

308

Q200304030003

Scientific Notebook # 541: Alloy 22

Repassivation Tests (Continues in S/N # 577)

LABORATORY NOTEBOOK

CNWRA/SwRI

CNWRA
CONTROLLED
COPY 541

NOTEBOOK NO. 541
ISSUED TO DARRELL DUNN *Darrell Dunn* *DD*
ON 20
DEPARTMENT 20
RETURNED 20

Brian K. Derby - *B. K. Derby* - *CKD*

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TITLE _____

From Page No. _____

Continued Testing From NB # 366, # 485, # 520, # 528, # 531

Copied from Previous Notebook.

Initial Scientific notebook entry for repassivation potential measurements**Title:** Alloy 22 Repassivation Tests**Tests Performed by:** Darrell S. Dunin, Letai Yang, Div 20; Brian Derby, Div. 18**Objectives:** Determine the effect of thermal aging time and temperature on the localized corrosion susceptibility of Alloy 22.**Equipment:** Laboratory oven for exposure of test specimens at 600 to 900 °C, Thermocouple and thermocouple meter. Keithley 614/617. Solartron 1287 Potentiostat and CorrView 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 and time of exposure, Potential and Current of specimen during test.**Required level of accuracy:** Temperature ± 2 °C, Time of exposure ± 1 minute, Potentials ± 1 mV, Current ± 0.01 microamp.**Uncertainty and Sources of Error:** 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.

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

8/8/02

From Page No. _____

Copies from Notebook #520

Initial Scientific notebook entry for polarization resistance measurements**Title:** Polarization Resistance Tests**Tests Performed by:** Darrell S. Dunn, Brian Derby, Div. 18, Jonathan Bost
Division 20 Summer Student**Objectives:** Determine uniform corrosion rate of passive alloys such as Alloy 22
using polarization resistance**Equipment:** Keithley 614/617. Solartron 1287 Potentiostat and CorrWare and
CorrView 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 $\pm 2^\circ\text{C}$, Potentials $\pm 1\text{mV}$, Current
 ± 0.01 microamp.**Uncertainty and Sources of Error:** Anodic current assumed to be from anodic
dissolution. Current from capacitive charging of the oxide film may interfere with
corrosion rate measurement.

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

8/8/02

From Page No. _____

Copies from Notebook #520

**Initial Scientific notebook entry for electrochemical impedance
measurements****Title:** Electrochemical Impedance Tests**Tests Performed by:** Darrell S. Dunn, Brian Derby, Div. 18, Jonathan Bost
Division 20 Summer Student**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 $\pm 2^\circ\text{C}$, Potentials $\pm 1\text{mV}$, 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.

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

8/8/02

From Page No. _____

FROM NB 157 P 208.

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 Performed 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" x 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 $\pm 2^\circ\text{C}$

Required level of accuracy: Potentials $\pm 5\text{mV}$. 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.

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

8/6/02

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Crevice Specimen thermally Agged for 5min @ 870°C (See NB #485) with 2 PTFE Crevice-Washers Attached At 50 In-Oz Using Photo 6/03 SN#2 Cal 7/5/02 Due 7/5/03 App C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt = 39.2145g

Sartorius Genius SN#12809099 Cal 6/4/02 Due 12/4/02

End wt = 39.2139g

Solution 4.0 M NaCl

467.57g NaCl Lot #020814

+ DI water To 2000ml

pH Start = 6.893

pH Adjusted To 2.843 with 748ml 20% HCl Solution

pH End = 2.73

Lot #002564

Orion 720A Meter SN#005805 Cal 7/10/02 Due 7/10/02 pH probe #13-620-296 SN#1100208

potentiostat: EG & G Versastat SN#20104

Counter Electrode: Pt Flag Used for OC Readings Only

Reference: Fisher 13-620-52 SN#0249090

Temperature: 100°C H_2 thermometer SN# C96-833 Cal 7/9/02 Due 1/9/03

Solution Bubbles with Zero Air - Also bubbles in Vapor phase of Cell

Alloy C-22 Plate

C-22 (870°C @ 5mm)

$E_{\text{corr}} = +48\text{mV}$

$E_{\text{corr}} = -141\text{mV}$

Keithley 614

$E_{\text{pt}} = -317\text{mV}$

$E_{\text{pt}} = -315\text{mV}$

SN#0704934

Cal 5/26/02 Due 5/26/02

Specimen Examination: No Crevice Corrosion / 24 feet of crevice washer

mil staining on all surfaces of Specimen

Data Tag #5

To Page No. _____

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Date _____

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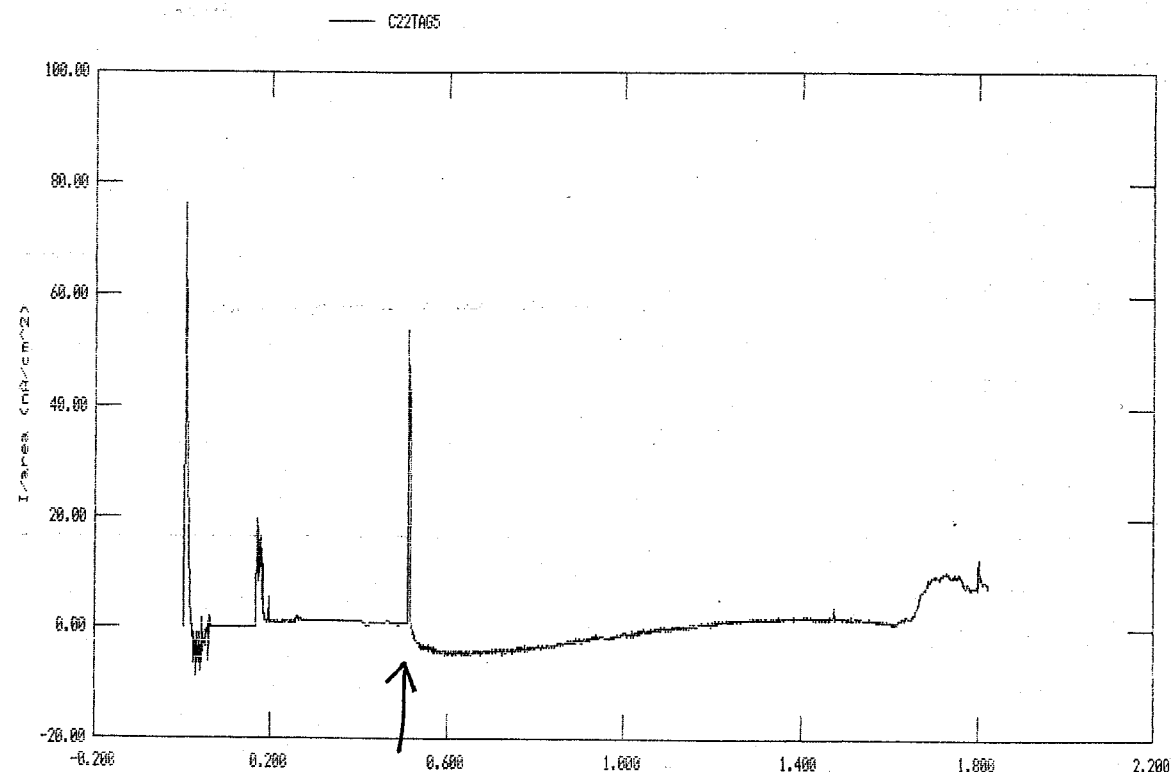
Date _____

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8/26/02

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.38
 GC GALVANIC CORROSION File Status: NORMAL Date Run: 06-17-02
 TP 1.073E+03 TI 1.824E+06 CR AUTO NP 1700 SD Pass FL 1 5.3Hz
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 2.000E+01 LS NO EH 2.604E+01
 DEN 8.690E+00 AU NO OC 0.835
 Comment: Alloy 22.5 min at 870 C, C-22 cathode, 4M Cl pH 2.8



Spikes Due To Temperature
 lose - Dropped to 60°C - Due to faulty RTD BKO

↑ = changed RTD

Model 352/252 Corrosion Analysis Software, v. 2.38
 Filename: .\data\C22TAG5
 Pstat: VStat[] Ver 2
 GC GALVANIC CORROSION
 Date Run: 06-17-02
 File Status: NORMAL
 Time Run: 15:13:36

Time/Pt.	TP	1.073E3	s	Time Step 1	TI	1.824E6	s
No. of Points	NP	1700		Curr. Range	CR	Auto	
				Stop On	SO	Pass	

Line Sync. LS no
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 20.00 cm²
 Density DE 8.690 g/ml
 Open Circuit OC 35.00E-3 V

Filter FL 1 5.3Hz
 Ref. Elec. RE SCE 241.5E-3V
 Equiv. Rt. EH 26.04 g
 AUX A/D AU no

Comment: Alloy 22.5 min at 870 C, C-22 cathode, 4M Cl pH 2.8

To Page No. _____

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Date _____

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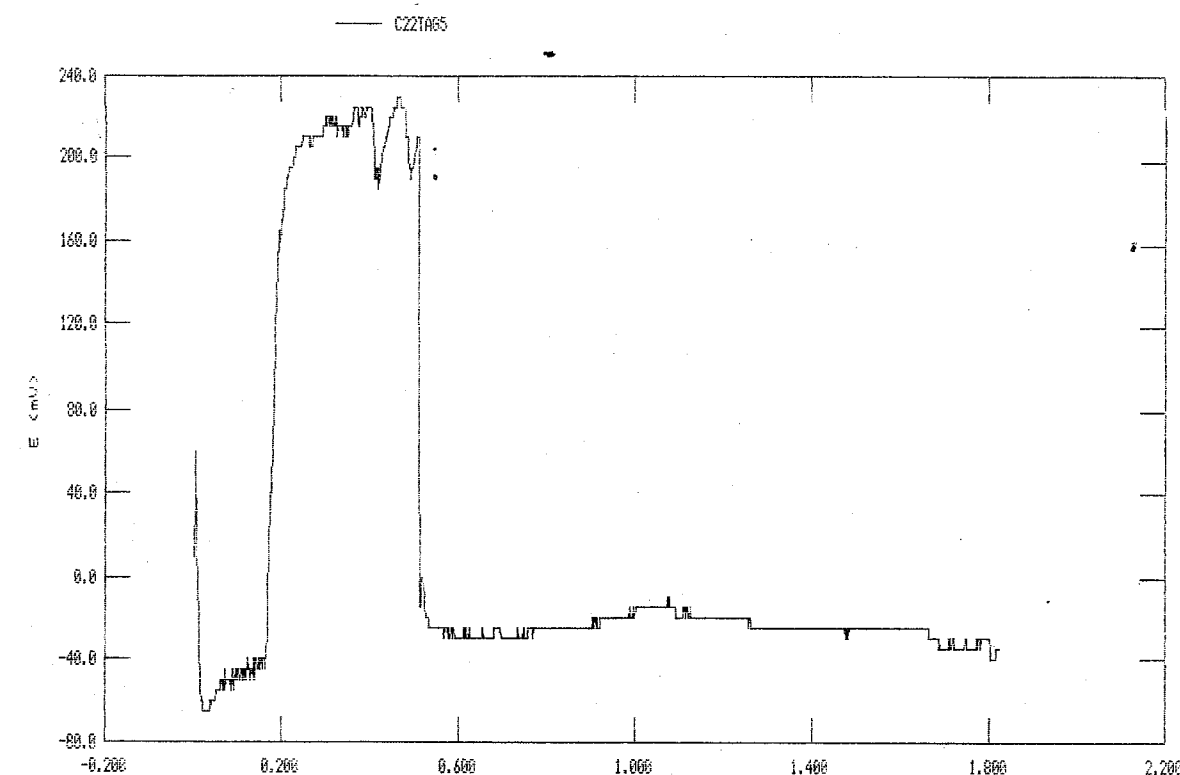
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9/12/02

