LABORATORY NOTEBOOK

CNWRA/SwRI

NOTEBOOK NO. _____
ISSUED TO DARRELL DUNN DD
ON _____ **20**____
DEPARTMENT _____
RETURNED _____ **20**____

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Project No.
Book No.
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Initial Scientific notebook entry for corrosion resistant material potentiostatic and potentiodynamic polarization tests.

Title: Potentiostatic tests, cyclic polarization tests, crevice repassivation tests, passive current density tests, critical pitting temperature tests critical repassivation temperature tests.

Tests Preformed by: Darrell S. Dunn

Objectives: Measure passive current densities, crevice repassivation potentials, critical pitting temperature and critical repassivation temperature for corrosion resistant candidate materials.

Equipment: EG&G Versastat Serial Number 20104. EG&G model 352 corrosion software. NEC 586 computer. Keithley Electrometer model 614 SN 555368 or equivalent. ASTM G-5 polarization cell, Large 2 L glass cells with Teflon tops, Electrochemical Impedance Spectroscopy system including Solartron 1260 FRA and Solartron 1287 Potentiostat. ESC 440 multichannel potentiostats with National instruments Labview data acquisition software or Strawberry Tree data acquisition software.

Materials: Alloy C-22, Alloy 825, Alloy 625 and Type 316 L stainless steel

Specimen specifications: Cylindrical CPP specimens 1.915" × 0.250" and Crevice repassivation specimens with Teflon crevice washers attached to surface.

Measurement Parameters: Current and Potential as described in TOP-008. Temperature of solution ± 2°C

Required level of accuracy: Potentials ± 5mV. Current less than 0.1 microamp.

Uncertainty and Sources of Error: Current density calculated as current divided by sample area. Actual current density of corroding areas is not determined. Resolution limit of data acquisition systems may limit accuracy of passive current density measurements.

Copied from NB #157 pg 208 NB# 571 NB# 638

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Initial Scientific notebook entry for electrochemical impedance measurements

Title: Electrochemical Impedance Tests

Tests Preformed by: Darrell S. Dunn, Brian Derby, Div. 18

Objectives: Determine uniform corrosion rate of passive alloys such as Alloy 22 using electrochemical impedance

Equipment: Keithley 614/617. Solartron 1287 Potentiostat, Solartron 1260 Impedance/Gain-Phase Analyzer, and ZPlot and ZView Software or equivalent, Electrochemical test cell.

Materials: Alloy C-22, heat 2277-8-3175. Other materials and heats to be added and identified prior to testing.

Specimen specifications: Specimens will be equivalent to 20.01402.571.006 unless otherwise specified.

Measurement Parameters: Temperature, Potential, and Current of specimen during test.

Required level of accuracy: Temperature ± 2 °C, Potentials ± 1mV, Current ± 0.01 microamp.

Uncertainty and Sources of Error: Models for oxide solution interface. Multiple models exist and may be applicable. Models used will be identified.

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Initial Scientific notebook entry for passive current density with metal ion concentration measurements

Revised 3/2/04

Title: Passive film chemistry

Tests Preformed by: Darrell S. Dunn

Objectives: Determine the effect of potential and environment on the passive corrosion of candidate container materials.

Equipment: Keithley 614/617. EG&G Versastat Model Potentiostat serial number 20104 or equivalent, EG&G model 352c software or equivalent, Electrochemical test cell with machined from Alloy 22 with a small volume (2 mL). Solution analyses conducted by Division 1 Using ICP-MS

Materials: Alloy C-22, heat 2277-8-3175. Other materials and heats to be added and identified prior to testing.

Specimen specifications: Alloy 22 heat 2277-8-3175 passive film chemistry

Measurement Parameters: Potential and Current of specimen during test. Concentration of metal ions in test electrolyte as a result of corrosion of the specimen.

Required level of accuracy: Potentials ± 1mV, Current ± 0.01 microamp. Minimum detectable concentrations of metal ions dependent on test method and determined using standards.

Uncertainty and Sources of Error: Minimum detectable concentrations of metal ions in the electrolyte may not be the same for all alloying additions. Precipitation of corrosion products will interfere with metal ion concentration measurements.

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ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Objective: See pg #2

SPECIMEN: C-22 cylinder heat # 2277-8-3175 polished to 600 Grit Finish.

Initial Weight: 12.80262g Model: Sartorius Genius SN: 12809099
Final Weight: 12.80542g Cal: 11/14/03 Due: 5/14/04

SOLUTION: UZ62 Groun water 31XUZ
6.513g $CaCl_2$ Lot # 025259 | 0.088g NaF Lot # 991559 | 0.991g NaCl 035421 Lot
3.976g $MgSO_4$ Lot # 034816 | 0.020g $NaHCO_3$ Lot # 028966 | 0.218g $NaNO_3$ 020809 Lot
7.318g KNO_3 Lot # 010186 | 1.522g $MgCl_2$ Lot # 020320

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 8/4/04

Initial pH: 6.22 Model: ~~Fisher Accumet 950 Meter~~ Orion EA940 BKG 3/3/04 SN: ~~3340~~ 2330 BKG 3/3/04
Final pH: 5.08 Cal: 7/15/03 Due: 7/15/04
pH Probe: #13-620-296 SN: 2291257P6

pH Adjustments: None - other than .334g of NaOH Lot # 033972 made to achieve mass balance for Na

TEST TEMPERATURE: 95°C - 25°C Measured with Hg Thermometer SN: C96-783
Cal: 10/30/03 Due: 4/30/04

CELL INFO: Area= 8cm² Density= 8.69 g/cm² Eq wt= 26.04

Reference Electrode: Fisher SCE SN: 0066112
Counter Electrode: Platinum Flag
GAS: Nitrogen 99.999 % with O_2 Trap

ECORR: Not Taken Model: Keithley 614 SN#: 467374
EPT: Cal: 11/6/03 Due: 11/6/04

Potentiostat: 1287 Solartron SN#: 00148500
Impedance Analyzer: 1260 Solartron SN# 400122

Specimen Examination: Test started on 2/3/04 Ended 6/2/04

No sign of corrosion or pitting on specimen
Slight build up of material at solution vapor interphase. Specimen has a dull gray uniform staining on all surfaces that were in solution

* will repolish for further testing

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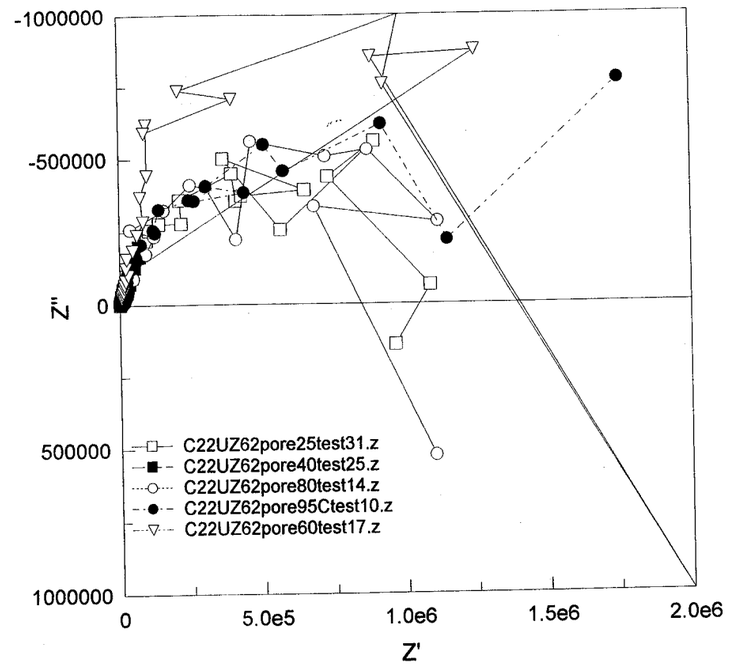

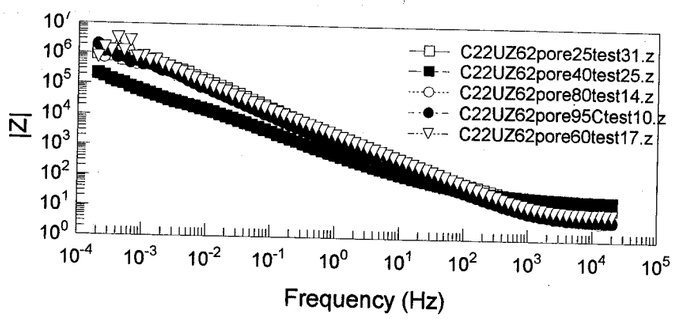

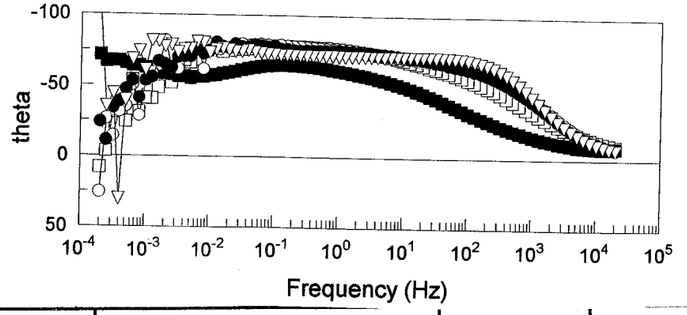

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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block Test cell from NB #485 pg #35
See Set up from NB # 485 pg # 34-35

SOLUTION: 1000ppm Cl⁻ As KCl
2109 g KCl Lot #005573
+ DI To 1000 ml's

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 2/4/04 **Due:** 8/4/04

TEST TEMPERATURE: 60°C **Thermocouple:** 328
Cal: 1/22/04 **Due:** 7/22/04

Thermocouple Meter Omega **Model#** DP465 **SN#** 3130900
Cal: 1/30/04 **Due:** 7/30/04

Reference Electrode: Fisher SCE **SN:** 0249107
Counter Electrode: Platinum Flag

GAS: N_2 99.995% Purge then 5% Hydrogen/N_2 mix
ECORR: Not Taken **Model:** Keithley **SN#:** 467374
EPT: **Cal:** 11/6/03 **Due:** 11/6/04

Potentiostat: EG+G Versastat **SN#:** 20104

TEST DETAILS: Purged Glovebox with N_2 for 2 hrs thru Solution - then Started Hydrogen/N_2 Mix Placed Catalyst And Desecant In Glovebox O_2 level Reached 0 ppm - Assembled Cell started To heat placed Solution In well (1800ml) - Solution was purged with Mix Gas Also started Test
Data PFCGB14

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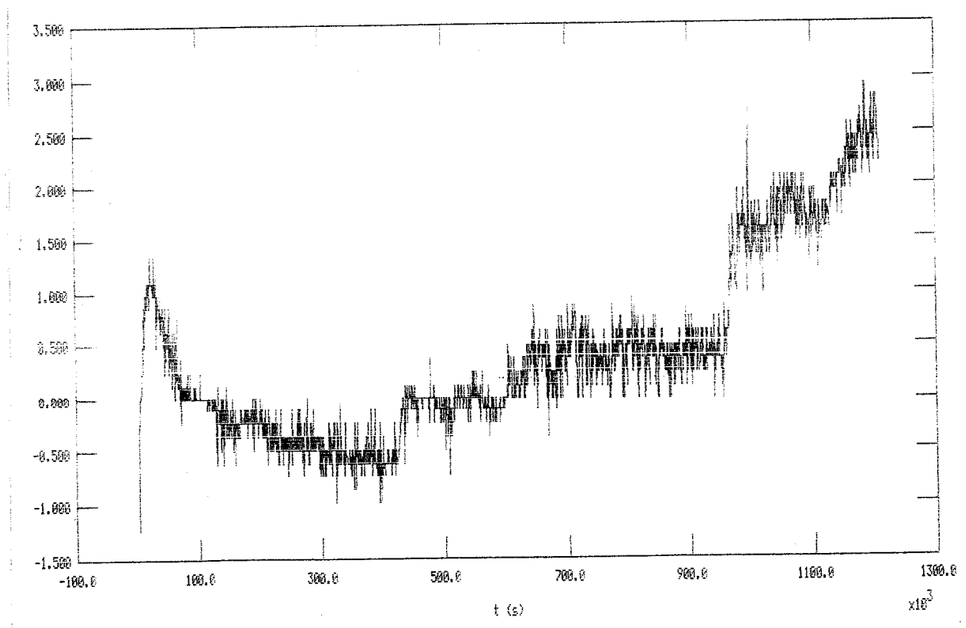
Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: A:PFCGB14
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC
Date Run: 01-24-04
File Status: NORMAL
Time Run: 10:22:41

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.208E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	1 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	207.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: A:PFCGB14 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 01-24-04 Time Run: 10:22:41
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.027E+02 T1 1.208E+06
CR AUTO NP 3000 SO Pass IR NONE FL 1 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.207
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



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PASSIVE FILM CHEMISRTY

Objective: See Pg #3

SPECIMEN: C-22 Black Test Specimen from NB #485 Pg #35
see Set up from NB #485 Pg #34-35

SOLUTION: 1000 ppm Cl⁻ As KCl
2.104 g KCl Lot # 005573
+ DI To 1000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 2/4/04 **Due:** 8/4/04

TEST TEMPERATURE: 60°C **Thermocouple:** 328
Cal: 1/22/04 **Due:** 7/22/04

Thermocouple Meter Omega **Model#** DP465 **SN#** 3130900
Cal: 1/30/04 **Due:** 7/30/04

Reference Electrode: Fisher SCE **SN:** 0249107
Counter Electrode: Platinum Flag

GAS: N_2 Purge 99.999% then 5% Hydrogen/N_2 Mix
ECORR: -67 mv **Model:** Keithley **SN#:** 467374
EPT: +71 mv **Cal:** 11/6/03 **Due:** 11/6/04

