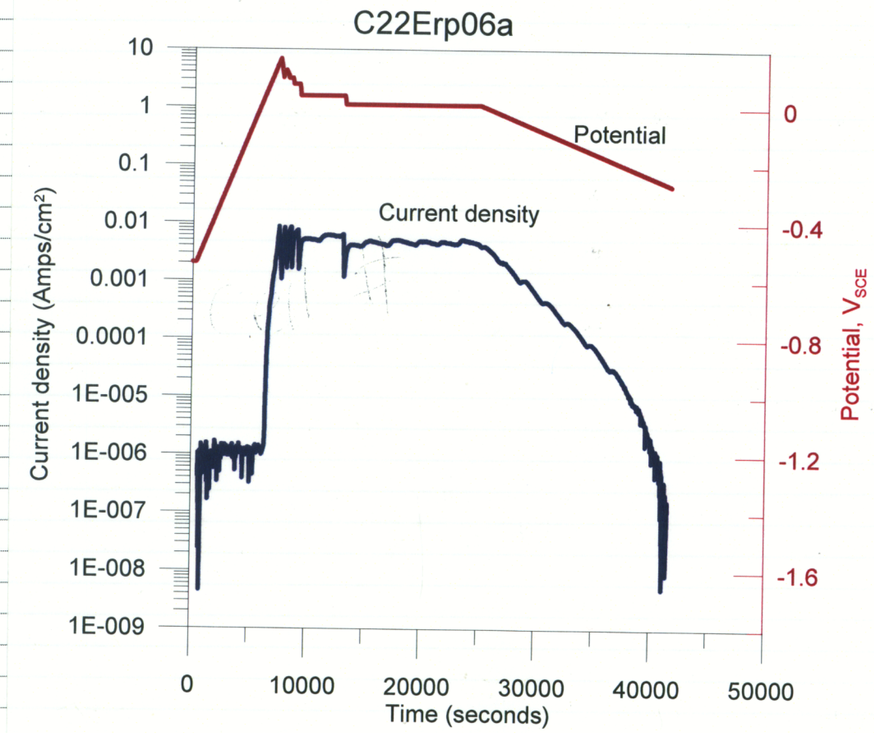

Mill-annealled C22/PTFE; Torque: 50 in-oz;
N_2 deaerated, 90 °C, 5 M $CaCl_2$ solution
Forward scan rate: 0.1 mV/s, Potential hold: 10 mV_{SCE} for 5 hours
Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at -211 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -239 mV_{SCE};
$i < 10^{-6}$ A/cm² at -245 mV_{SCE}

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