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.38
 GC GALVANIC CORROSION File Status: NORMAL Date Run: 06-17-02
 TP 1.073E+03 TI 1.824E+06 CR AUTO NP 1700 SD Pass FL 1 5.3Hz
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 2.000E+01 LS NO EH 2.604E+01
 DEN 8.690E+00 AU NO OC 0.835
 Comment: Alloy 22.5 min at 870 C, C-22 cathode, 4M Cl pH 2.8



Spike Due To Temperature
 lose - Dropped to 60°C - faulty RTD BKO

Model 352/252 Corrosion Analysis Software, v. 2.38
 Filename: .\data\C22TAG5
 Pstat: VStat[] Ver 2
 GC GALVANIC CORROSION
 Date Run: 06-17-02
 File Status: NORMAL
 Time Run: 15:13:36

Time/Pt.	TP	1.073E3	s	Time Step 1	TI	1.824E6	s
No. of Points	NP	1700		Curr. Range	CR	Auto	
				Stop On	SO	Pass	

Line Sync. LS no
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 20.00 cm²
 Density DE 8.690 g/ml
 Open Circuit OC 35.00E-3 V

Filter FL 1 5.3Hz
 Ref. Elec. RE SCE 241.5E-3V
 Equiv. Rt. EH 26.04 g
 AUX A/D AU no

Comment: Alloy 22.5 min at 870 C, C-22 cathode, 4M Cl pH 2.8

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

9/12/02

From Page No. _____

Repassivation Potential of Alloy C-22

objective: See pg #1

specimen: C22 2277-8-3175 polished to A 600 Grit Finish
with 2 PTFE crevice washers Attached at 50 In-O₂ Using
Photo 6103 SN#2 Cal 7/5/02 Due 1/5/03start wt: 40.36677g Sartorius Genius SN#12809099 Cal 6/4/02 Due 12/4/02
End wt: 40.28156gSolution: 4 M NaCl
467.58g NaCl Lot # 020814
+ DI₂O To 2000mlspH start: 7.327 Orion 720A meter SN#005885 Cal 7/10/02 Due 7/10/03
pH End: 7.272 pH probe SN#13-620-296 SN#1100208

potentiostat: EG & G model #273 SN#41108

Counter Electrode: Pt Flag

Reference: Fisher 13-620-52 SN#8210502

Temperature: 95°C Hg Thermometer SN#H98-170 Cal 5/10/02 Due 5/10/03

E_{corr} = -362 mV Keithley 614 SN#467374 Cal 10/4/01 Due 10/4/02
E_p = +14 mVSolution Degassed with 99.999% N₂Specimen Examination: crevice corrosion on 7/24 feet of crevice washer
staining on all surfaces of specimen

Data C22R134

To Page No. _____

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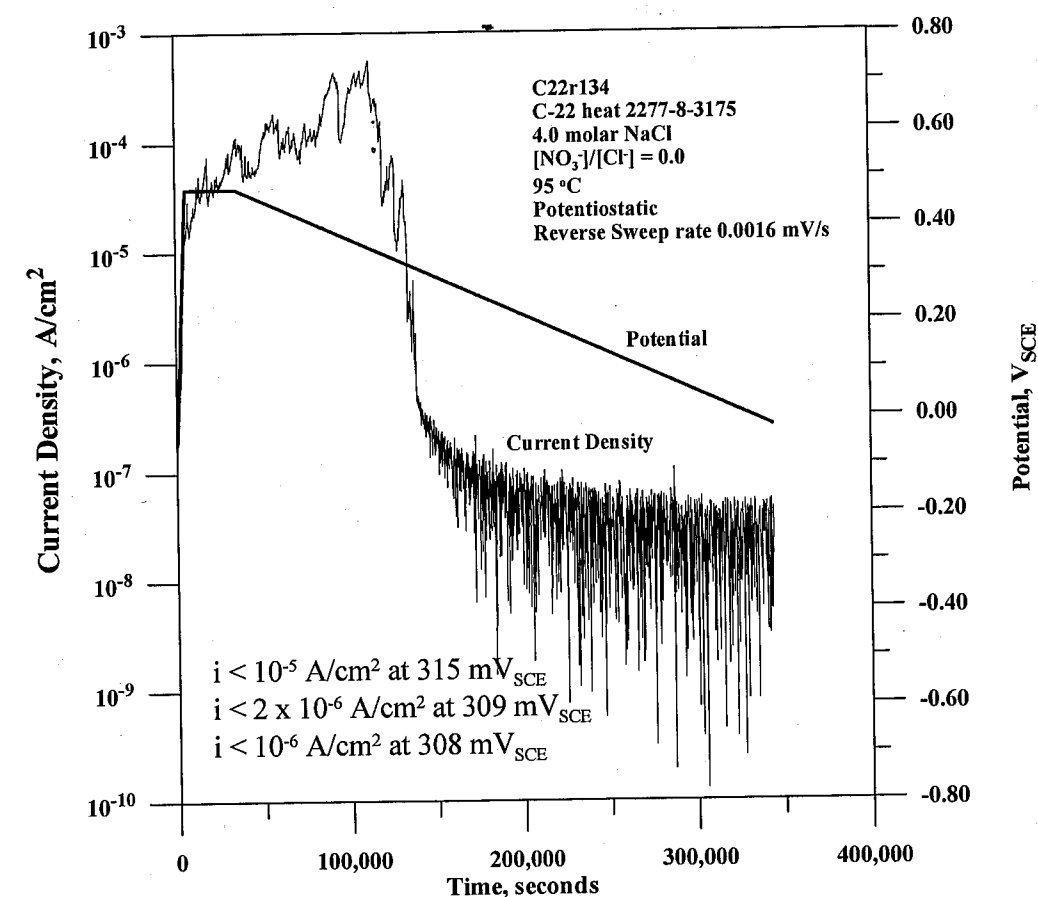
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8/26/02

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To Page No. _____

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Date

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B. J. [Signature]

8/29/02

From Page No. _____

Repassivation Potential of Alloy C-22

Objective: See pg #1

Specimen: C-22 2277-8-3175 polished To A 600 Grit Finish
with 2 PTFE Crevice washers Attached At 50 In-Oz
Using Proto 6103 SN#2 cal 7/5/02 due 1/5/02Start wt: 40.22812g Sartorius Genius SN#12809099 cal 6/4/02 due 12/4/02
End wt: 40.22348gSolution: 4.0 M NaCl
467.56g NaCl Lot#020814
+ DI To 2000mlspH Start = 7.632 Orion 720p Meter SN#005885 cal 7/14/02 due 7/14/03
pH End = 7.468 pH probe # 13-620-296 SN#1100208

Potentiostat: EG&G model # 273 SN#10120

Counter Electrode: Pt Fly

Reference: Fisher 13-620-52 SN#192121

Temperature: 95°C Hg thermometer SN#00-387 cal 5/10/02 due 5/10/03

Ecorr: -401 mV Keithley 614 SN#467374 cal 10/4/01 due 10/4/02
Ept = -17 mVSolution Deaerated with 99.999% N₂Specimen Examination: Crevice Corrosion on 1/24 feet of Crevice Washer
stripping on All Surfaces of Specimen

Data C22R135

To Page No. _____

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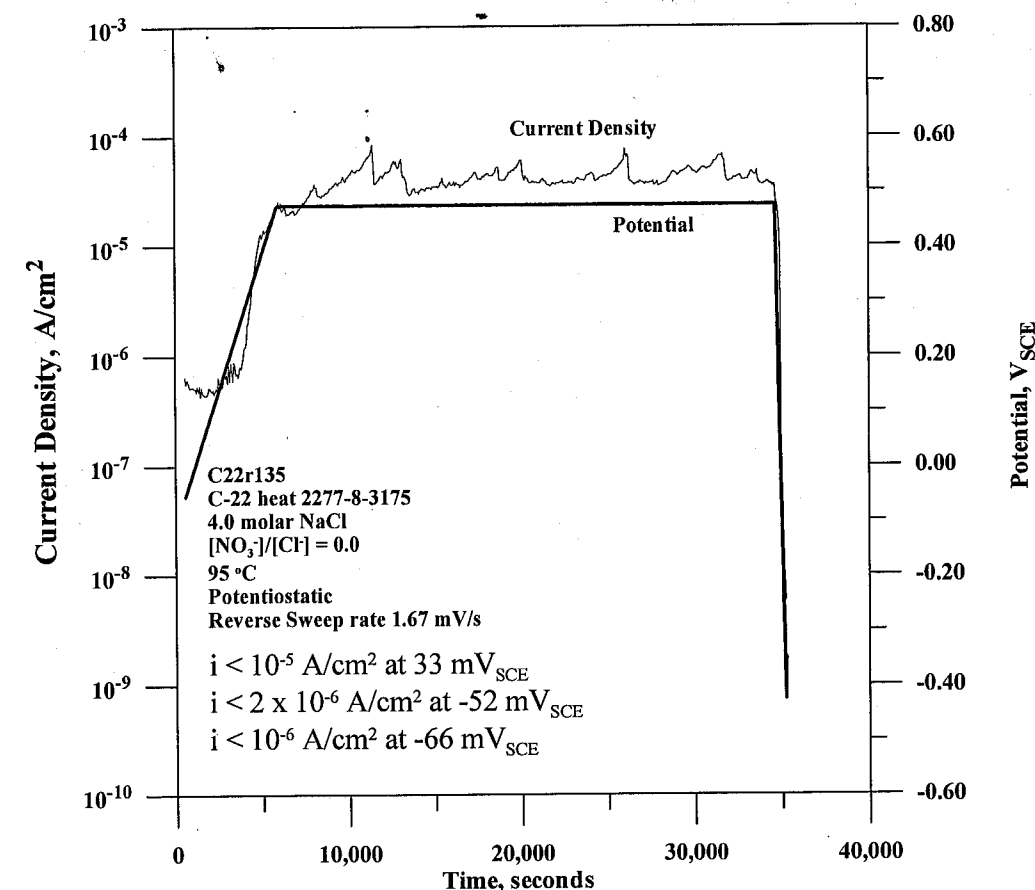
Date 8/26/02

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Date 8/29/02

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B. R. [Signature]

From Page No. C22L13 P

Specimen: C-22 weld 60
 Start wt = 39.49254g Santarious Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt. - Not Taken
 2 PTFE Crevise washers Attached At 50 In-Oz Using
 Photo 6104 SN#139072 cal 2/14/02

Solution: 4m Cl⁻ + 0.208mM SO₄²⁻ + 0.162mM NO₃⁻
 0.105mM F⁻ + 1.4mM HCO₃⁻ Prepared As Follows

467.57g NaCl Lot# 020814
 0.245g NaHCO₃ Lot# 92337A
 40mls SO₄
 20mls NO₃
 4mls F⁻
 + DI water To 2000mls

Start pH = 7.415 Fisher Accumet 950 meter SN#3340 cal 8/1/02 due 8/7/05
 End pH = Not Taken Fisher pH probe #13-620-296 SN#1100205