Potentiostat: EG+G Versastat **SN#:** 20104

TEST DETAILS: Purged glovebox with N_2 for 3 hr then Solution. Started Hydrogen/N_2 Mix gas Also then solution. placed In Catalyst And Desiccant In glovebox O_2 level Reached Zero. Assembled Test cell. Start to heat placed Solution In well (1800 ml) started Test. Data PFCGB15

* Had A Problem CE was touching side of well. Prepared To Re Run the Test changed Solution. Test Details Remained the Same 3:15pm
New OC Measurements Ecorr = +209 mv Ept = +189 mv BLG 3/8/04

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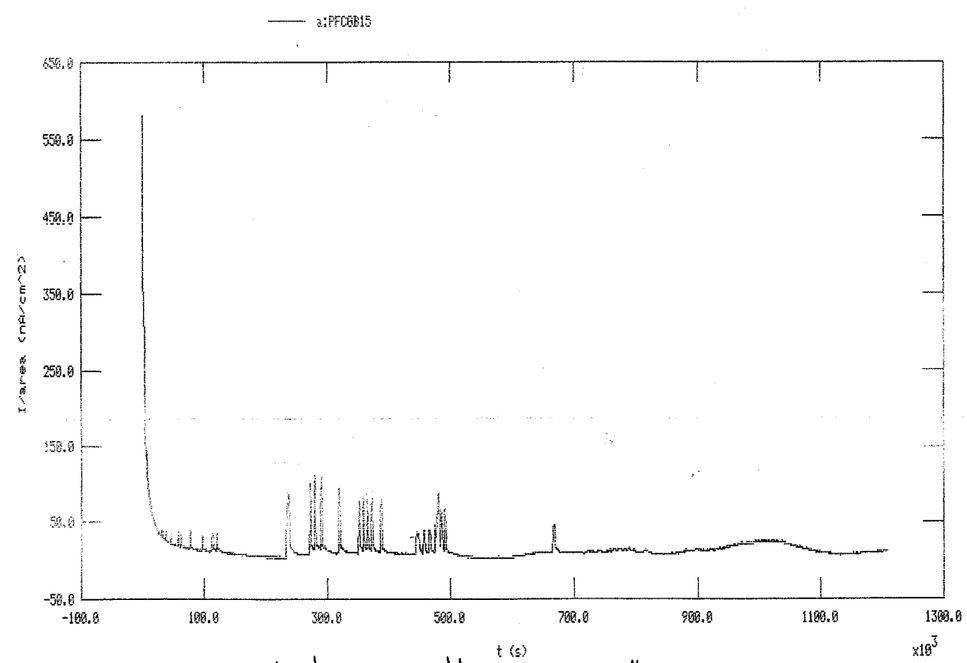
Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:PFCGB15
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC
Date Run: 03-08-04
File Status: NORMAL
Time Run: 15:46:27

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.200E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	I 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	25.00E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:PFCGB15 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 03-08-04 Time Run: 15:46:27
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.027E+02 T1 1.200E+06
CR AUTO NP 3000 SO Pass IR NONE FL I 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.025
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



ICP Analysis Results See Pg #30

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		Recorded by	3/23/04

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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block Test Specimen from NB #485 pg #35
See Set Up from NB #485 pg #34-35

SOLUTION: 1000 ppm Cl⁻ As KCl
2.104g KCl Lot #005573

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 2/4/04 **Due:** 8/4/04

TEST TEMPERATURE: 60°C **Thermocouple:** 328
Cal: 1/22/04 **Due:** 7/22/04

Thermocouple Meter Omega **Model#** DP465 **SN#** 3130900
Cal: 1/30/04 **Due:** 7/30/04

Reference Electrode: Fisher SCE **SN:** 0249107
Counter Electrode: Platinum Flag

GAS: N_2 Purge 99.999% then 5% Hydrogen/N_2 Mix
ECORR: +124 mV **Model:** Keithley 614 **SN#:** 467374
EPT: +269 mV **Cal:** 11/6/03 **Due:** 11/6/04

Potentiostat: EG&G Versastat **SN#:** 20104

TEST DETAILS: Purged Glove Box with N_2 for 3hrs then Test solution. Started Hydrogen N_2 Mix gas placed Catalyst/Desecant Into Glove box. O_2 level To 0ppm Build Cell In 0ppm Environment Placed Solution Into Well Heated Cell To Test Temperature Started Test

ICP Analysis Results See pg #31

Data PFCGB16

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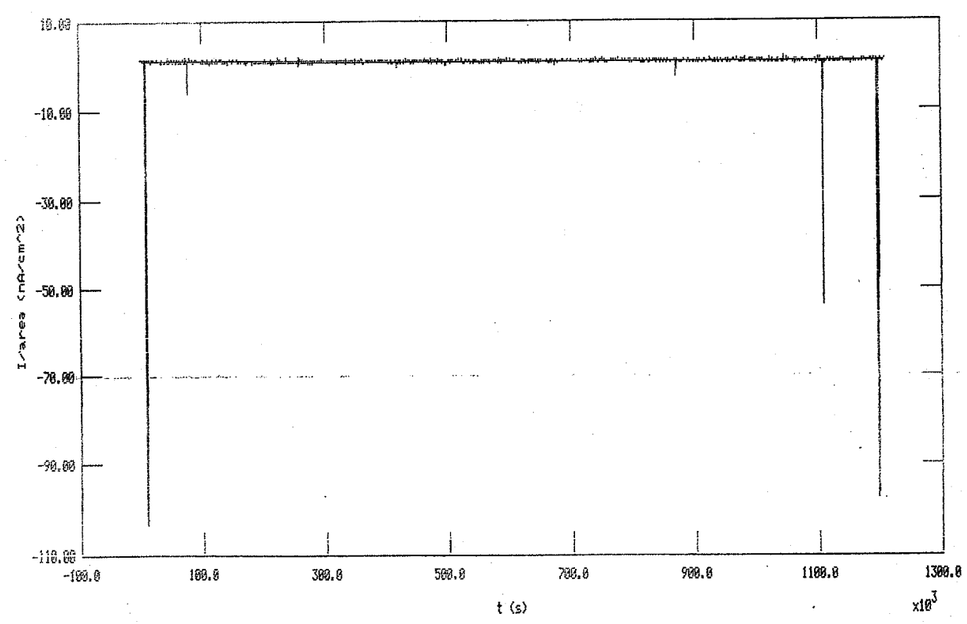
Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:PFCGB16
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC — File Status: NORMAL
Date Run: 03-11-04 — Time Run: 10:55:06

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.200E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	I 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	197.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:PFCGB16 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 03-11-04 Time Run: 10:55:06
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.027E+02 T1 1.200E+06
CR AUTO NP 3000 SO Pass IR NONE FL I 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.197
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block Specimen from NB #485 pg #35.
See Set Up from NB #485 pg #34-35

SOLUTION: 1000 ppm Cl⁻ As KCl
2.104g KCl Lot # 005573

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 8/4/04

TEST TEMPERATURE: 60°C Thermocouple: 328
Cal: 1/22/04 Due: 7/22/04

Thermocouple Meter Omega Model#DP465 SN# 3130900
Cal: 1/30/04 Due: 7/30/04

Reference Electrode: Fisher SCE 13-620-52 SN: 0249107
Counter Electrode: Platinum Flag

GAS: N_2 Purge 99.999% then 5% Hydrogen/N_2 Mix
ECORR: -124mv Model: Keithley 614 SN#: 467374
EPT: +179mv Cal: 11/6/03 Due: 11/6/04

Potentiostat: EG&G Versastat SN#: 20104

TEST DETAILS: Purged Glove Box with N_2 for 3hrs then Test Solution - Started H w/N_2 Mix Gas In glovebox And Solution - Placed Catalyst/Descant Inside O_2 levels Reached 0ppm - Built Cell - placed solution In well Heated To Temperature started Test

Data: PFCGB17

ICP Analysis See pg # 32

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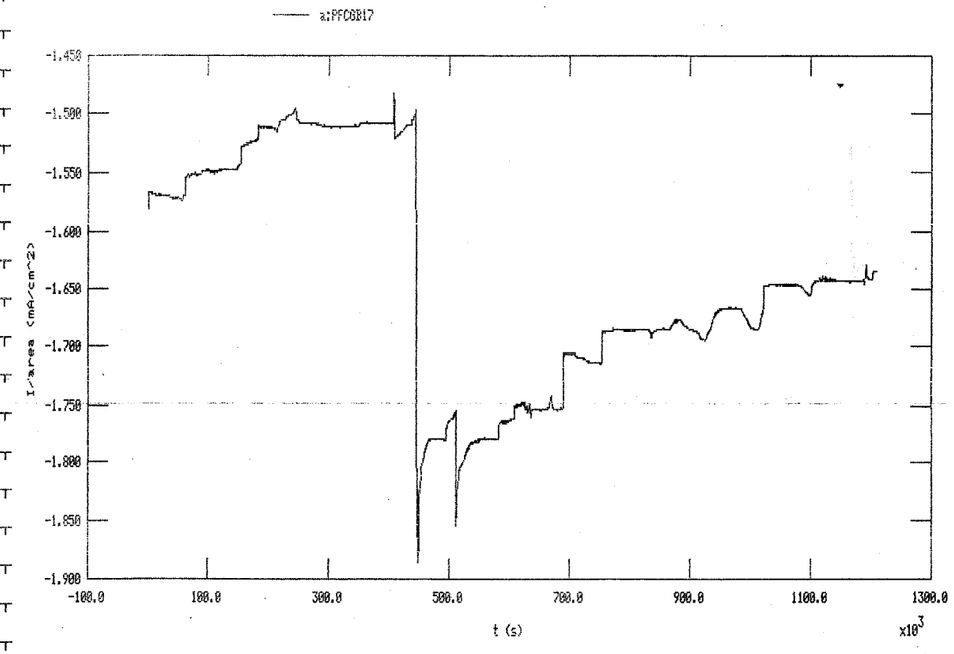
Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:PFCGB17 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 03-15-04 Time Run: 13:35:14
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 s TP 4.027E+02 T1 1.208E+06
CR AUTO NP 3000 SO Pass IR NONE FL I 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.141
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:PFCGB17
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC File Status: NORMAL
Date Run: 03-15-04 Time Run: 13:35:14

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.208E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	I 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	141.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block Specimen from NB #485 pg #35
See Set Up from NB #485 pg #34-35

SOLUTION: 1000 ppm Cl^- As KCl
2.104g KCl Lot #005573
+ DI to 1000 mls

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 8/4/04

TEST TEMPERATURE: 60°C Thermocouple: 328
Cal: 1/22/04 Due: 7/22/04

Thermocouple Meter Omega Model# DP465 SN# 3130900
Cal: 1/30/04 Due: 7/30/04

Reference Electrode: Fisher SCE 13-620-52 SN: 0249107
Counter Electrode: Platinum Flag

GAS: N_2 Purge 99.999% then 5% Hydrogen/N_2 Mix
ECORR: +86mV Model: Keithley 614 SN#: 467374
EPT: +123mV Cal: 11/6/03 Due: 11/6/04

Potentiostat: EG+G Versastat SN#: 20104

TEST DETAILS: Purged Glove Box for 4 hrs with N_2 then Test Solution - Started H w/N_2 Mix Gas In glovebox And then Solution. Placed Catalyst/Descant Inside O_2 levels Reached 0ppm - Assembled Cell placed solution Into well. Heated To Temperature Started Test.

Data: PFCGB18

* Lost Computer And Data for this Test will Not Repeat continue Test 19*

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Computer Crashed Almost At the end of Completion of this Test - Decided To Restart And continue Run Everything was fine Until A Extended Power failure - Stop Test lost All Data associated with this Test will Break Down glovebox And Restart

No ICP Analysis

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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block Specimen from NB #485 pg #35
See set up from NB #485 pg #34-35

SOLUTION: 1000 ppm KCl
2.109g KCl Lot # 005573
+ DI to 1000 mls

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 5/4/04

TEST TEMPERATURE: 60°C Thermocouple: 328
Cal: 1/22/04 Due: 7/22/04

Thermocouple Meter Omega Model# DP465 SN# 3130900
Cal: 1/30/04 Due: 7/30/04

Reference Electrode: Fisher SCE 13-620-52 SN: 0249107
Counter Electrode: Platinum Flag

GAS: N_2 Purge with 99.999% the 5% Hydrogen/N_2 mix
ECORR: -45mv Model: Keithley SN#: 467374
EPT: +123 mv Cal: 11/6/03 Due: 11/6/04

Potentiostat: EG+G Versastat SN#: 20104

TEST ID: PFC GB19

TEST DETAILS: Set up test same As PFC GB18
Just Dumped Solution In well And Achieved same
Conditions then Restarted

* Shutdown Test - Had leak In water line
for Luggin Probe Cooler flood Bottom of glove box
Became to Hazardous to Continue test Also Had A
electrical Grounding Problem will Restart Testing

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Model 352/252 Corrosion Analysis Software, v.   2.30
Filename:  a:pfcgb19
Pstat:  VStat[] Ver 2
PS POTENTIOSTATIC                          File Status:  NORMAL
Date Run:  06-09-04                        Time Run:  09:32:44

Cond. Time     CT  pass        s     Initial Pot.   IP  200.0E-3    V
Cond. Pot.     CP  pass        V     Time Step 1    T1  1.208E6     s
Initial Delay  ID  5           s     Stop On        SO  Pass