Temperature: 95°C Hg Thermometer SN#C96-783 cal 4/22/02 due 10/22/02
 Econ = > see NB 528 pg#58
 Ept =
 E Applied = +100mv

Counter Electrode: Pt Flag
 Reference: Fisher 13-620-52 SN#006610

Test Starts = 9-9-02 @ 2:30pm
 Computer shutdown 10/7/02 @ 6:00am Restarted New File C22L13Q @ 7:30am
 Test End = 11-11-02 @ 7:17am

Specimen Examination:
 Looks Good from outside of cell - Restarted New Test
 without Removal of Specimen - Visual Inspection only

Note: Re-fitted Luggin Probe And continues with Testing Procedure
 * Continued Testing with Same Solution from Notebook #528 pg#58

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

7/9/02

From Page No. C22L12 Q

Specimen: C-22 WGLPCD
 Base Metal: 2277-8-3235 Filler: XX164T0611
 Start wt: 39.40726g Santarious Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt: Not Taken
 2 PTFE Crevise washer Attached At 50 In-Oz Using
 Photo 6104 SN#139072 cal 2/14/02

Solution: 4m Cl⁻ + 1.4mM HCO₃⁻ + 0.208mM SO₄²⁻
 0.162mM NO₃⁻ + 0.105mM F⁻ Prepared As Follows

467.57g NaCl Lot# 020814
 0.244g NaHCO₃ Lot# 92337A
 40mls SO₄
 20mls NO₃
 4mls F⁻
 + DI water To 2000mls

pH Start = 7.465 Fisher Accumet 950 meter SN#3340 cal 8/1/02 due 8/7/05
 pH End = Not Taken Fisher pH probe #13-620-296 SN#1100205

Temperature: 95°C Hg Thermometer SN#H96-1090 cal 7/9/02 due 1/9/03
 Econ = > see NB 528 pg#59
 Ept =
 E Applied = +150mv

Counter Electrode: Pt Flag
 Reference: Fisher 13-620-52 SN#9250071

Test Starts 9/9/02 @ 2:30pm
 Computer shutdown 10/7/02 @ 6:00am - Restarted New File C22L12R @ 7:30am
 Test End = 11-11-02 @ 7:17am

Specimen Examination: Looks Good from Visual Inspection from outside
 of cell - Restarted New Test

Note: Re-fitted Luggin Probe And continues with Testing Procedure
 with Same Solution from NB #528 pg#59

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

9/9/02

From Page No.	C22L14 N
Specimen:	C-22 2277-8-3175
Start wt:	39.16720g Santarious Genus SN#12809099 cal 6/4/02 due 12/4/02
End wt:	Not Taken
2 PTFE Crevice Washers Attaches At 50 In-O ₂ Using	
Photo 6104 SN#139072 cal 2/14/02	
Solution: 4 M Cl ⁻ + 1.4 mM HCO ₃ ⁻ + 0.208 mM SO ₄ ²⁻ 0.162 mM NO ₃ ⁻ + 0.105 mM F ⁻ Prepared As Follows	
467.57g NaCl Lot# 020814 0.245g NaHCO ₃ Lot# 923337A 40 mls SO ₄ } Stock Solutions 20 mls NO ₃ } Notebook #366 pg #145 4 mls F ⁻ } Prepared 5/24/02 + DI water To 2000mls	
Start pH =	7.476 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03
End pH =	Not Taken Fisher pH probe #13-620-296 SN#1100208
Temperature:	95°C Hg Thermometer SN#C96-827 cal 6/18/02 due 12/18/02
Ecorr =	> see NB #528 pg #60
Ept =	
E Applies	+250 mV
Counter Electrode:	PT Flg
Reference:	Fisher 13-620-52 SN#006128
Test started:	9-9-02 @ 2:30pm
Computer shutdown 10/1/02 @ 6:00am - Restarted New File C22L14 N @ 7:30am	
Test Ended:	11-11-02 @ 7:17 am
Specimen Examination:	looks Good for outside of cell Visual Inspection only - Restarted New Test
Note: Rebutted Luggin Probe And Continued Testing Procedure with same solution from NB #528 pg #60	
Witnessed & Understood by me,	Date
Invented by	Date
Recorded by	9/7/02

From Page No.	C22L3 Z
Specimen:	C-22 2277-8-3175
Start wt:	47.21329g Santarious Genus SN#12809099 cal 6/4/02 due 12/4/02
End wt:	Not Taken
2 PTFE Crevice Washers Attaches At 50 In-O ₂ Using	
Photo 6104 SN#139072 cal 2/14/02	
Solution: 4 M Cl ⁻ + 1.4 mM HCO ₃ ⁻ + 0.208 mM SO ₄ ²⁻ 0.162 mM NO ₃ ⁻ + 0.105 mM F ⁻ Prepared As Follows	
467.54g NaCl Lot# 020814 0.246g NaHCO ₃ Lot# 923337A 40 mls SO ₄ } Stock Solution 20 mls NO ₃ } Notebook #366 pg #145 4 mls F ⁻ } Prepared 5/24/02 + DI water To 2000ml	
Start pH =	7.469 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03
End pH =	Not Taken Fisher pH probe #13-620-296 SN#1100208
Temperature:	95°C Hg Thermometer SN#C96-852 cal 8/18/02 due 11/18/02
Ecorr =	> see NB #528 pg #61
Ept =	
E Applies =	Open Circuit
Solution Bubbles with Zero Air	
Reference:	Fisher 13-620-52 SN#9250063
Test started	9-9-02 @ 2:30pm
Computer shutdown 10/1/02 @ 6:00am - Restarted New File C22L3 AA @ 7:30am	
Test Ended:	11-11-02 @ 7:17 am
Specimen Examination:	looks Good from outside of cell - Visual Inspection only - Restarted New Test
Note: Rebutted Luggin Probe And Continued Testing Procedure with same solution from NB #528 pg #61	
Witnessed & Understood by me,	Date
Invented by	Date
Recorded by	9/7/02

From Page No. _____ DC 825 CIAW
 Specimen: 825 MH 4371 F6
 Start wt = 39.29836g Sartorius Genius SN#12809099 cal 6/4/02 acc 12/4/02
 End wt = Not Taken
 2 PTFE Crevise Washers Attached At 50 In Oz Using
 Proto 6104 SN#139072 cal 2/14/02

Solution: 0.028 M Cl^- + 1.4 mM HCO_3^- + 0.208 mM SO_4^{2-}
 0.162 mM NO_3^- + 0.105 mM F^- Prepared As Follows

3.300g NaCl Lot# 020814
 0.241g NaHCO_3 Lot# 923337A
 40 mL SO_4 } stock Solution
 20 mL NO_3 } Notebook #366 Pg #145
 4 mL F^- } Prepared 5/24/02
 + DI water To 2000 mL

Start pH = 8.292 Fisher Accumet 950 meter SN# 3340 cal 8/7/02 acc 8/7/03
 End pH = Not Taken Fisher pH probe #13-620-296 SN# 1100208

Temperature: 95°C Hg Thermometer SN# 96.816 cal 4/22/02 acc 10/22/02

Exorn } SCC NS 528 pg #62

Ept
 E Applico: Open Circuit

Solution Bubbles with Zero Air
 Reference: Fisher 13-620-51 SN# 8027166

Test started 9-9-02 @ 2:30 pm
 Computer Crash/shutdown @ 6:00 am 10/7/02 - Restarted Nowfile DC825CIAW 2:30 am

Test Ended: 11-11-02 @ 7:17 am

Specimen Examination

Looks Good from outside of Cell - Visual Inspection
 only - Restarted Tests

Note: Re-fitted Luggin probe and continued Testing Procedure
 with same solution from NS #528 pg #62

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

9/9/02

From Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

1/22/03

From Page No. _____

Open Circuit Potential Measurements

Specimen: C-22 #4 - 625 - 825 cylindric - All specimens in cell #1

C-22 #4 2277-8-3175 600 Grit Finish

Start wt = 12.06904g Santorionic Genies SN#12809099 cal 6/4/02 due 12/4/02

End wt = 12.06489g
625 600 Grit Finish

Start wt = 12.17201g Santorionic Genies SN#12809099 cal 6/4/02 due 12/4/02

End wt = 12.16842g
825 600 Grit Finish

Start wt = 11.54249g Santorionic Genies SN#12809099 cal 6/4/02 due 12/4/02

End wt = 11.54054g

Solution: 4 M NaCl
467.57g NaCl Lot# 025149
+ DI water To 2000mls

pH Start = 6.891 Adjusted To 3.147 with 20% HCl solution Lot# 062729 350ml

pH End = 3.330

Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03 pH probe #13-620-296 SN#100208

Reference: Fisher 13-620-52 SN#820524U

Counter Electrode: Pt Flag

Temperature: 95°C Hg Thermometer SN#F98-393 cal 7/9/02 due 1/9/03

Solution Bubbles with Zero Air

Specimen Examination

C-22 #4 = Specimen looks good No Signs of corrosion or pitting
m.la staining And Outcrop Along Solution Line At Top of Specimen. Cleaned off

625 = No Sign of Corrosion or Pitting. Cleaned for further Testing

825 = Specimen looks good No Sign of Corrosion or pitting
Slight Outcrop of material Along solution line. Came off with cleaning

Test started: 9/11/02

Test Ended 11/18/02

Data - 745C

To Page No. _____

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Date _____

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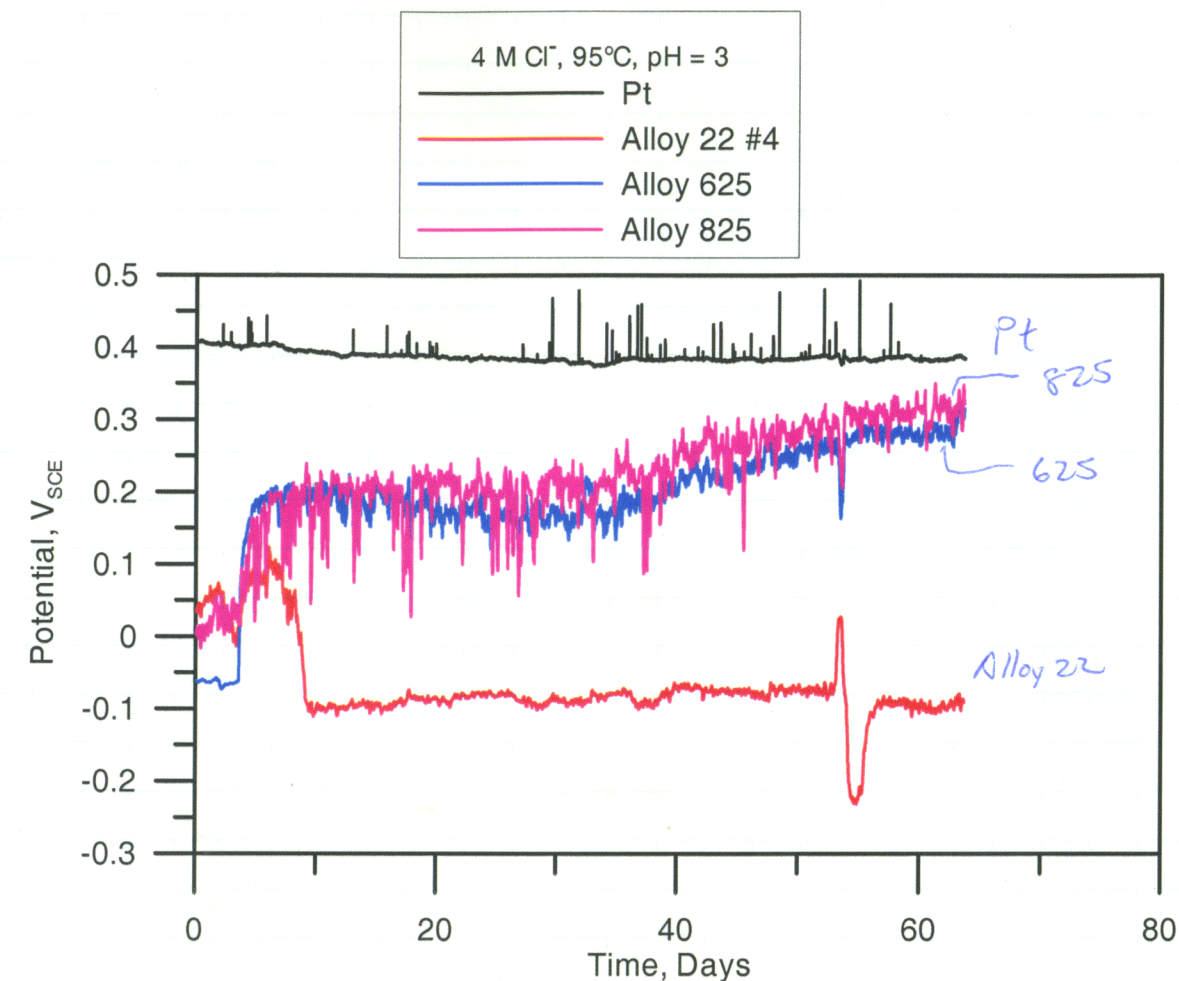
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9/11/02

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From Page No. _____



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Date _____

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Date _____

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11/25/02

To Page No. _____

From Page No. _____

Open Circuit Potential Measurements

Specimen: C-22^{#1} + C-22^{#2} + C-22^{#3} cylindrical Specimen In Cell #2
 C-22^{#1} 2277-8-3175 600 Grit Finish
 Start wt = 12.27412g Santarious Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt = 12.27391g
 C-22^{#2} 2277-8-3175 600 Grit Finish
 Start wt = 12.43501g Santarious Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt = 12.43156g
 C-22^{#3} 2277-8-3175
 Start wt = 12.47348g 600 Grit Finish
 End wt = Santarious Genius SN#12809099 cal 6/4/02 due 12/4/02

Solution: 4 M NaCl
 467.57g NaCl Lot# 025149
 + DI water to 2000mls

pH Start: 7.275 Adjusted To 2.993 with 20% HCl Solution Lot# 002729 400ul
 pH End: 3.972
 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03 pH probe #13-620-296 SN#1100208

Reference: Fisher 13-620-52 SN#0042119
 Counter Electrode: Pt Flag

Temperature: 95°C Hg Thermometer SN#H-98-182 cal 5/10/02 due 5/10/03

Solution Bubbles with Zero Air

Specimen Examination

C-22^{#1} = Specimen looks Good No sign of corrosion - mild staining

C-22^{#2} = Specimen looks Good No sign of corrosion - mild staining

C-22^{#3} = Specimen looks Good No sign of corrosion - mild staining

Test started = 9/11/02

Test Ended = 11/18/02

Date: 7ASC

To Page No. _____

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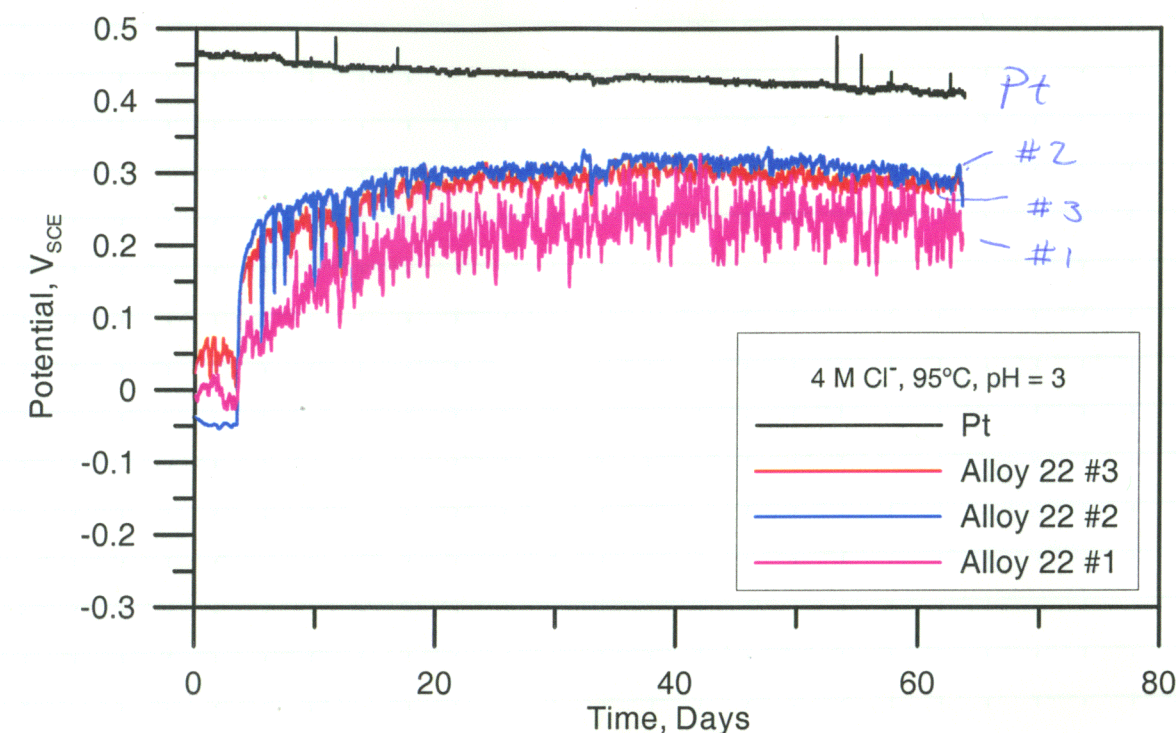
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9/11/02

From Page No. _____



To Page No. _____

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11/25/02

From Page No. _____

Thermally Aged Cylinders for Open Circuit Potential Measurement
Testing with 3 Different materials * Note: thermally oxidized
Not thermally Aged *

Specimens: All specimens Polished To A 600 Grit Finish

^{per 10/4/02}
825 = start wt: 12.16724 g
825 = start wt: 11.06307 g

C-22

#1 = start wt: 12.59528 g
#2 = start wt: 12.45572 g
#3 = start wt: 12.32287 g
#4 = start wt: 12.21633 g

All weight measurements taken with Sartorius Genius SN# 12809099 cal 6/4/02 due 12/4/02

All specimens placed into - Linbong oven SN# 909172 model# 51333
oven set point Temperature = 200°C

Measured Temperature with - Thermocouple #332 cal 7/15/02
due 1/15/03

Omega Meter SN# T-94140 cal 3/22/02
due 9/22/02

Meter Reading Temperature: 201.2°C

Continued on pg #23

To Page No. _____

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10/9/02

From Page No. _____

Oven Temperature Readings for Cylinder

Started At 9:30 A.M. on 9/4/02

Oven set point = 200°C

Oven Temperature Readings

9/5/02 = 203°C
9/6/02 = 200°C
9/9/02 = 203°C
9/10/02 = 203°C
9/11/02 = 204°C
9/12/02 = 203°C
9/16/02 = 203°C
9/17/02 = 202°C
9/19/02 = 201°C
9/23/02 = 203°C
9/24/02 = 205°C
9/25/02 = 202°C
9/26/02 = 202°C
9/27/02 = 203°C
9/30/02 = 200°C
10/1/02 = 200°C
10/2/02 = 200°C
10/3/02 = 204°C
10/4/02 = 202°C

Test stopped over shutdown @ 9:42am on 10/4/02

Rechecked oven Temperature with thermometer 10/4/02 @ 9:30
Temperature Reading = 201.6°C

To Page No. _____

Witnessed & Understood by me, _____

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Date _____

Recorded by _____

10/9/02

From Page No. _____

Galvanic Corrosion Tests - *Running Trial Experiment*

Objective: See pg #4

Specimen: C-22 Alloy Plate Dimensions:

No specimen weight taken

Solution: 4.0 M NaCl
467.59 g NaCl Lot # 025148
+ DI water to 2000 ml

pH Start: 6.982 Fisher Accumet 950 meter SN# 3340 cal. 8/1/02 Due 8/1/03

pH probe # 13-620-296 SN# 1100205

pH Adjusted with 20% HCl Solution Lot # 002564 50% $T_0 = 2.963$

pH End: Not Taken

potentiostat: EG & G Versastat SN# 20164

Counter Electrode: Pt Flag for OC Reading Only

Reference: Fisher 73-620-52 SN# 0249090

Temperature: 95°C Hg Thermometer SN# C96-833 cal 7/9/02 Due 1/9/03

Solution Bubbles with Zero Air - Also bubbler in Vapor phase of cell

I_{corr} = -109 mV Keithley 614 SN# 0704936 cal 5/26/02 Due 5/26/03E_{pot} = -160 mV* Note: Trial Experiment To Get Ranges Need For Future
Testing - Spiked cell with NaOCl 4%-6% Lot # 012449.9

Continued on pg #25

To Page No. _____

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10/4/02

From Page No. _____

Continued from pg #24

Started Testing on 10/3/02 - Used Eppendorf pipette SN# 381446
10-100 µl10/4/02 @ 10:07 am 6.48 E4 sec.
Spiked cell with 10 µl of NaOCl@ 4:07 pm 8.657 E4 sec
Spiked cell with 40 µl of NaOCl10/7/02 @ 8:25 am 3.183 E5 sec
Spiked cell with 50 µl of NaOCl10/8/02 @ 10:17 am 4.116 E5 sec
Spiked cell with 50 µl of NaOCl10/10/02 @ 8:52 am 5.790 E5 sec
Spiked cell with 50 µl of NaOCl10/14/02 @ 8:50 am 9.248 E5 sec
spiked cell with 50 µl of NaOCl