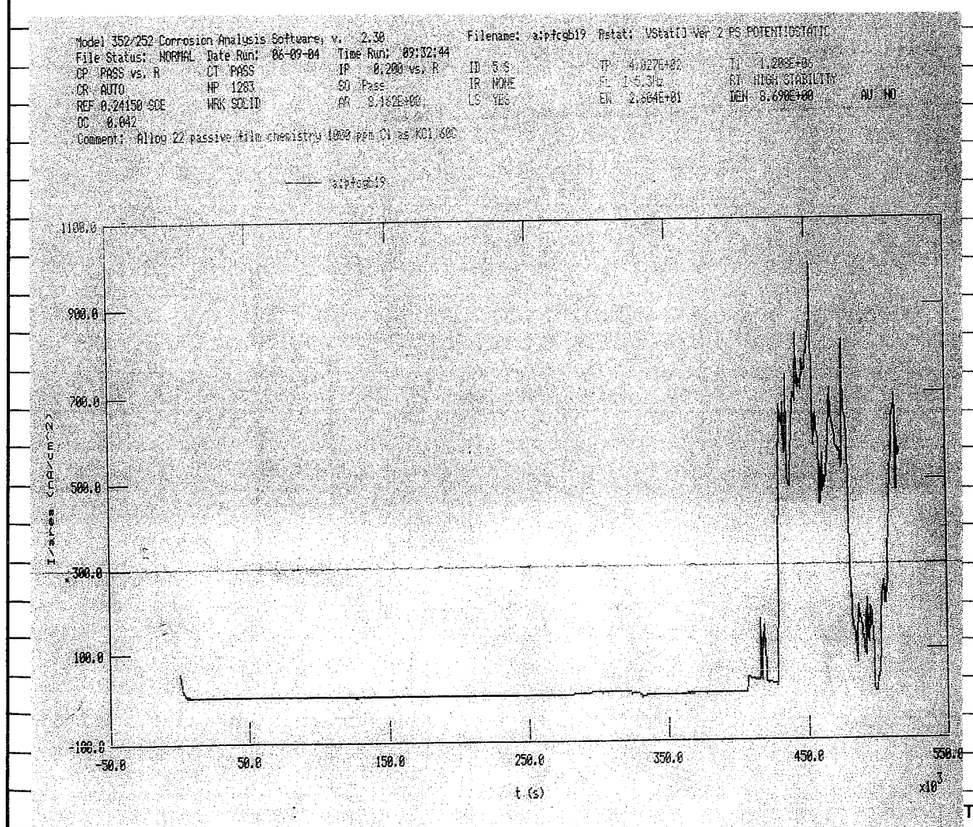
Time/Pt.       TP  402.7       s     Curr. Range    CR  Auto
No. of Points  NP  1283

Line Sync.     LS  yes               IR Mode        IR  none
Rise Time      RT  high stability    Filter         FL  I 5.3Hz
Working Elec.  WE  Solid             Ref. Elec.     RE  SCE  241.5E-3V
Sample Area    AR  8.162       cm^2  Equiv. Wt.     EW  26.04       g
Density        DE  8.690       g/ml  AUX A/D        AU  no
Open Circuit   OC  42.00E-3    V