10/18/02 Test Ends

Data NaOCl.H.02

To Page No. _____

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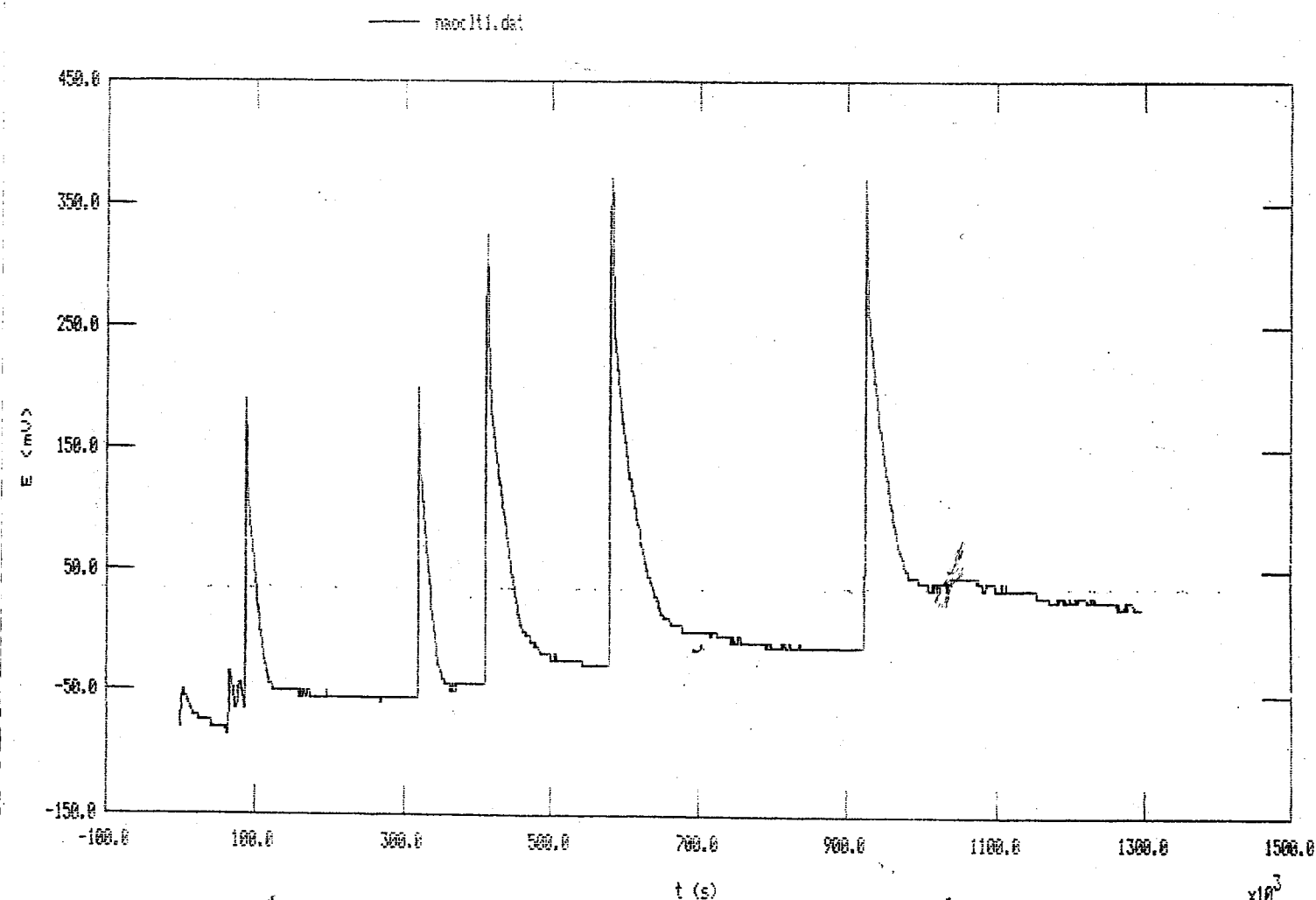
Recorded by

10/4/02

From Page No. _____

Graph for Trial Galvanic Corrosion Test Pg #24

Model 352/252 Corrosion Analysis Software, v. 2.30
 EC CORR VS. TIME File Status: NORMAL Date Run: 06-20-02 Time Run: 14:57:50
 TP 5.184E+02 T1 1.296E+06 NP 2500 SO Pass RT HIGH STABILITY REF 0.24150 SCE
 NPK SOLID AR 1.000E+00 LS YES EW 0.000E+00 IEN 8.690E+00 AD NO
 OC -0.078
 Comment: C-22 plate in 4M Cl solution pH=2.963 Trial- NaOCl spike tests



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From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30

Filename: A:\naoclt1.dat

Pstat: VStat[] Ver 2

EC CORR VS. TIME

Date Run: 06-20-02

File Status: NORMAL

Time Run: 14:57:50

Time/Pt. TP 518.4 s

No. of Points NP 2500

Time Step 1 T1 1.296E6 s

Stop On SO Pass

Line Sync. LS yes

Working Elec. WE Solid

Filter FL Off

Ref. Elec. RE SCE 241.5E-3V

Sample Area AR 1.000 cm²

Density DE 8.690 g/ml

Equiv. Wt. EW 0.0000 g

Open Circuit OC -78.00E-3 V

AUX A/D AU no

Comment: C-22 plate in 4M Cl solution pH=2.963 Trial- NaOCl spike tests

Will Continue Testing on Pg # 38

Solution change And start Testing Procedure with 150ml of NaOCl In solution Already

Test will Also Be Use As A Trial To Get Ranges for future Testing

Witnessed & Understood by me, _____		Date _____	Invented by _____	Date _____
Recorded by <i>[Signature]</i>		10/20/02		

From Page No. _____

Electrochemical Impedance Test for Alloy C-22

Objective: Same As pg #3

Specimen: Alloy C-22 heat = 2277-8-3175 Cylinder
Polished To A 600 Grit FinishStart wt: 12.43755g Sartorius Genius SN# 12889099 cal 6/4/02 due 12/4/02
End wt: 12.42798gSolution: 6.0 M $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$
1,764.31g $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ Lot # 972443
+ DI water To 2000 mlpH Start: 3.097 Fisher Accumet 950 meter SN# 3340 cal 8/7/02 due 8/7/03
pH End: 6.020 pH probe 13-620-296 SN# 1100208Cell Info: Area: 8 cm²
Density: 8.69 g/cm³
Exemplar wt: 26.04

Impedance Analyzer = Solartron 1260

Counter Electrode: Pt Flag

Reference: Fisher 13-620-5L SN# 0052132

Temperature: 25°C - 115°C Hg Thermometer SN# 498-162 cal 4/22/02 due 4/22/03

E_{corr}: -70mV Keithley 614 SN# 0704936 cal 5/26/02 due 5/26/03
E₀₁: +309mVSolution Deaerated with 99.999% N₂

Specimen Examination: Crystallization of Solution on Specimen And Bottom of Cell

See picture pg #43 - some pitting on Specimen And staining

To Page No. _____

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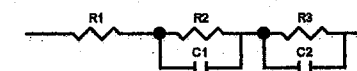
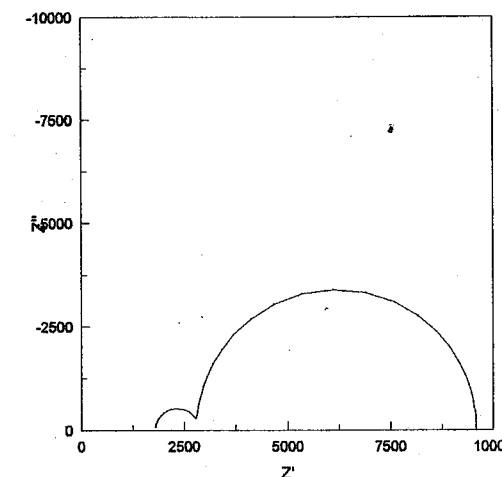
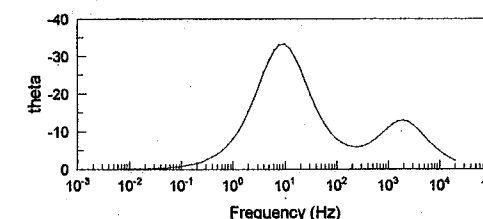
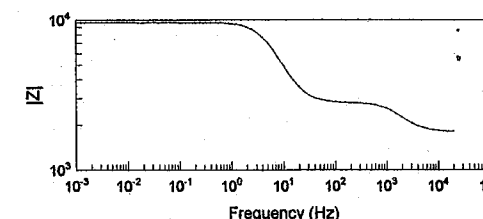
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10/10/02

From Page No. _____

Equipment Test Prior To Starting
Electrochemical Impedance Testing

Element	Freedom	Value	Error	Error %
R1	Free(+)	1801	0.44334	0.024816
R2	Free(+)	6788	1.1802	0.017092
C1	Free(+)	4.758E-6	2.0602E-9	0.04372
R3	Free(+)	1000	0.59361	0.059361
C2	Free(+)	1.008E-7	1.4155E-10	0.14043

Chi-Squared: 1.326E-5
Weighted Sum of Squares: 0.0019227Data File: D:\Corrosion Data\C-22 tests\C22.pcd tests\12861 module.z
Circuit Model File: D:\Corrosion Data\C-22 tests\12861 ECI Test Module.mdl
Mode: Run Fitting / Freq. Range (1E-5 - 20000)
Maximum Iterations: 100
Optimization Iterations: 0
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

Graph from Test #69 - #82 on pg #30-42

To Page No. _____

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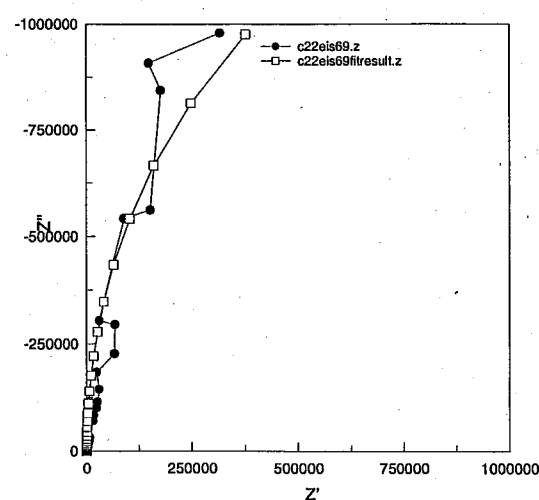
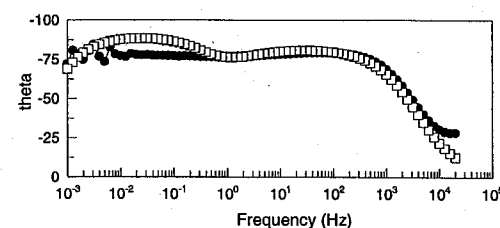
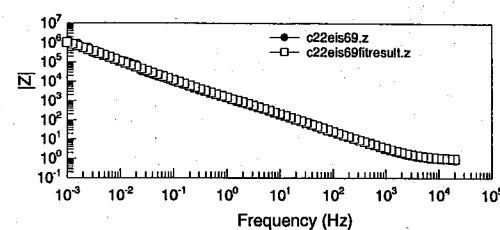
Date _____

Recorded by _____

10/10/02

From Page No. _____

Data Test #69



Element	Freedom	Value	Error	Error %
Rs	Fixed(X)	0.9	N/A	N/A
Rox porous	Free(+)	152.3	231.39	151.93
CPEporous-T	Free(+)	0.0026051	0.0011298	43.369
CPEporous-P	Free(+)	1.022	0.21305	20.846
Rox barrier	Free(+)	4.1658E6	1.7439E5	4.1862
CPEbarrier-T	Free(+)	0.00017139	3.6197E-6	2.112
CPEbarrier-P	Free(+)	0.90314	0.0047476	0.52568

Chi-Squared: 0.014018
Weighted Sum of Squares: 2.2709

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis70.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 84)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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Date