Comment:  Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C
```

* Note: Had to shut down Testing In glovebox - will clean And Restrapture water line to prevent further Incidents from Occuring - [illegible]

No ICP Analysis



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Witnessed & Understood by me, | Date | Invented by | Recorded by | Date 6/29/04

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ELECTROCHEMICAL IMPEDANCE SPECTROSCOPY

Objective: See pg #2

SPECIMEN: C-22 Cylinder Heat # 2277-8-3175
Polished to A 600 Gait Finish

Initial Weight: 12.7862 g
Final Weight: 12.7866 g
Model: Sartorius Genius
Cal: 5/14/04
SN: 12809099
Due: 11/14/04

SOLUTION: 0.028 M Cl⁻
3.287 g NaCl Lot # 035421
+ DI water To 2000 mls

Reagents measured with
Model: OHAUS
Cal: 2/4/04
SN: 2883
Due: 8/4/04

Initial pH: 6.39
Final pH: 7.922
Model: Orion EA940
Cal: 7/15/03
pH Probe: 13-620-296
SN: 2330
Due: 7/15/04
SN: 4079126 P17

pH Adjustments: None

TEST TEMPERATURE: 95°C - 25°C
Measured with Hg Thermometer SN: C 96-637
Cal: 3/10/04
Due: 9/10/04

CELL INFO: Area= 8 cm² Density= 8.69 g/cm² Eq wt= 26.04

Reference Electrode: Fisher SCE
SN: 0066112
Counter Electrode: Platinum Flag
GAS: Nitrogen 99.999% with O₂ Trap

ECORR: - 495 mv
EPT: - 1 mv
Model: Keithley 614
Cal: 6/7/04
SN#: 0704936
Due: 6/7/05

Potentiostat: 1287 Solartron
SN#: 00148500
Impedance Analyzer: 1260 Solartron
SN# 400122

DATA FILE: C22 EIS 1000ppm 1-38

Specimen Examination: Test started 7/14/04 @ 4:00pm

No Visual Signs of Corrosion or pitting on Specimen
Very Mild Surface Staining

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File	Temp. (C)	R inner oxide(+)	R inner oxide(Error)	Rp	Icorr (A/cm2)	Corrosion Rate (mm/yr)	max Corr Rate (mm/yr)	min Corr Rate (mm/yr)
C22EIS1000ppm95CT1.z	95	265400	23185	265400	4.90818E-08	0.000480938	5.2697E-04	4.4230E-04
C22EIS1000ppm95CT2.z	95	523020	49534	523020	2.49059E-08	0.000244046	2.6958E-04	2.2293E-04
C22EIS1000ppm95CT3.z	95	386190	15567	386190	3.37303E-08	0.000330513	3.4440E-04	3.1771E-04
C22EIS1000ppm95CT4.z	95	503810	14796	503810	2.58556E-08	0.000253351	2.6102E-04	2.4612E-04
C22EIS1000ppm95CT5.z	95	361860	19977	361860	3.59982E-08	0.000352736	3.7335E-04	3.3428E-04
C22EIS1000ppm95CT6.z	95	362440	16981	362440	3.59406E-08	0.000352171	3.6948E-04	3.3641E-04
C22EIS1000ppm95CT7.z	95	1242500	41284	1242500	1.04839E-08	0.000102729	1.0626E-04	9.9426E-05

File	Temp. (C)	R inner oxide(+)	R inner oxide(Error)	Rp	Icorr (A/cm2)	Corrosion Rate (mm/yr)	max Corr Rate (mm/yr)	min Corr Rate (mm/yr)
C22EIS1000ppm80CT8.z	80	2444100	164580	2444100	5.32969E-09	5.22241E-05	5.5995E-05	4.8929E-05
C22EIS1000ppm80CT11.z	80	1793800	63314	1793800	7.26185E-09	7.11567E-05	7.3760E-05	6.8731E-05
C22EIS1000ppm80CT12.z	80	1876100	80145	1876100	6.94329E-09	6.80353E-05	7.1071E-05	6.5248E-05
C22EIS1000ppm80CT14.z	80	1742800	61991	1742800	7.47435E-09	7.3239E-05	7.5940E-05	7.0723E-05
C22EIS1000ppm80CT15.z	80	1875600	242620	1875600	6.94514E-09	6.80534E-05	7.8164E-05	6.0259E-05

File	Temp. (C)	R inner oxide(+)	R inner oxide(Error)	Rp	Icorr (A/cm2)	Corrosion Rate (mm/yr)	max Corr Rate (mm/yr)	min Corr Rate (mm/yr)
C22EIS1000ppm60CT16.z	60	3073600	284490	3073600	4.23812E-09	4.15282E-05	4.5764E-05	3.8010E-05
C22EIS1000ppm60CT17.z	60	2568400	236620	2568400	5.07176E-09	4.96967E-05	5.4740E-05	4.5504E-05
C22EIS1000ppm60CT18.z	60	3299700	182460	3299700	3.94772E-09	3.86829E-05	4.0947E-05	3.6656E-05
C22EIS1000ppm60CT20.z	60	4659700	397800	4659700	2.79552E-09	2.73925E-05	2.9949E-05	2.5238E-05
C22EIS1000ppm60CT21.z	60	4872100	481430	4872100	2.67365E-09	2.61983E-05	2.9071E-05	2.3842E-05

File	Temp. (C)	R inner oxide(+)	R inner oxide(Error)	Rp	Icorr (A/cm2)	Corrosion Rate (mm/yr)	max Corr Rate (mm/yr)	min Corr Rate (mm/yr)
C22EIS1000ppm40CT22.z	40	5773700	1235300	5773700	2.25614E-09	2.21073E-05	2.8125E-05	1.8211E-05
C22EIS1000ppm40CT26.z	40	4631900	923100	4631900	2.8123E-09	2.75569E-05	3.4416E-05	2.2978E-05

File	Temp. (C)	R inner oxide(+)	R inner oxide(Error)	Rp	Icorr (A/cm2)	Corrosion Rate (mm/yr)	max Corr Rate (mm/yr)	min Corr Rate (mm/yr)
C22EIS1000ppm25CT30.z	25	6949300	1089000	6949300	1.87448E-09	1.83675E-05	2.1781E-05	1.5879E-05
C22EIS1000ppm25CT36.z	25	12576000	3872300	12576000	1.03581E-09	1.01496E-05	1.4865E-05	7.7601E-06
C22EIS1000ppm25CT37.z	25	24118000	12980000	24118000	5.40107E-10	5.29235E-06	1.1460E-05	3.4406E-06
C22EIS1000ppm25CT38.z	25	20804000	10185000	20804000	6.26144E-10	6.1354E-06		4.1189E-06

Density g/cm3	Bc (Volts)	Ba (Volts)	Equivalent Weight (g/mol)	Heat
8.69	0.03	Infinite	26.04	2277-8-3175

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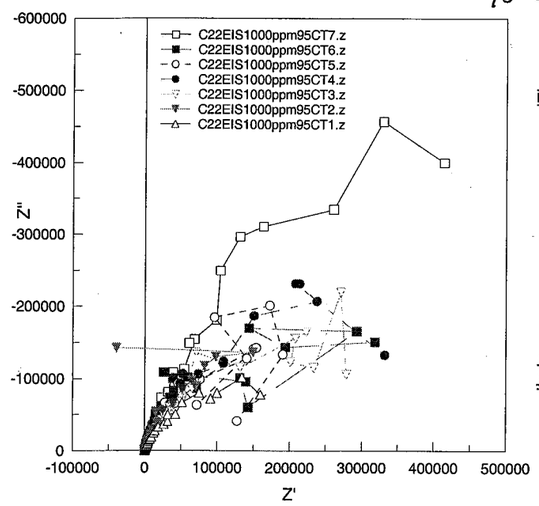
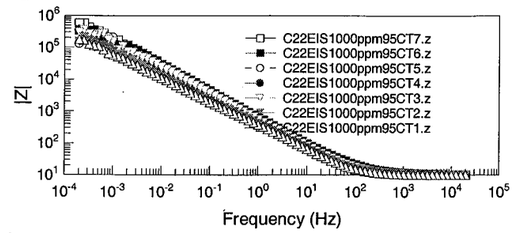
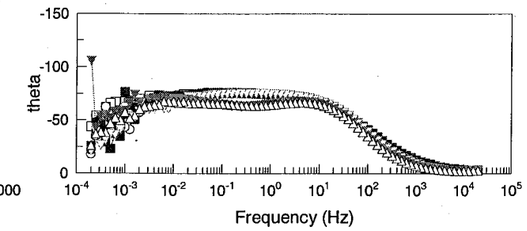
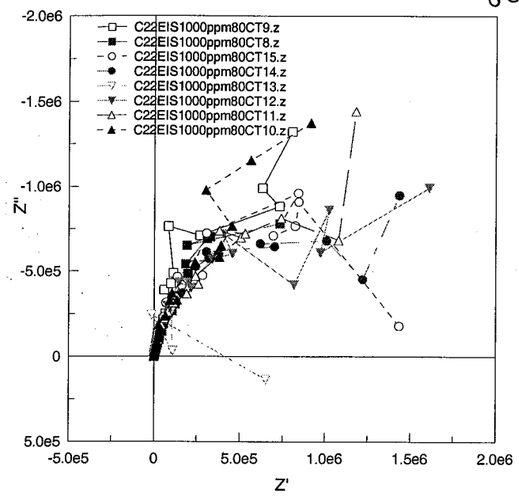
95°C

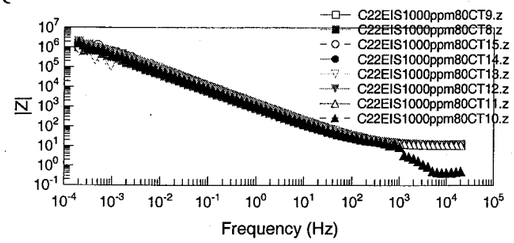


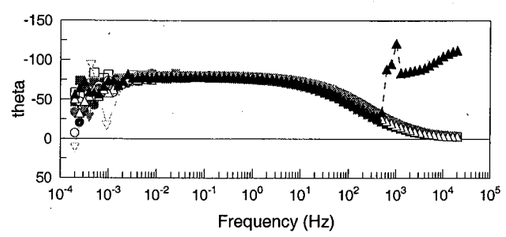




80°C







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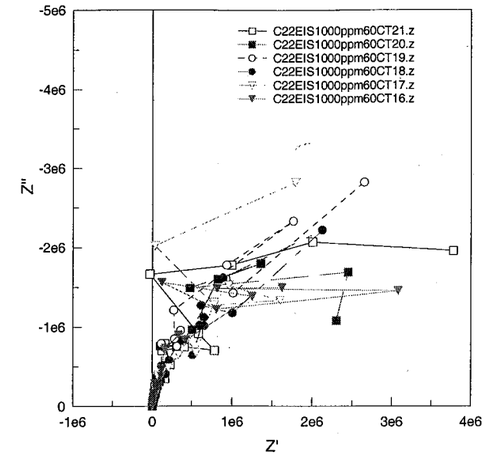
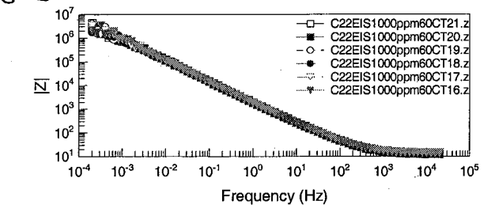
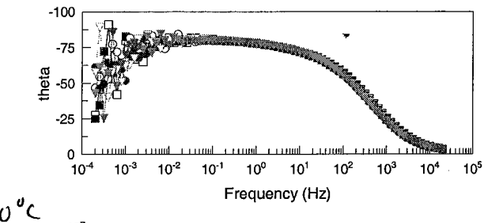
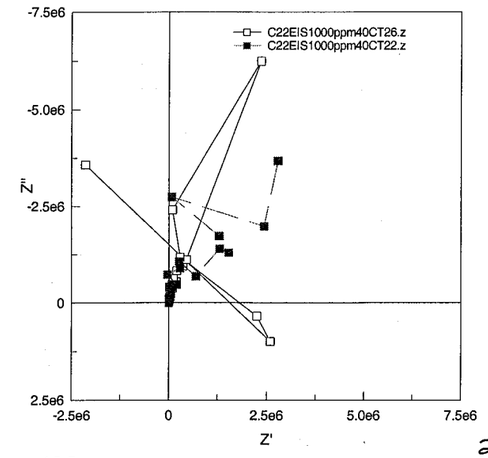
60°C

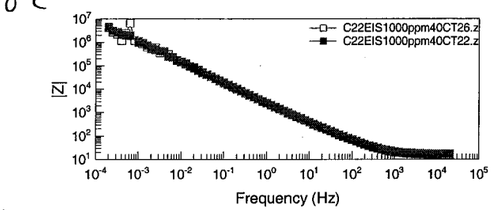


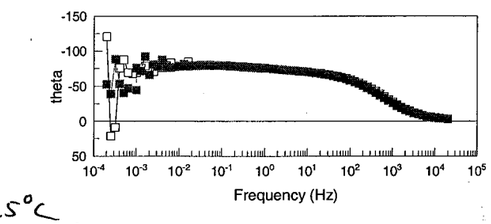




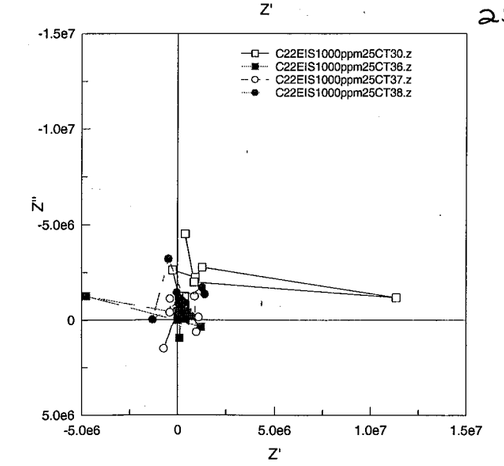
40°C

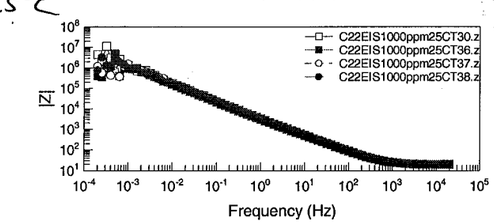


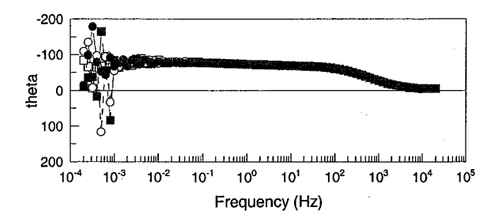




25°C







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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Block specimen from NB #485 pg #35
See Set up from #485 pg #34-35

SOLUTION:
1000 ppm KCl
2.109g KCl Lot #005573
+ DI water to 1000mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 2/4/04 **Due:** 8/4/04

TEST TEMPERATURE: 60°C **Thermocouple:** ~~328~~ 335 7/27/04
Cal: ~~4/22/04~~ 7/27/04 7/20/04 **Due:** 1/20/05

Thermocouple Meter Omega **Model#** DP465 **SN#** 3130900
Cal: 7/13/04 **Due:** 1/13/05

Reference Electrode: Fisher SCE 13-620-32 **SN:** 0249107
Counter Electrode: Platinum Flag

GAS: N_2 And Hydrogen/N_2 mix
ECORR: +153 mv **Model:** Keithley 614 **SN#:** 0704936
EPT: +201 mv **Cal:** 6/7/04 **Due:** 6/7/05

Potentiostat: EG+G Versastat **SN#:** 20104

TEST ID: PFC GB 20

TEST DETAILS: Purged glove Box for 4 hrs with N_2 then Test Solution - started Hydrogen with N_2 mix gas placed Catalyst/Dessicant Into glove box held glove box @ 2.0% Hydrogen overnight - placed/purged more mix gas thru glove box Hydrogen level 3.9% Assembled Cell placed Solution Into Well started test - Also Solution was purged with Mix gas - Heated To 60°C Started Test

ICP Analysis Results See pg #33

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		Recorded by	7/27/04

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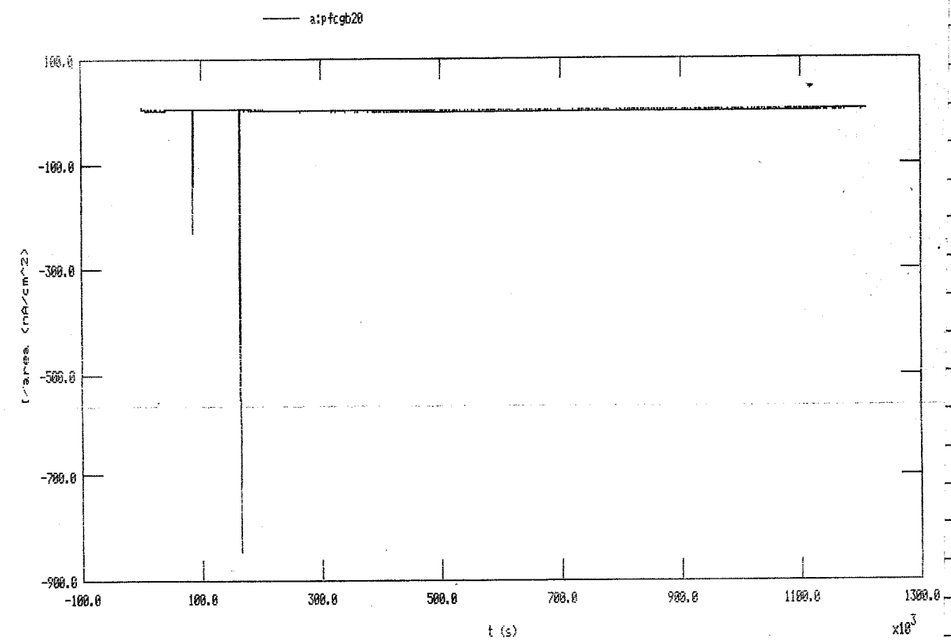
Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:pfcgb20 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 07-23-04 Time Run: 09:51:53
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.027E+02 T1 1.200E+06
CR AUTO NP 3000 SO Pass IR NONE FL I 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.151
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:pfcgb20
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC File Status: NORMAL
Date Run: 07-23-04 Time Run: 09:51:53

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.200E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	I 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	151.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/11/04

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PASSIVE FILM CHEMISRTY

Objective: See pg # 3

SPECIMEN: C-22 Blank Specimen from NB # 485 pg # 35
See set up from NB # 485 pg # 34-35

SOLUTION: 1000 ppm KCl
2.109g KCl Lot # 005573
+ DI water To 1000mL

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 8/4/04

TEST TEMPERATURE: Thermocouple: 335
Cal: 7/20/04 Due: 1/20/05

Thermocouple Meter omega Model# DP465 SN# 3130900
Cal: 7/13/04 Due: 1/13/05

Reference Electrode: Fisher SCE 13-620-52 SN: 0249107
Counter Electrode: Platinum Flag

GAS: N_2 And Hydrogen/N_2 mix
ECORR: +114 mV Model: Keithley 614 SN#: 0704936
EPT: +182 mV Cal: 6/7/04 Due: 6/7/05

Potentiostat: EG+G Versastat SN#: 20104

TEST ID: PFCGB21

TEST DETAILS: Same test details As Test # PFCGB20 But placed catalyst And Descarnt Into Oven for 2hrs @ 200°C Before this test Run

ICP Analysis Results see pg # 34

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Witnessed & Understood by me, | Date | Invented by | Recorded by | Date 8/11/04

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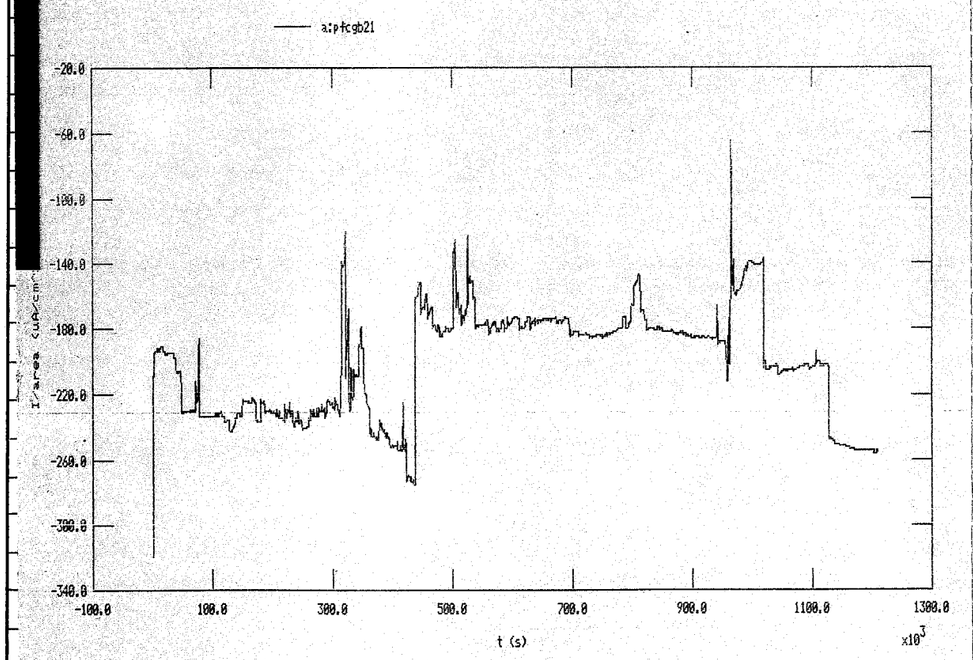
Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:pfcgb21
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC File Status: NORMAL
Date Run: 07-26-04 Time Run: 12:09:44

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	1.200E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	I 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	190.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:pfcgb21 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 07-26-04 Time Run: 12:09:44
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.022E+02 T1 1.200E+06
CR AUTO NP 3000 SO Pass IR NONE FL I 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.190
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



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Witnessed & Understood by me, | Date | Invented by | Recorded by | Date 8/27/04

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PASSIVE FILM CHEMISRTY

Objective: See pg #3

SPECIMEN: C-22 Black Specimen from NB #485 pg #35
See Set up from NB # 485 pg #34-35

SOLUTION: 1000 ppm KCl
2.109g KCl Lot # 005573
+ DI water To 1000 mls

Reagents measured with Model: OHAUS SN: 2883
Cal: 2/4/04 Due: 8/4/04

TEST TEMPERATURE: Thermocouple: 335
Cal: 7/20/04 Due: 1/20/05

Thermocouple Meter Omega Model# DP465 SN# 3130900
Cal: 7/13/04 Due: 1/13/05

Reference Electrode: Fisher SCE 13-620-54 SN: 0249107
Counter Electrode: Platinum Flag

GAS: N_2 And Hydrogen/N_2 mix
ECORR: + 184 mV **Model:** Keithley 614 **SN#:** 0704936
EPT: +282 mV **Cal:** 6/7/04 **Due:** 6/7/05

Potentiostat: EG+G Versastat **SN#:** 20104

TEST ID: PFC GB22

TEST DETAILS: Purged Glove Box for 3 hrs with N_2 then Solution - Started H/N_2 mix gas Also then Solution And Direct placed Desicant And Catalyst Into glove box continue to purge till O_2 level Reaches zero then Assembles cell And began Test.

* No ICP Analysis Done for this test

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		Recorded by	8/31/04

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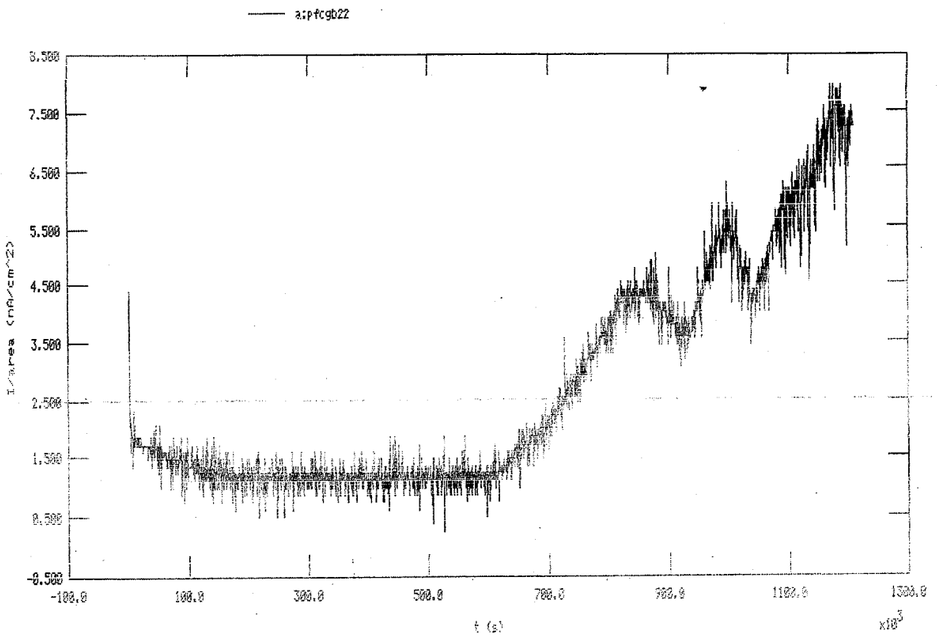
Model 352/252 Corrosion Analysis Software, v. 2.30 Filename: a:pfcgb22 Pstat: VStat[] Ver 2 PS POTENTIOSTATIC
File Status: NORMAL Date Run: 09-01-04 Time Run: 07:55:00
CP PASS vs. R CT PASS IP 0.200 vs. R ID 5 S TP 4.027E+02 TI 1.200E+06
CR AUTO NP 3000 SO Pass IR NONE FL 1 5.3Hz RT HIGH STABILITY
REF 0.24150 SCE WRK SOLID AR 8.162E+00 LS YES EW 2.604E+01 DEN 8.690E+00 AU NO
OC 0.163
Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C



Model 352/252 Corrosion Analysis Software, v. 2.30
Filename: a:pfcgb22
Pstat: VStat[] Ver 2
PS POTENTIOSTATIC File Status: NORMAL
Date Run: 09-01-04 Time Run: 07:55:00

Cond. Time	CT	pass	s	Initial Pot.	IP	200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	TI	1.200E6	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	402.7	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					
Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	1 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	AR	8.162	cm^2	Equiv. Wt.	EW	26.04	g
Density	DE	8.690	g/ml	AUX A/D	AU	no	
Open Circuit	OC	163.0E-3	V				

Comment: Alloy 22 passive film chemistry 1000 ppm Cl as KCl 60C

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		Recorded by	9/15/04

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: pt 15

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253440

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	0.145	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	2273	10
Sodium	<7.5	7.5
Tungsten	<0.250	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: W 15

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253445

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	0.678	0.125
Potassium	104214	200
Sodium	29.7	15
Tungsten	0.285	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: pt 16

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253441

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	3277	10
Sodium	<7.5	7.5
Tungsten	<0.250	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: W 16

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253446

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	61444	200
Sodium	23.9	15
Tungsten	<0.250	0.250

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: pt 17

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253442

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	3289	10
Sodium	<7.5	7.5
Tungsten	<0.250	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: W 17

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253447

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	91255	200
Sodium	20.5	15
Tungsten	<0.250	0.250

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: pt 20

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253443

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	1655	5