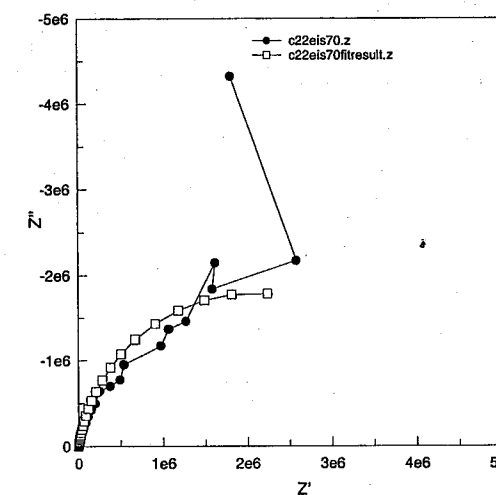
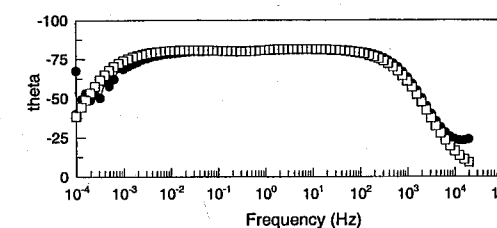
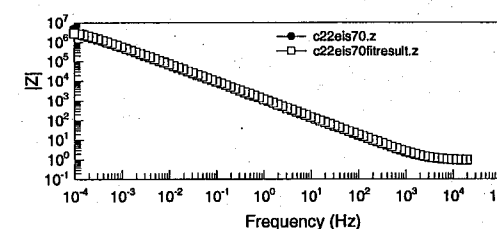
Recorded by

B. K. Pat

12/11/02

From Page No. _____

Data Test #70



Element	Freedom	Value	Error	Error %
Rs	Fixed(X)	0.9	N/A	N/A
Rox porous	Free(+)	152.3	231.39	151.93
CPEporous-T	Free(+)	0.0026051	0.0011298	43.369
CPEporous-P	Free(+)	1.022	0.21305	20.846
Rox barrier	Free(+)	4.1658E6	1.7439E5	4.1862
CPEbarrier-T	Free(+)	0.00017139	3.6197E-6	2.112
CPEbarrier-P	Free(+)	0.90314	0.0047476	0.52568

Chi-Squared: 0.014018
Weighted Sum of Squares: 2.2709

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis70.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 84)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

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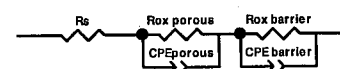
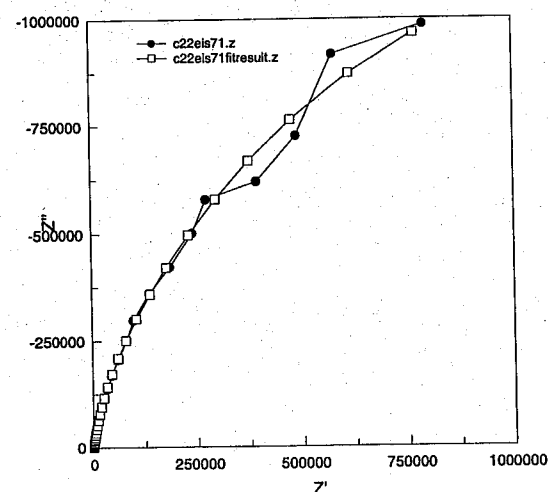
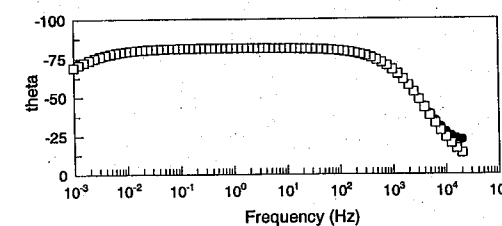
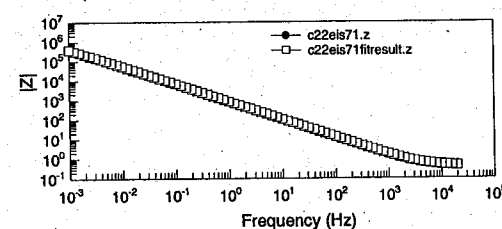
Recorded by

B. K. Pat

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From Page No. _____

Data Test #71



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.4173	0.0040907	0.98028
Rox porous	Free(+)	1.6539E5	62047	37.516
CPEporous-T	Free(+)	0.00080609	0.00011292	14.008
CPEporous-P	Free(+)	0.89773	0.0084436	0.94055
Rox barrier	Free(+)	2.5381E6	1.1272E5	4.4411
CPE barrier-T	Free(+)	0.00032096	3.8393E-5	11.962
CPE barrier-P	Free(+)	0.90673	0.00964	1.0632

Chi-Squared: 0.002163
Weighted Sum of Squares: 0.33527

Data File: D:\corrosion tests\valley c-22\impedance\c22eis71.z
Circuit Model File: D:\corrosion tests\valley c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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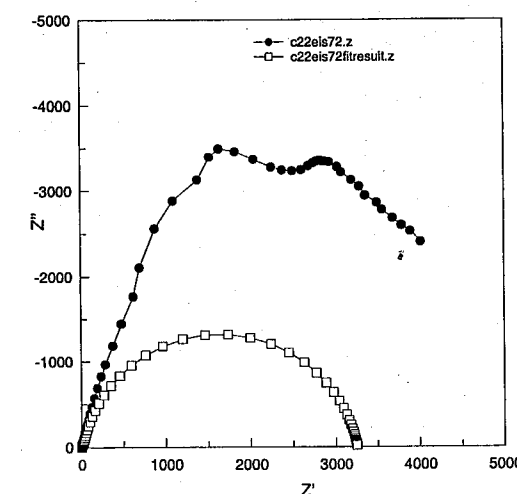
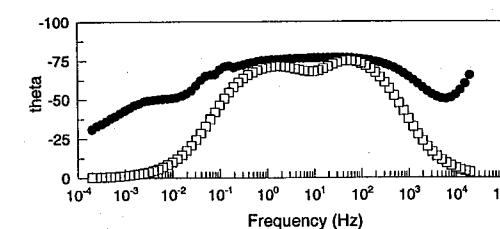
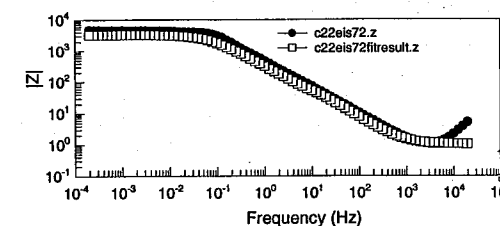
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Recorded by _____

12/11/02

From Page No. _____

Data Test #72



Element	Freedom	Value	Error	Error %
Rs	Free(+)	1.031	0.25113	24.358
Rox porous	Free(+)	12.65	34.286	271.04
CPEporous-T	Free(+)	0.00058502	0.0020393	348.59
CPEporous-P	Free(+)	1.08	0.6319	58.509
Rox barrier	Free(+)	3242	449.68	13.87
CPE barrier-T	Free(+)	0.00063875	5.8213E-5	9.1136
CPE barrier-P	Free(+)	0.86947	0.06496	7.4712

Chi-Squared: 1.1835
Weighted Sum of Squares: 183.45

Data File: D:\corrosion tests\valley c-22\impedance\c22eis72.z
Circuit Model File: D:\corrosion tests\valley c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

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Invented by _____

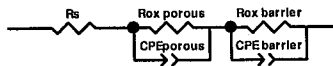
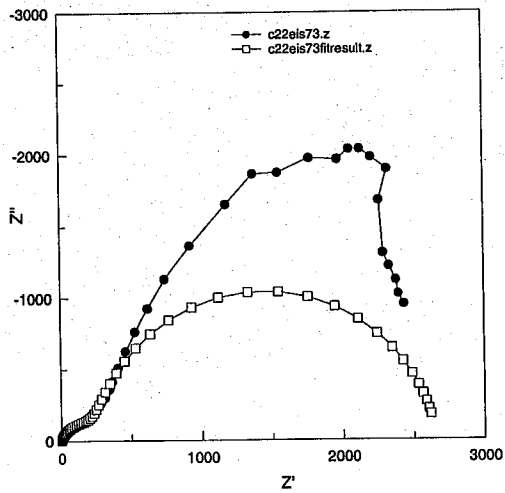
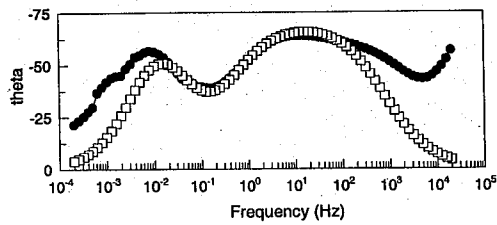
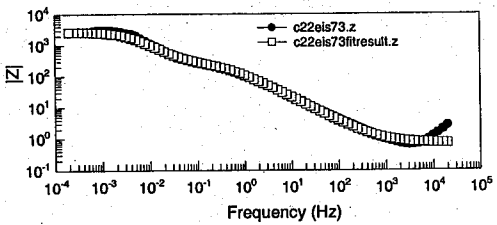
Date _____

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12/11/02

From Page No. _____

Data Test #73



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.69902	0.10565	15.114
Rox porous	Free(+)	236.9	51	21.528
CPEporous-T	Free(+)	0.0020453	0.00034775	17.002
CPEporous-P	Free(+)	0.77674	0.031108	4.0049
Rox barrier	Free(+)	2424	421.31	17.381
CPE barrier-T	Free(+)	0.012731	0.0035111	27.579
CPE barrier-P	Free(+)	0.89982	0.075105	8.3467

Chi-Squared: 0.26842
Weighted Sum of Squares: 41.605

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis73.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me,

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Date

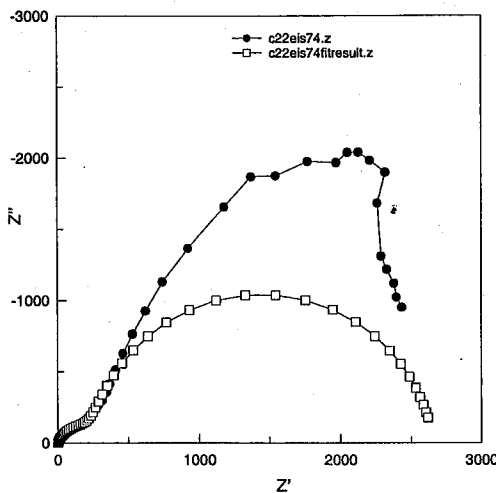
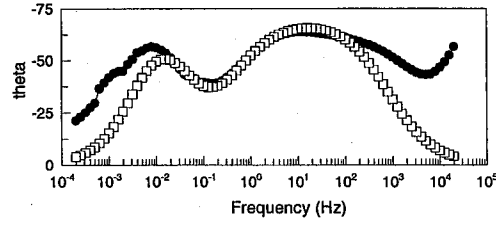
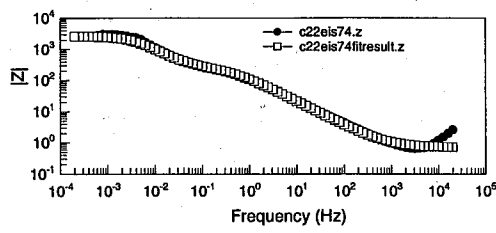
Recorded by

B. K. D.

12/11/02

From Page No. _____

Data Test #74



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.69902	0.10565	15.114
Rox porous	Free(+)	236.9	51	21.528
CPEporous-T	Free(+)	0.0020453	0.00034775	17.002
CPEporous-P	Free(+)	0.77674	0.031108	4.0049
Rox barrier	Free(+)	2424	421.31	17.381
CPE barrier-T	Free(+)	0.012731	0.0035111	27.579
CPE barrier-P	Free(+)	0.89982	0.075105	8.3467

Chi-Squared: 0.26842
Weighted Sum of Squares: 41.605

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis74.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

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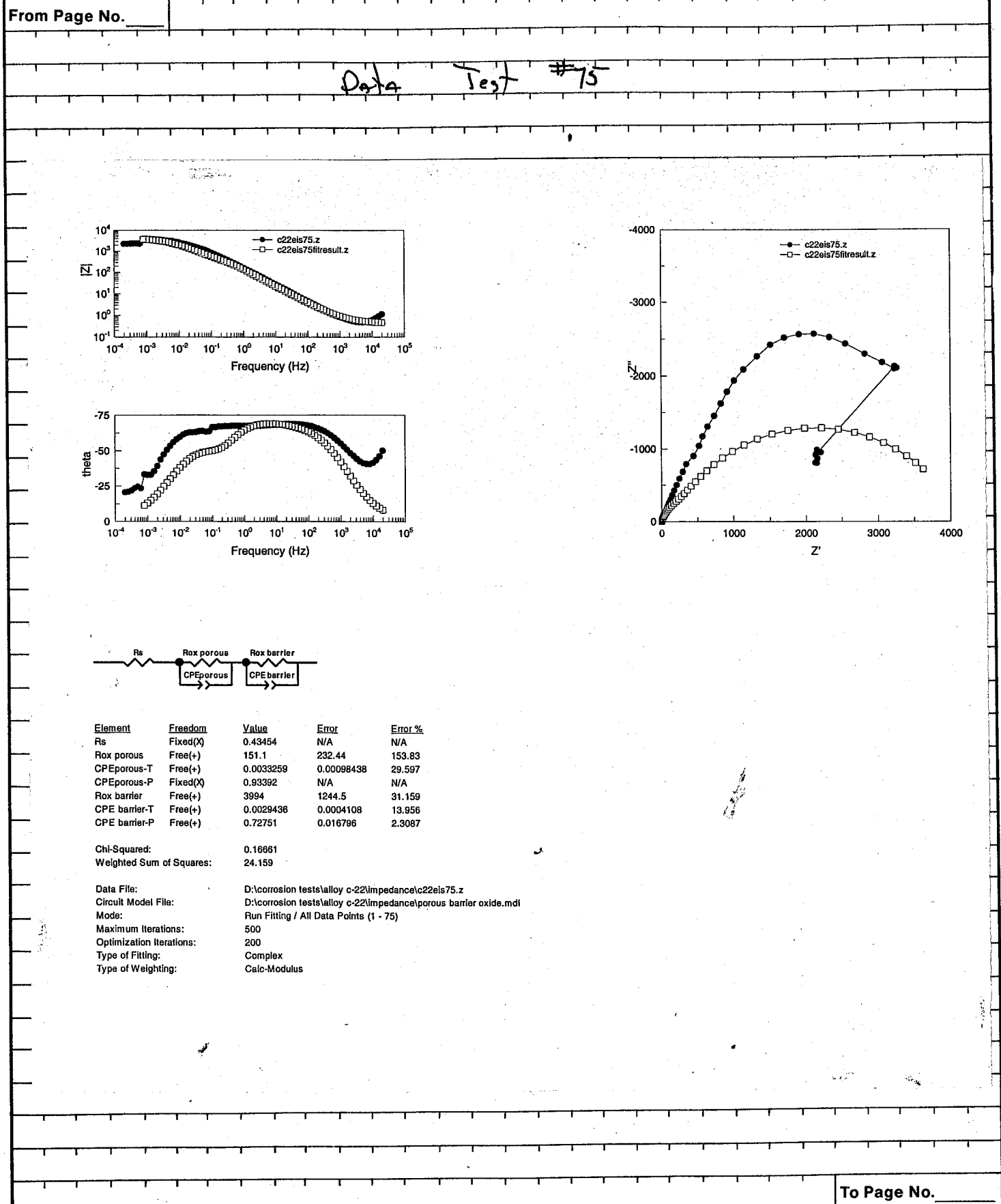
Invented by

Date

Recorded by

B. K. D.

12/11/02



Witnessed & Understood by me,

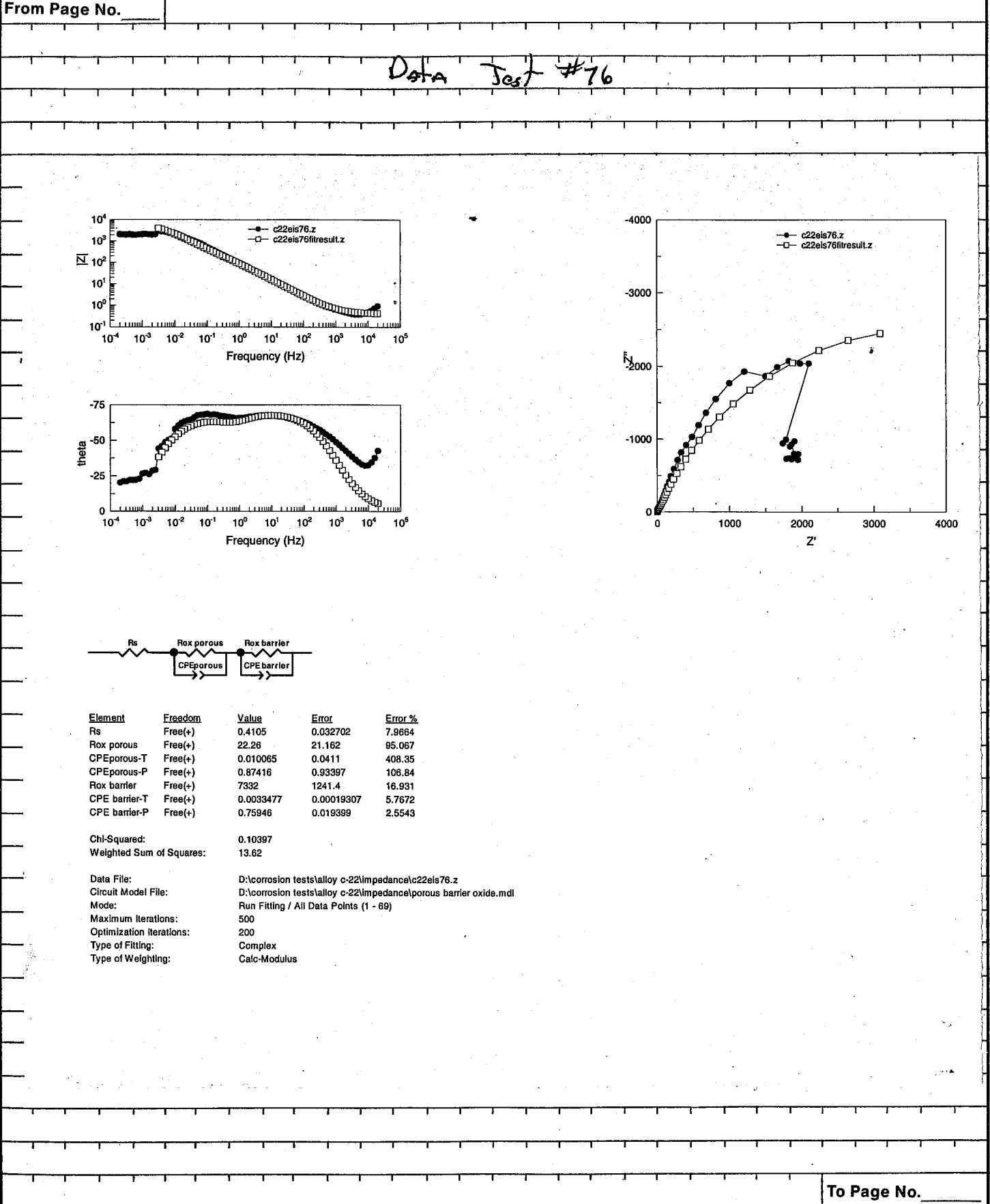
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Date

Recorded by

12/11/02



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Date

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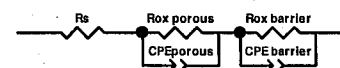
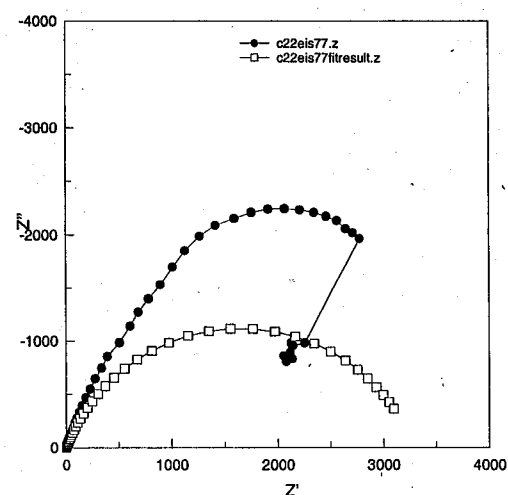
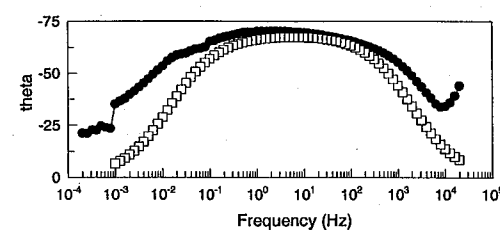
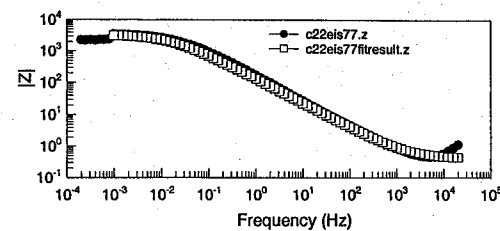
Date

Recorded by

12/11/02

From Page No. _____

Data Test #77



Element	Freedom	Value	Error	Error %
Rs	Fixed(X)	0.4105	N/A	N/A
Rox porous	Free(+)	20.34	288.81	1419.9
CPEporous-T	Free(+)	0.068621	N/A	N/A
CPEporous-P	Fixed(X)	0.82	N/A	N/A
Rox barrier	Free(+)	3271	543.09	16.603
CPE barrier-T	Free(+)	0.0019111	0.00014144	7.401
CPE barrier-P	Free(+)	0.76022	0.01446	1.9021

Chi-Squared: 0.18034
Weighted Sum of Squares: 25.97

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis77.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 74)
Maximum iterations: 500
Optimization iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

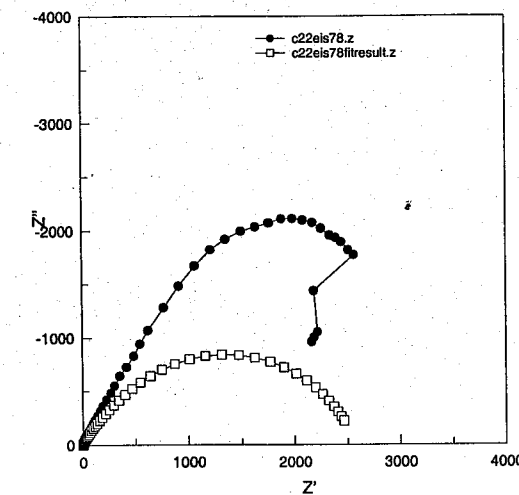
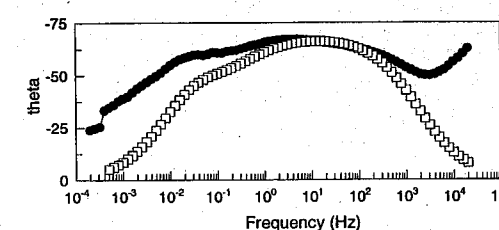
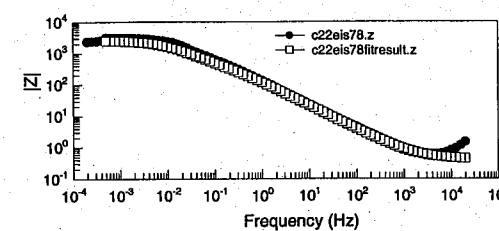
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B. D. J.