Sodium	9.93	3.75
Tungsten	<0.250	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: W 20

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253448

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	38298	100
Sodium	212	75
Tungsten	<0.250	0.250

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: pt 21

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253444

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	0.146	0.125
Potassium	1395	5
Sodium	4.68	3.75
Tungsten	<0.250	0.250

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID: W 21

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Liquid
Lab System ID: 253449

Client: Division 20
Date Received: 10/05/04
Project No.: 06002.01.081
SRR: 26668
Task Order: 041006-1

Analysis	Sample Result (mg/L)	Reporting Limit (mg/L)
Chromium	<0.125	0.125
Cobalt	<0.125	0.125
Iron	<1.25	1.25
Molybdenum	<0.125	0.125
Potassium	52188	100
Sodium	139	75
Tungsten	<0.250	0.250

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Closeout of Passive film Chemistry Tests

The passive film chemistry tests were discontinued after the last test documented on pages 28-34. DD 5/03/05 Analyses of solutions from these ~~do~~ tests did not provide results that could be used to evaluate passive dissolution characteristics. The passive dissolution rate is low and the corrosion products are insoluble. These factors prevented meaningful analysis of solution composition after testing. Additional analyses will be conducted by analyses of oxide films on select specimens.

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Project No.
Book No. TITLE

From Page No.

Initial Scientific notebook entry for passive oxide film analyses tests

Title: Passive oxide film analyses

Tests Preformed by: Darrell S. Dunn, Yi-Ming Pan Div 20, Brian Derby Div 18

Objectives: Determine the effect of potential and environment on the passive oxide composition of Alloy 22.

Equipment: Keithley 614/617. EG&G Versastat Model Potentiostat serial number 20104 or equivalent, EG&G model 352c software or equivalent, Standard electrochemical test cells

Materials: Alloy C-22 Heat 2277-3-3266. Other materials and heats to be identified prior to testing.

Specimen specifications: Alloy 22 XPS specimen CNWRA Drawing 20-06002-01-081-005.

Measurement Parameters: Potential and Current of specimen during test. Composition of the oxide film after testing. Analyses methods will be identified.

Required level of accuracy: Potentials ± 1mV, Current ± 0.1 microamp.

Uncertainty and Sources of Error: To be identified depending on analyses methods

To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	4/21/05

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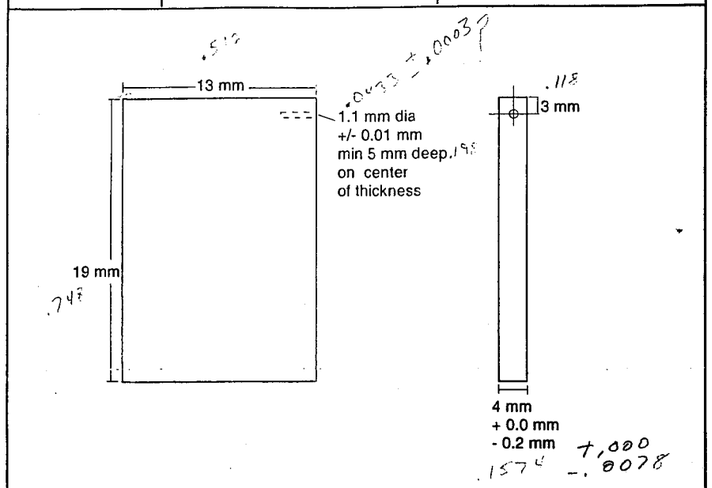
From

Witne

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

XPS Specimen
CNWRA Drawing 20-06002-01-081-005
Dimensional tolerances 0.5 mm
unless otherwise specified

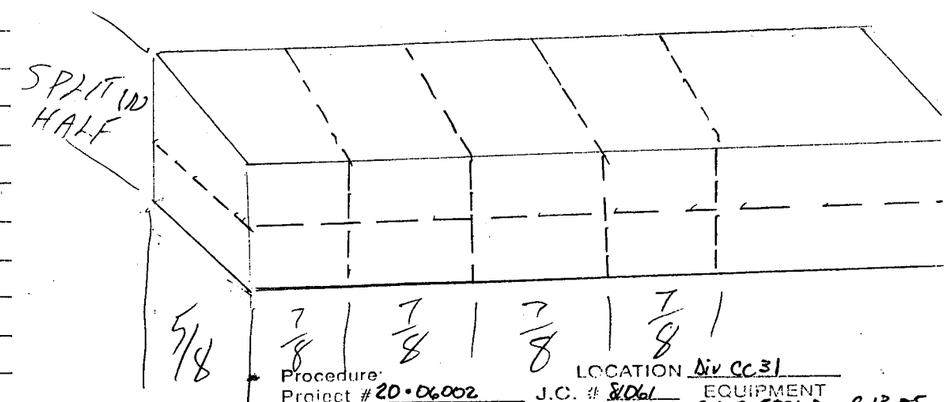
To be completed at time of order:
Material: C-22
Heat: 2277-3-3266
Specimen Orientation:
Other: Project # 20.06002.01.321



Initiated by. D. Dunn — 8/4/03 Date

Reviewed by V. Jain — 8/4/03 Date

QA Approval B. Brient — 8/5/03 Date



Procedure:
Project # 20-06002
TOTAL PCS. INSPECTED 15
TOTAL PCS. ACCEPTED 15
TOTAL PCS. REJECTED 0
"NR #" IF REJECTS NA
INSPECTOR

LOCATION Div CC31
J.C. # 8061
EQUIPMENT Cal 005051 Due 8-13-05
DATE MAR - 1 2005

5/3/05

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing # 20-06002-01-081-065

SOLUTION: SCW - Simulated Concentrated water
KCl = 12.968 g Lot # 005573
NaCl = 10.865 g Lot # 037047A
$NaNO_3$ = 17.557 g Lot # 020009
Na_2SO_4 = 41.42 g Lot # 025401
$NaHCO_3$ = 192.65 g # 044994
NaF = 6.194 g Lot # 991559
+ DI water To 2000 ml

Start weight: 8.18221 g
End weight: 8.18164 g

Model: Sartorious Genius
Cal: 11/10/01
SN: 12809099
Due: 5/16/05

TEST TEMPERATURE: 95°C
Thermometer: ~~183305~~ 183305
Cal: 1/6/05
Due: 7/6/05

Initial pH: 7.837
Final pH: 9.501

Model: orion EA940
Cal: 7/21/04
Due: 7/21/05
SN: 2330

pH Probe: #13-620-296
SN: 2291257P6

Reference Electrode: Fisher SCE 13-620-52
SN: # 0251439
Counter Electrode: Platinum Flag

GAS: 99.995 % N_2
ECORR: -212 mv
EPT: -105 mv

Model: Keithley 614
Cal: 7/12/04
SN#: 0704939
Due: 7/12/05

Potentiostat: EG&G Versastat
Applied Potential: 400 mv
SN#: 20104

TEST ID: POF-01

Specimen Examination: Slight Blue tint staining. No sign of pitting on the specimen

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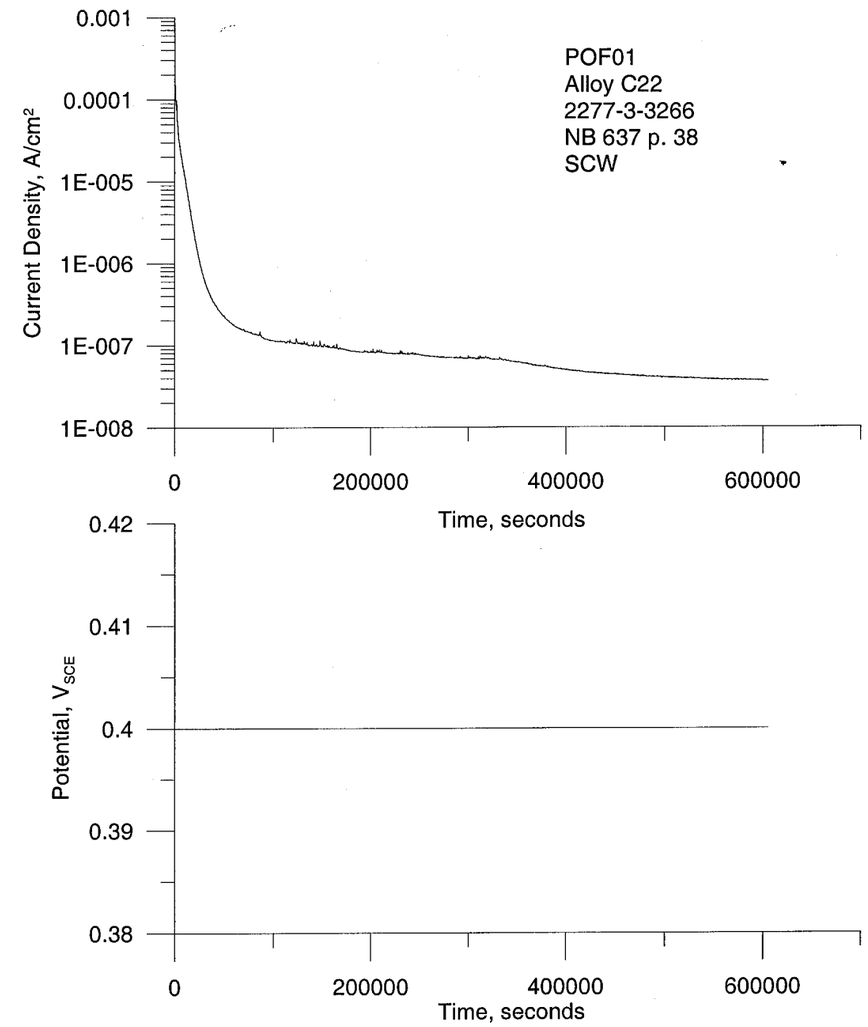

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Witnessed & Understood by me, | Date | Invented by | Date 5/11/05
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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing 20-06002-01-081-005

SOLUTION: SCW - Simulates Concentrates water

KCl = 12.968g Lot # 005573
NaCl = 10.865g Lot # 037047A
$NaNO_3$ = 17.557g Lot # 020009
Na_2SO_4 = 41.42g Lot # 035401
$NaHCO_3$ = 192.69g Lot # 044998
NaF = 6.194g Lot # 991556
+ DI water to 2000ml

Start weight: 8.16732g Model: Sartorious Genius SN: 12809099
End weight: — Cal: 11/10/04 Due: 5/10/05

TEST TEMPERATURE: 95°C Thermometer: 183305
Cal: 1/6/05 Due: 7/6/05

Initial pH: 7.837 Model: orion EA940 SN:2330
Final pH: — Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6

Reference Electrode: Fisher SCE 13-620-52 SN: #0251439
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -262 mv Model: Keithley 614 SN#: 0704934
EPT: -27 mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG&G Versastat SN#: 20104
Applied Potential: 100 mv

TEST ID: POF-02

Specimen Examination: - will Repolish Specimen for Next Test

* Computer Crash Rerun Test

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Computer Crash Lost All Data for POF-02

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		Recorded by	5/12/05

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Book No. TITLE

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Potentiostatic Tests

Objective: See pg # 36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing # 20-06002.01.081-005

SOLUTION: SCW - Simulates Concentrates Water
KCl = 12.968g lot # 005573
NaCl = 10.865g lot # 037047A
$NaNO_3$ = 17.557g lot # 020009
Na_2SO_4 = 41.42g lot # 035201
$NaHCO_3$ = 192.69g lot # 044998
NaF = 6.194g lot # 991559
+ D2 water to 2000 ml

Start weight: 8.14208g
End weight: 8.14185g
Model: Sartorious Genius SN: 12809099
Cal: 11/10/04 Due: 5/10/05

TEST TEMPERATURE: 95°C
Thermometer: 183305
Cal: 1/6/05 Due: 7/6/05

Initial pH: 7.837
Final pH: 10.223
Model: orion EA940 SN:2330
Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6

Reference Electrode: Fisher SCE 13-620-52 SN: # 0251439
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -468mV
EPT: -84mV
Model: Keithley 614 SN#: 0704924
Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG&G Versastat SN#: 20104
Applied Potential: 100 mV

TEST ID: POF-02A

Specimen Examination: No signs of pitting or corrosion on surface
mild surface staining

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Recorded by 5/9/05

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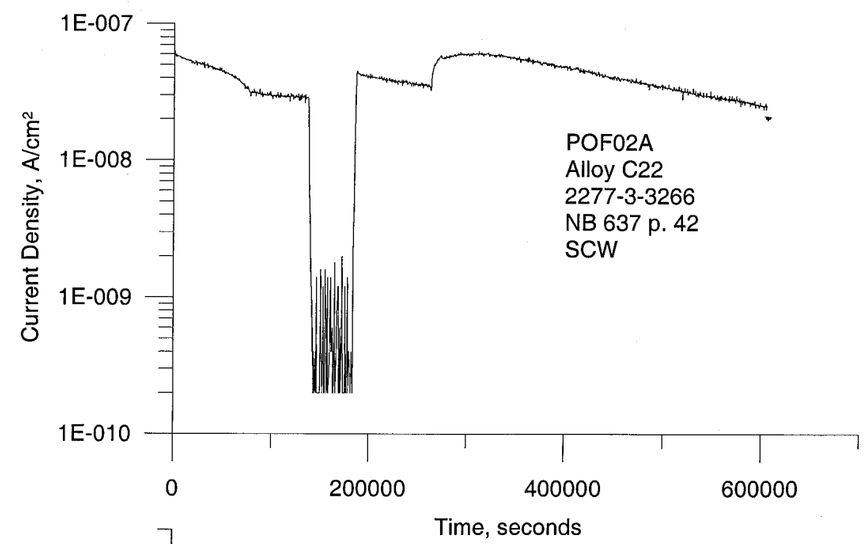

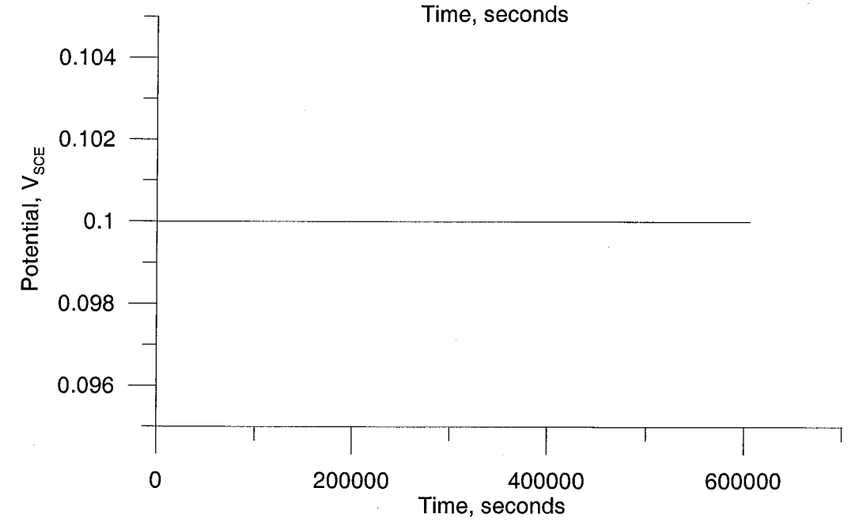

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Recorded by 5/16/05

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat #2277-3-3266 See Drawing # 20-06002-01-051.005

SOLUTION: SCW - Simulated Concentrated Water
KCl = 12.965g Lot # 005573
NaCl = 10.865g Lot # 037047A
$NaNO_3$ = 17.557g Lot # 020009
Na_2SO_4 = 41.44g Lot # 035401
$NaHCO_3$ = 192.69g Lot # 044998
NaF = 6.194g Lot # 991559
+ DI water to 2000mL

Start weight: 8.10627g
End weight: 8.10524g
Model: Sartorious Cognis
Cal: 5/11/05
SN: 12809099
Due: 11/11/05

TEST TEMPERATURE: 95 °C
Thermometer: 183305
Cal: 1/6/05
Due: 7/6/05

Initial pH: 7.837
Final pH: 10.53
Model: orion EA940
Cal: 7/21/04
SN: 2330
Due: 7/21/05
pH Probe: #13-620-296
SN: 2291257P6

Reference Electrode: Fisher SCE 13-620-52
SN: # 025435
Counter Electrode: Platinum Flag

GAS: 99.999 % N_2
ECORR: -604 mV
EPT: -434 mV
Model: Keithley 614
Cal: 7/12/04
SN#: 0704934
Due: 7/12/05

Potentiostat: EG+G Versastat
SN#: 20104
Applied Potential: 200 mV

TEST ID: POF-03

Specimen Examination: Showing no signs of Corrosion or pitting
All surfaces have A Dull Blue tint staining

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		Recorded by	5/18/05

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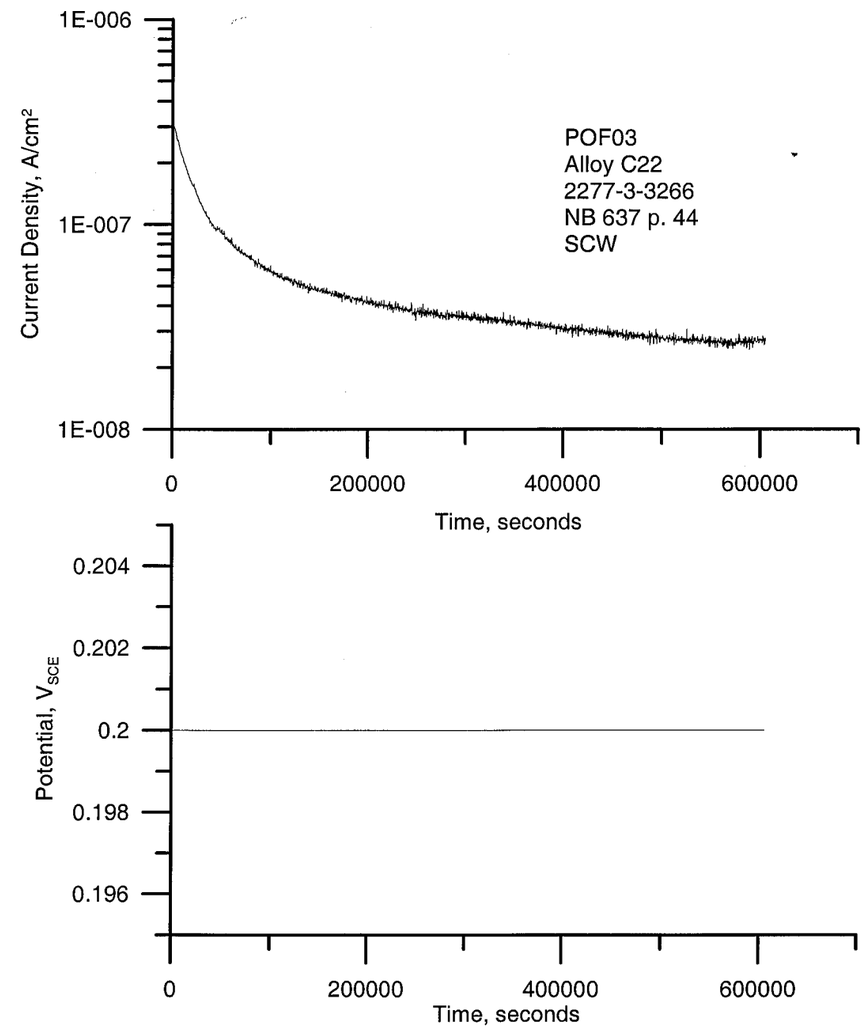

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		Recorded by	5/25/05

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing # 20-06002-01-081-005

SOLUTION: SCW - Simulated Concentrated water (Cl⁻ only)
KCl = 12.969g Lot # 005573 + DI water To 2000ml
MgCl = 10.871g Lot # 050089

Start weight: 8.10955g Model: Sartorious Genius SN: 12809099
End weight: 8.10911g Cal: 3/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: 183305
Cal: 1/6/05 Due: 7/6/05

Initial pH: 5.274 Model: orion EA940 SN:2330
Final pH: 8.841 Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6
SN: 0251439

Reference Electrode: Fisher SCE 13-620-52
Counter Electrode: Platinum Flag

GAS: 99.999 % N_2
ECORR: -472 mv Model: Keithley 614 SN#: 0704934
EPT: +185 mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG & G Versastat SN#: ~~20104~~ 0W0 9/29/05 20104
Applied Potential: 400 mv

TEST ID: POF-04

Specimen Examination: No sign of corrosion or pitting
Blue tint staining on All surfaces of Specimen

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		Recorded by	5/25/05

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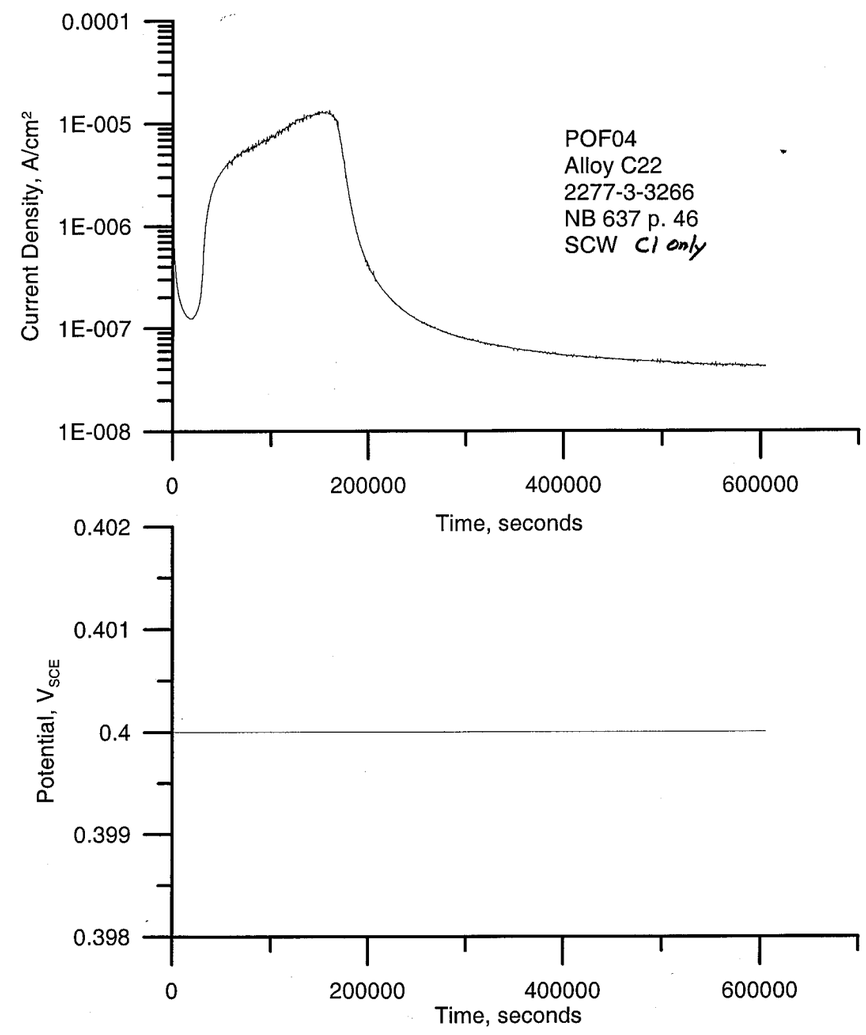

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	6/2/05

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing # 20.06062-01-081-005

SOLUTION: SCW - Simulated Concentrated Water (Cl⁻ Only)
KCl = 12.969g Lot # 005573
NaCl = 10.871g Lot # 050059
+ DI To 2000mls

Start weight: 8.21153g
End weight: 8.21149g
Model: Sartorious Genius
Cal: 5/11/05
SN: 17809099
Due: 11/11/05

TEST TEMPERATURE: 95°C
Thermometer: 183305
Cal: 1/6/05
Due: 7/6/05

Initial pH: 5.274
Final pH: 8.37
Model: orion EA940
Cal: 7/21/04
Due: 7/21/05
SN: 2330

pH Probe: #13-620-296
SN: 2291257P6
SN: 02514139
13-620-52

Reference Electrode: Fisher SCE
Counter Electrode: Platinum Flag

GAS: 99.999 % N_2
ECORR: -244 mv
EPT: -39 mv
Model: Keithley 614
Cal: 7/12/04
SN#: 0764934
Due: 7/12/05

Potentiostat: EG+G Veersostat
Applied Potential: 100 mv
SN#: 20104

TEST ID: POF-05

Specimen Examination: No visual signs of corrosion or pitting on specimen - Very Very mild surface staining on All surfaces

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	6/2/05

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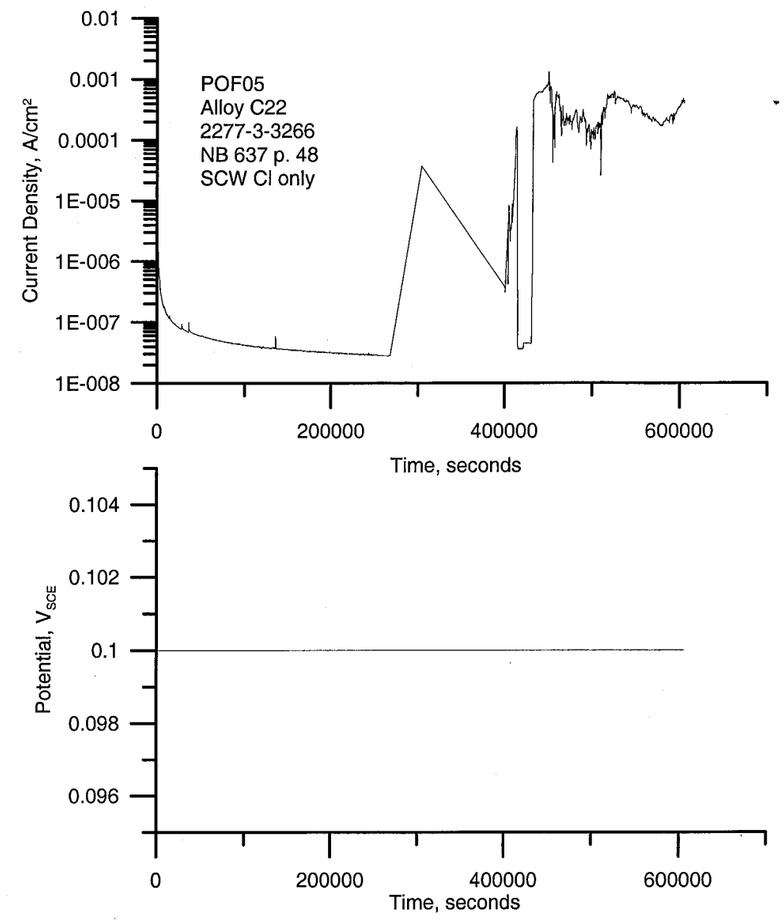

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	7/14/05

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C22 Specimen Heat # 2277-3-3266 See Drawing 20-06002-01-0051-005

SOLUTION: SCW - Simulated Concentrated Water 96.38g $NaHCO_3$ Lot # 025924 + DI To 1000 ml.

Start weight: 8.20511 g Model: Sartorious Genius SN: 12809099
End weight: 8.20996 g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: 183305
Cal: 1/6/05 Due: 7/6/05

Initial pH: 7.73 Model: orion EA940 SN:2330
Final pH: 10.26 Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6
13-220-52 SN: 025143g

Reference Electrode: Fisher SCE
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -580 mv Model: Keithley 614 SN#: 0704924
EPT: -58 mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG+G Versastat SN#: 20104
Applied Potential: 400 mv

TEST ID: POF-06

Specimen Examination: Mg Visual sign of corrosion or pitting on Specimen - Gold/Blue Tint staining on Surface of Specimen

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Witnessed & Understood by me, | Date | Invented by | Date 6/9/05
Recorded by

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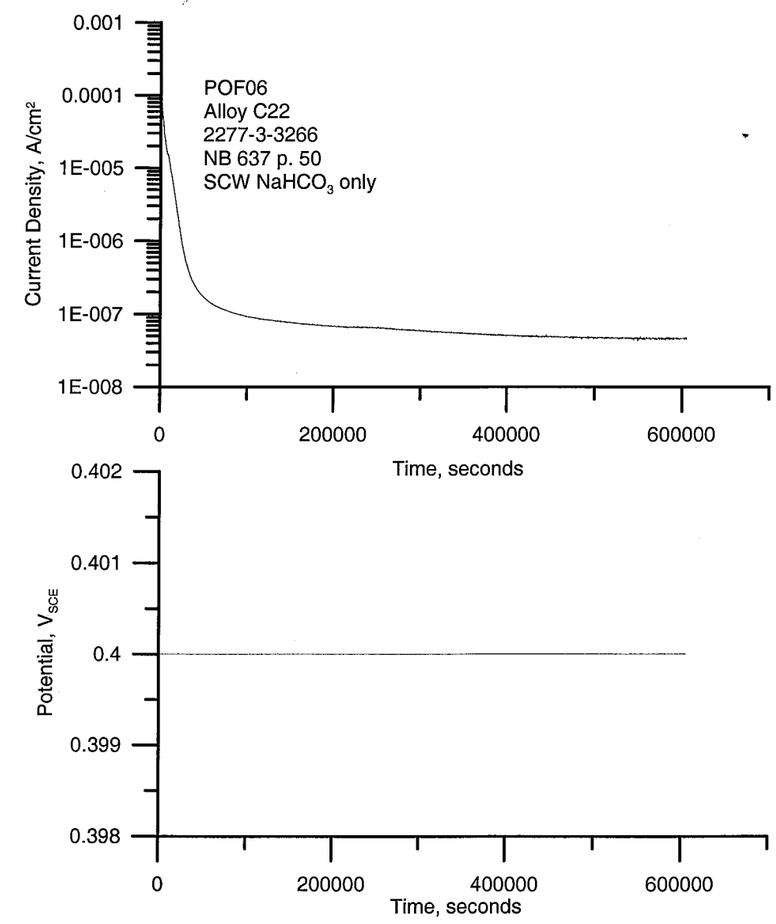

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Witnessed & Understood by me, | Date | Invented by | Date 7/14/05
Recorded by

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C22 Specimen Heat #2277-3-3266 See Drawing 20-06002-01-081.005

SOLUTION: SCW - Simulated Concentrated Water
96.38g $NaHCO_3$ Lot # 028524
+ DI To 1000ml

Start weight: 8.2041g
End weight: 8.2053g
Model: Sartorious Genius
Cal: 5/11/05
SN: 12509099
Due: 11/11/05

TEST TEMPERATURE: 95°C
Thermometer: 183205
Cal: 1/6/05
Due: 7/6/05

Initial pH: 7.73
Final pH: 9.71
Model: orion EA940
SN:2330
Cal:7/21/04
Due:7/21/05
pH Probe: #13-620-296
SN: 2291257P6
SN: 0251439

Reference Electrode: Fisher SCE 13-620-5C
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -624mv
Model: Keithley 614
SN#: 0204934
EPT: -78mv
Cal: 7/12/04
Due: 7/12/05

Potentiostat: EG&G Veersastat
SN#: 201044
Applied Potential: 100mv

TEST ID: POF-07

Specimen Examination: No Visual Sign of Corrosion or Pitting
Very Slight Surface staining on Specimen Surfaces

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		Recorded by	6/16/05

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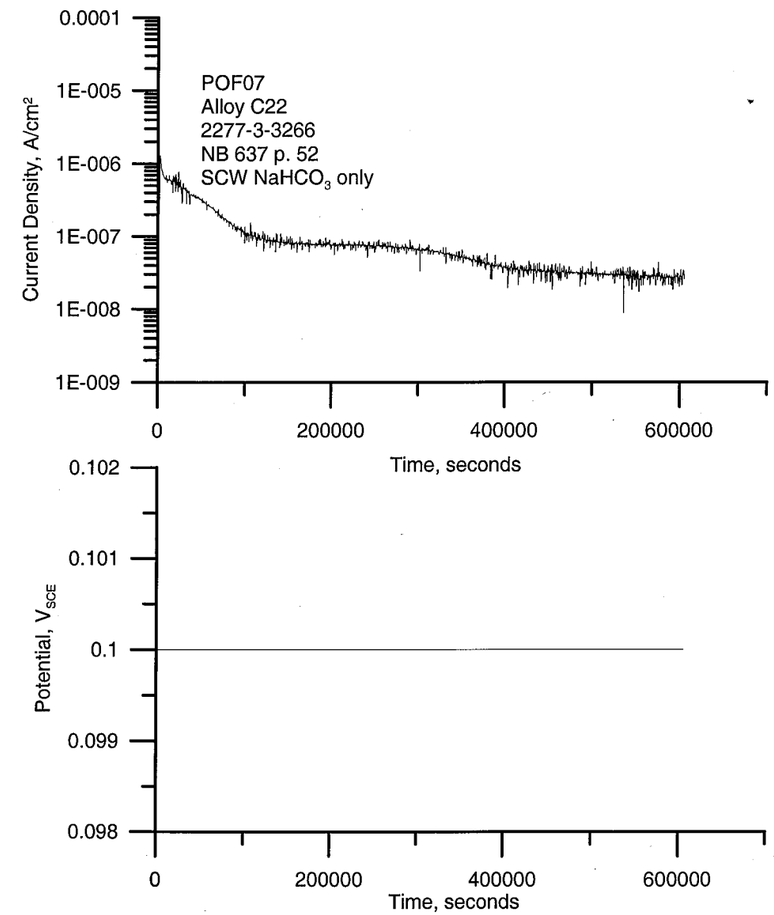

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		Recorded by	7/14/05

Project No.
Book No. TITLE

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing 20-06002.01.081.005

SOLUTION: SCW - Simulated Concentrated water
5.471 g NaCl Lot # 045904 + DI water
6.481 g KCl Lot # 005573 To 1000 ml
96.37 g $NaHCO_3$ Lot # 041522

Start weight: 8.21374 g Model: Sartorious Genius SN: 12809099
End weight: 8.19636 g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: 183305
Cal: 1/6/05 Due: 7/6/05

Initial pH: 8.05 Model: orion EA940 SN:2330
Final pH: 10.17 Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6
13-620-52 SN: 025/439

Reference Electrode: Fisher SCE
Counter Electrode: Platinum Flag

GAS: 99.999 % N_2
ECORR: -678 mv Model: Keithley 614 SN#: 0704934
EPT: -121 mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG&G Versastat SN#: 20104
Applied Potential: 100 mv

TEST ID: POF-08

Specimen Examination: Stopped Test Lost Ref Electrode
will Re Run Test POF-08

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		Recorded by	6/24/05

TITLE Project No.
Book No.

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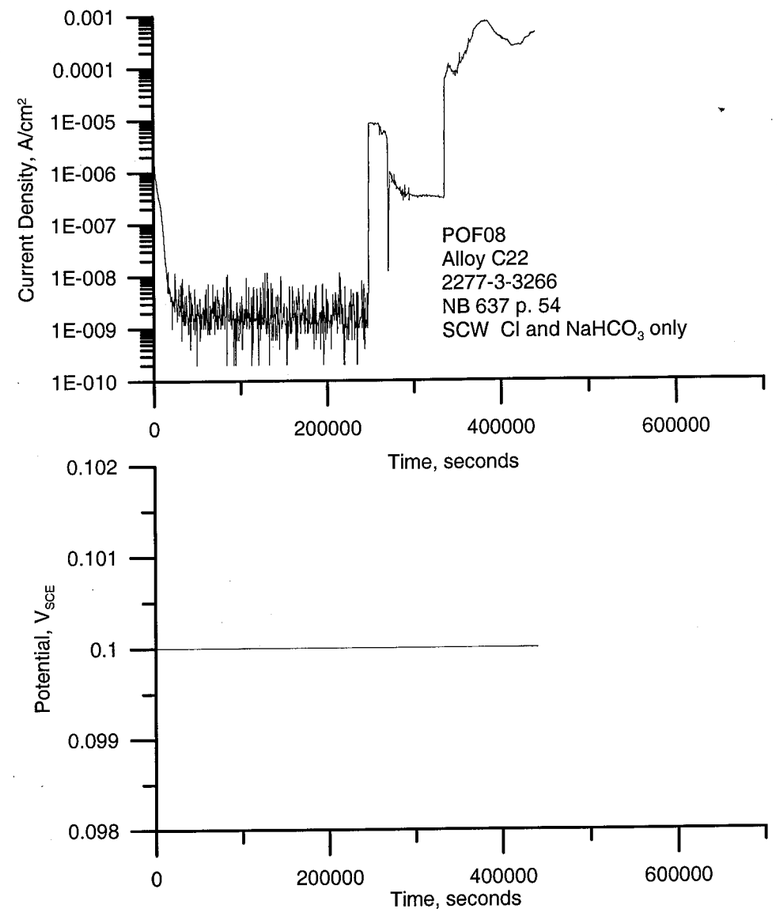

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing 20.06002.01.081.005

SOLUTION: SCW - Simulated Concentrated Water
5.471g NaCl Lot# 045904
6.481g KCl Lot# 065573
96.37g $NaHCO_3$ Lot# 041522
+ DI water To 1000mls

Start weight: 8.19488g Model: Sartorious Genius SN: 12809099
End weight: 8.19597g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: H98-187
Cal: 9/10/04 Due: 9/10/05

Initial pH: 8.05 Model: orion EA940 SN:2330
Final pH: 11.03 Cal:7/21/04 Due:7/21/05
pH Probe: #13-620-296 SN: 2291257P6
SN: 4028037

Reference Electrode: Fisher SCE 13-620-52
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -470mv Model: Keithley 614 SN#: 0704934
EPT: -132mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG+G Versastat SN#: 20104
Applied Potential: 100mv

TEST ID: POF-08A

Specimen Examination: No Visual signs of Corrosion or Pitting
Mild Surface Staining

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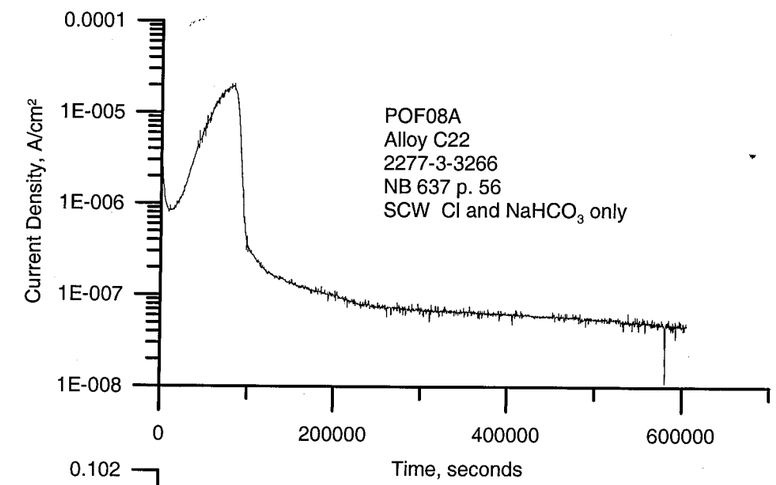

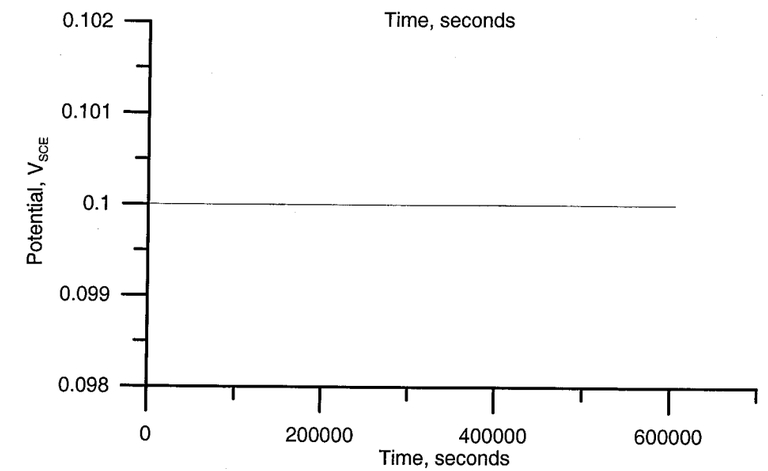

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266 See Drawing 20-06002.01-081.005

SOLUTION: SCW - Simulated Concentrated Water
5.471g NaCl Lot# 045904
6.481g KCl Lot# 005573
96.37g $NaHCO_3$ Lot# 041572
+ DI water To 1000ml

Start weight: 8.22581g Model: Sartorious Genius SN: 12809099
End weight: 8.22698g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 55°C Thermometer: H 58-187
Cal: 9/10/04 Due: 9/10/05

Initial pH: 8.05 Model: orion EA940 SN:2330
Final pH: 10.78 Cal: 7/21/04 Due: 7/21/05
pH Probe: #13-620-296 SN: 229125786
SN: 4028037

Reference Electrode: Fisher SCE 13-620-52
Counter Electrode: Platinum Flag

GAS: 99.995% N_2
ECORR: -471mv Model: Keithley 614 SN#: 0704934
EPT: +24mv Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG&G Versastat SN#: 20104
Applied Potential: 400mv

TEST ID: POF-09

Specimen Examination: Gold tint staining on All Surfaces of Specimen. No Sign of Corrosion or Pitting

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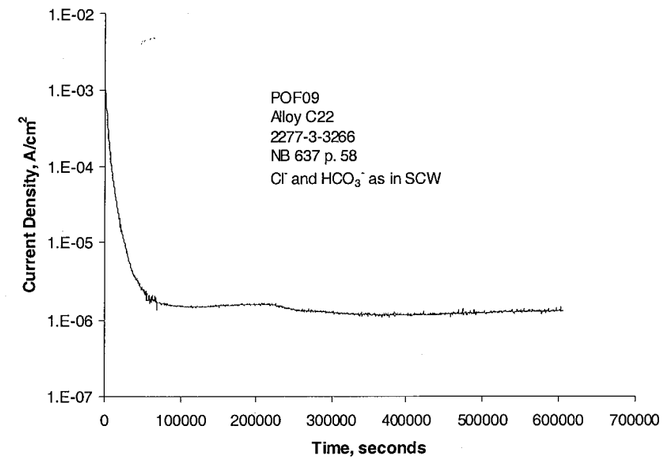

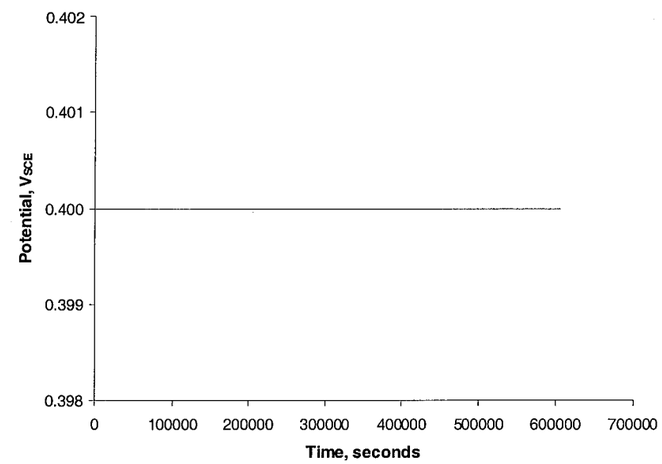

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat# 2277-3-3266 See Drawing 20.06007.01.051.005

SOLUTION: SCW - Simulated Concentrated Water
KCl 6.457g Lot# 005573 NaHCO3 96.38g Lot# 041522
NaCl 5.954g Lot# 045904 NaF 3.12g Lot# 991853
NaNO3 8.771g Lot# 020809
Na2SO4 20.708g Lot# 033461 + DI To 1000ml

Start weight: 8.09373g Model: Sartorious Genius SN: 12509095
End weight: 8.09481g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: N 98-187
Cal: 9/10/04 Due: 9/10/05

Initial pH: 7.78 Model: orion EA940 SN:2330
Final pH: 10.86 Cal: 7/21/04 Due: 7/21/05
pH Probe: #13-620-296 SN: 229125796
SN: 4028037

Reference Electrode: Fisher SCE 13-620-52
Counter Electrode: Platinum Flag

GAS: 99.999% N2
ECORR: -651mV Model: Keithley 614 SN#: 0204934
EPT: -129mV Cal: 7/12/04 Due: 7/12/05

Potentiostat: EG+G Versostat SN#: 20104
Applied Potential: 400mV

TEST ID: POF-10

Specimen Examination: Gold tint staining on surface of Specimen - No visual sign of corrosion or pitting

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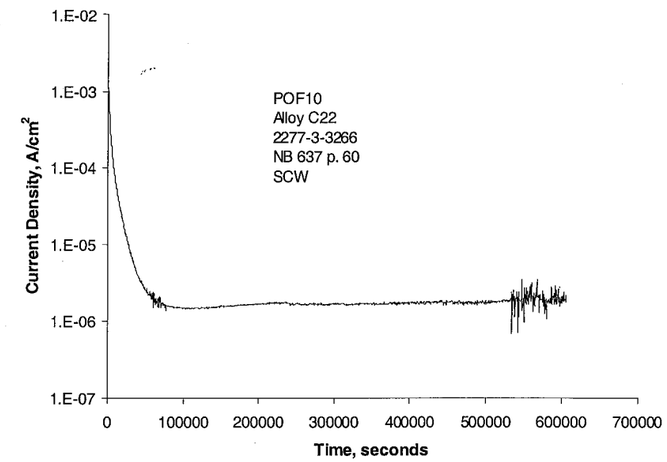

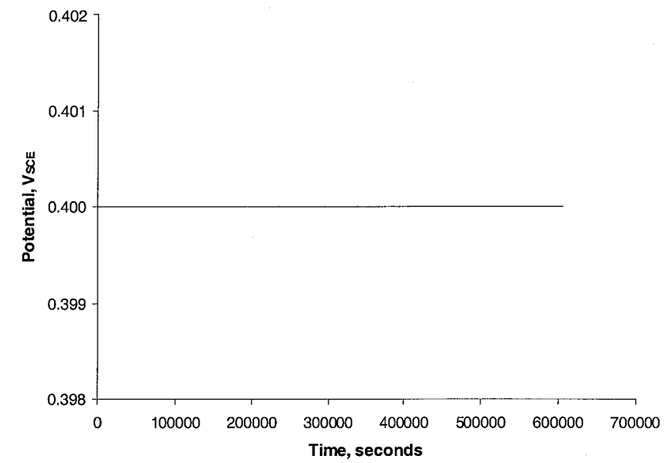

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Potentiostatic Tests

Objective: See pg #36

SPECIMEN: C-22 Specimen Heat # 2277-3-3266
See Drawing 20.06002.01.001.005

SOLUTION: SCW - simulated Concentrated Water
KCl 6.490g Lot # 044597
NaCl 5.431g Lot # 045904
$NaNO_3$ 8.764g Lot # 020809
+ DI To 1600mls

Start weight: 8.19400g Model: Sartorious Genius SN: 128090099
End weight: 8.19432g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: H 98-187
Cal: 9/10/04 Due: 9/10/05

Initial pH: 5.16 Model: orion EA940 SN:2330
Final pH: 9.06 Cal: 7/25/05 Due: 7/25/06
pH Probe: #13-620-296 SN: 229125794
SN: 4078037

Reference Electrode: Fisher SCE 13-620-52
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -381mv Model: Keithley 614 SN#: 0704936
EPT: +127mv Cal: 5/27/05 Due: 5/27/06

Potentiostat: EG+G Versastat SN#: 20104
Applied Potential: 100mv

TEST ID: POF-11

Specimen Examination: No visual sign of Corrosion or Pitting on Specimen. Not much staining on Surface if Any Very slight staining on Edge of Specimen

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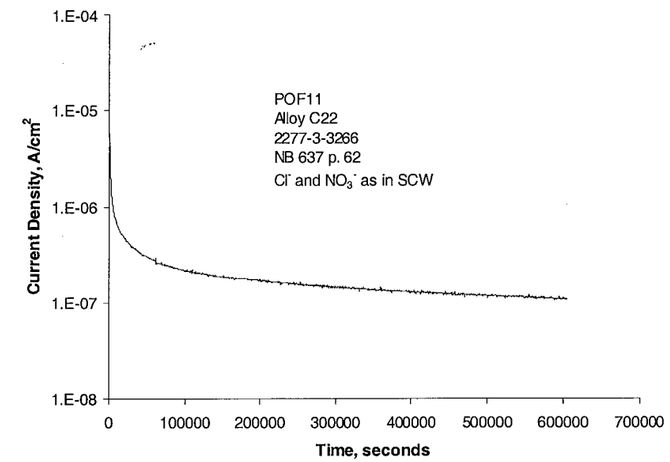

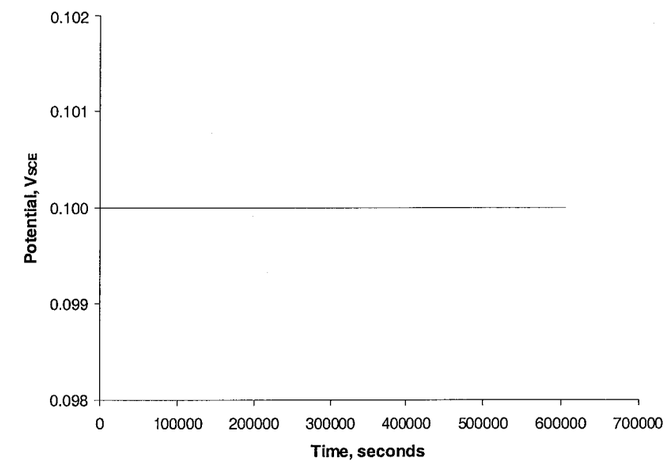

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Potentiostatic Tests

Objective: See Pg #36

SPECIMEN: C-22 specimen HT #2277-3-3266 See Drawing # 20.06007.01.081.005

SOLUTION: SCW - Simulated Concentrated Water
KCl 6.49g Lot # 044557
NaCl 5.431g Lot # 045904
$NaNO_3$ 8.761g Lot # 020809
+ DI To 1000 mls

Start weight: 8.2317g Model: Sartorious Genius SN: 12805095
End weight: 8.2333g Cal: 5/11/05 Due: 11/11/05

TEST TEMPERATURE: 95°C Thermometer: H98-187
Cal: 9/10/05 Due: 9/10/05

Initial pH: 5.16 Model: orion EA940 SN:2330
Final pH: 6.78 Cal: 7/25/05 Due: 7/25/06
pH Probe: #13-620-296 SN: 22 9135786
SN: 4078037

Reference Electrode: Fisher SCE
Counter Electrode: Platinum Flag

GAS: 99.999% N_2
ECORR: -276mv Model: Keithley 614 SN#: 0704936
EPT: +96mv Cal: 5/27/05 Due: 5/27/06

Potentiostat: EG+G Versastat SN#: 20104
Applied Potential: 400mv

TEST ID: POF-12

Specimen Examination: No visual sign of Corrosion or Pitting on Specimen - Dull tint staining on All Surfaces of Specimen

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Recorded by 8/3/05

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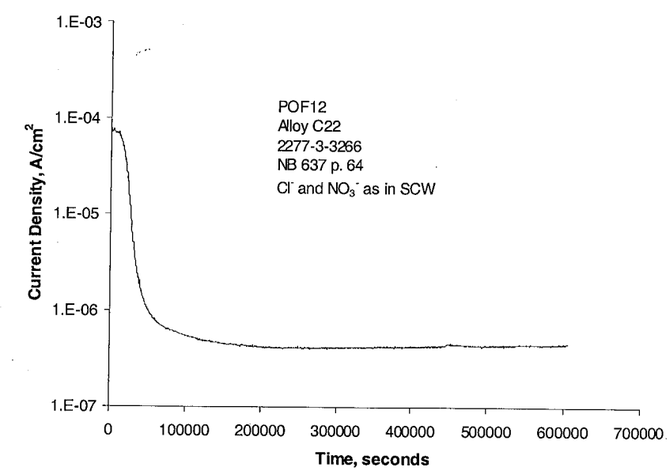

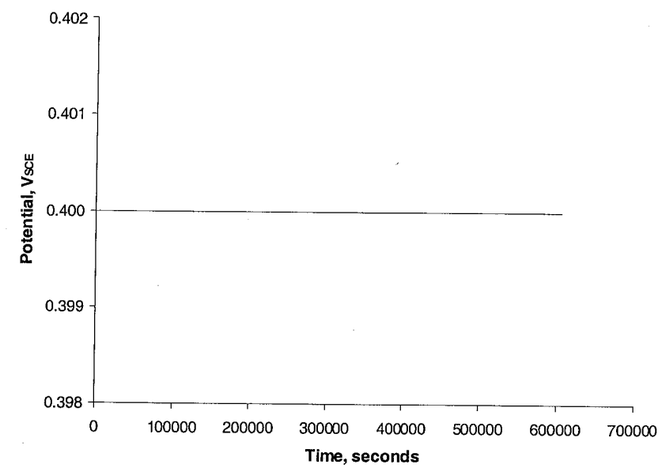

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Recorded by 8/3/05