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From Page No. _____

Data Test #78



Element	Freedom	Value	Error	Error %
Rs	Fixed(X)	0.41176	N/A	N/A
Rox porous	Fixed(X)	169.5	N/A	N/A
CPEporous-T	Fixed(X)	0.0043983	N/A	N/A
CPEporous-P	Free(+)	0.75577	0.015002	1.985
Rox barrier	Free(+)	2404	371.37	15.448
CPE barrier-T	Free(+)	0.0036689	0.00031586	8.6091
CPE barrier-P	Free(+)	0.76694	0.03705	4.8309

Chi-Squared: 0.34118
Weighted Sum of Squares: 51.177

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis78.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 77)
Maximum iterations: 500
Optimization iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

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Date _____

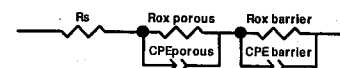
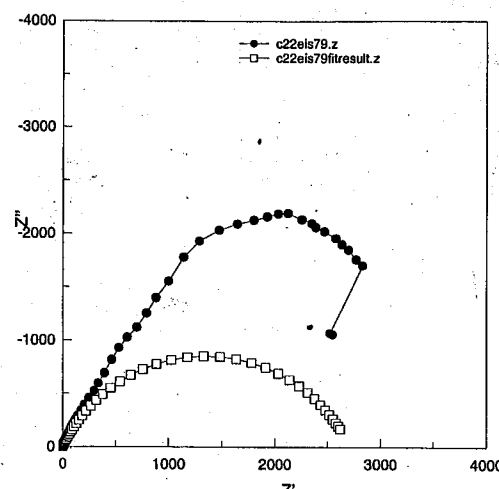
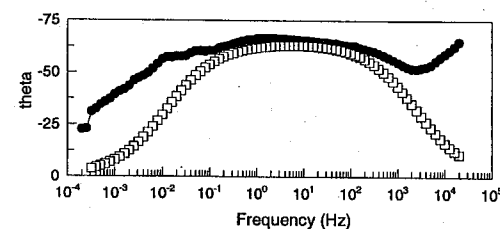
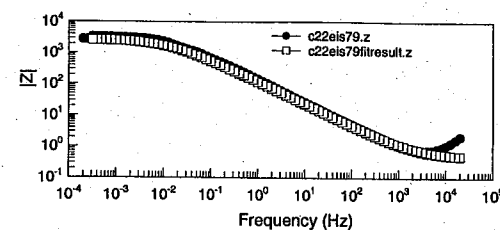
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B. D. J.

12/11/02

From Page No. _____

Data Test #79



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.38722	0.1041	26.884
Rox porous	Fixed(X)	0.051584	N/A	N/A
CPEporous-T	Fixed(X)	1.9217E-5	N/A	N/A
CPEporous-P	Fixed(X)	0.9	N/A	N/A
Rox barrier	Free(+)	2715	413.16	15.218
CPE barrier-T	Free(+)	0.0023099	0.00013326	5.7691
CPE barrier-P	Free(+)	0.71279	0.013685	1.9199

Chi-Squared: 0.30811
Weighted Sum of Squares: 47.449

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis79.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 79)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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Date _____

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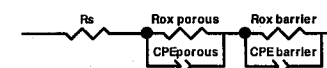
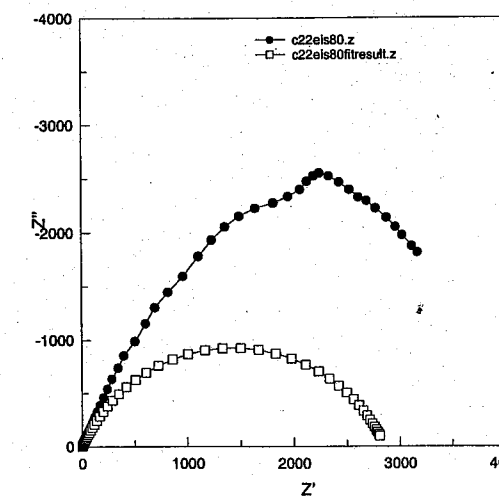
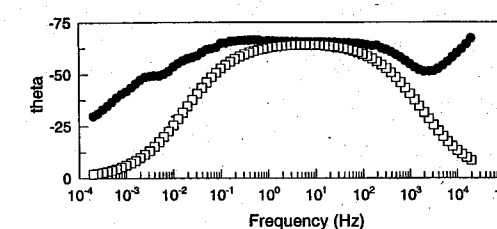
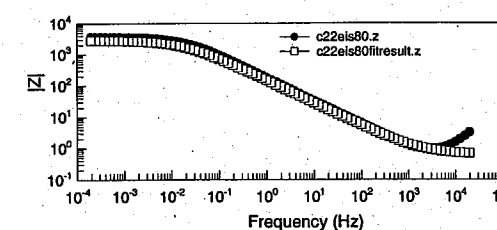
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12/11/02

From Page No. _____

Data Test #80



Element	Freedom	Value	Error	Error %
Rs	Fixed(X)	0.59002	N/A	N/A
Rox porous	Free(+)	0.035468	0.19011	536
CPEporous-T	Free(+)	2.8623E-5	1.2376E-5	43.238
CPEporous-P	Fixed(X)	0.9	N/A	N/A
Rox barrier	Free(+)	2856	386.66	13.539
CPE barrier-T	Free(+)	0.0017502	0.00011089	6.3358
CPE barrier-P	Free(+)	0.73007	0.015965	2.1868

Chi-Squared: 0.37832
Weighted Sum of Squares: 59.397

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis80.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

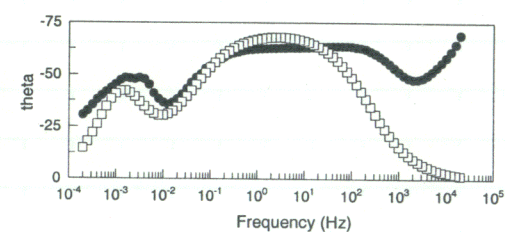
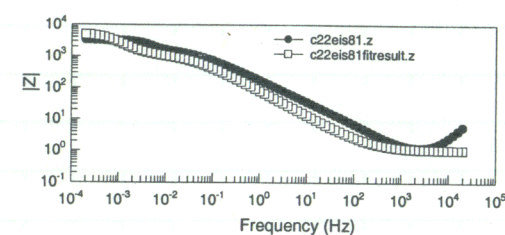
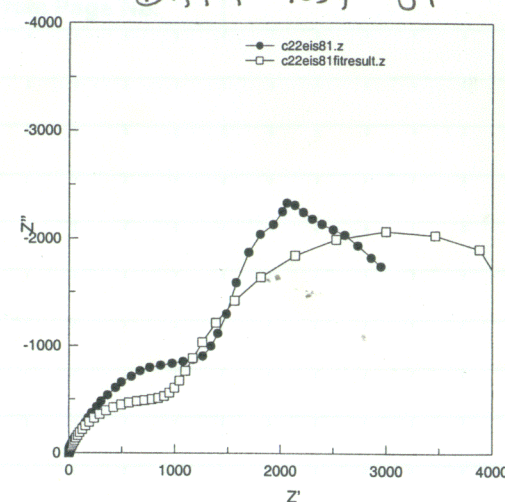
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Data Test #81

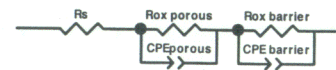
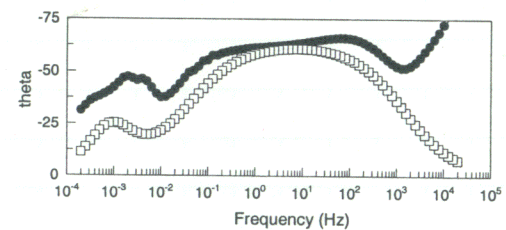
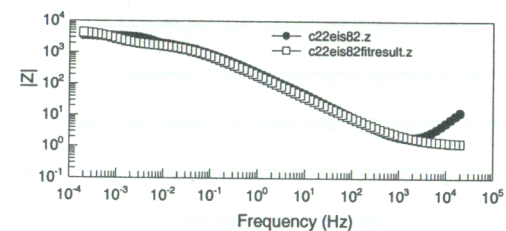
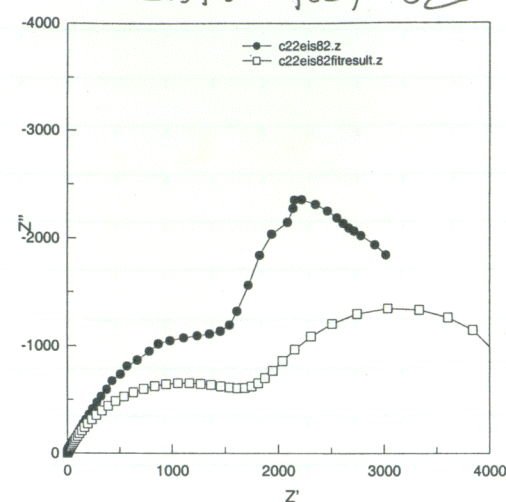


Element	Freedom	Value	Error	Error %
R_s	Fixed(X)	1.044	N/A	N/A
Rox porous	Fixed(X)	1106	N/A	N/A
CPEporous-T	Fixed(X)	0.0031003	N/A	N/A
CPEporous-P	Fixed(X)	0.78476	N/A	N/A
Rox barrier	Fixed(X)	4041	N/A	N/A
CPE barrier-T	Free(+)	0.066121	0.11105	167.95
CPE barrier-P	Fixed(X)	1	N/A	N/A

Chi-Squared: 3.5606
Weighted Sum of Squares: 573.25

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis81.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

Data Test #82



Element	Freedom	Value	Error	Error %
R_s	Fixed(X)	1.171	N/A	N/A
Rox porous	Free(+)	1993	120.69	6.0557
CPEporous-T	Fixed(X)	0.0014313	N/A	N/A
CPEporous-P	Fixed(X)	0.7	N/A	N/A
Rox barrier	Fixed(X)	2500	N/A	N/A
CPE barrier-T	Fixed(X)	0.11391	N/A	N/A
CPE barrier-P	Fixed(X)	1	N/A	N/A

Chi-Squared: 4.3769
Weighted Sum of Squares: 704.68

Data File: D:\corrosion tests\alloy c-22\impedance\c22eis82.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Recorded by _____

Date _____

12/11/02

From Page No. _____

See pg # 28 for Solution In Test cell
6.0M $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ Impedance Testing



Picture of Test cell After Completion of Test # 69-82

To Page No. _____

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Date _____

Invented by _____

Recorded by _____

Date _____

12/11/02

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Plate And C-22 Crevice Specimen Thermally Aged
At 870°C for 5 min with 2 PTFE Crevice Washers Attached At 50 In-Oz Using
No Specimen Weight Taken on Plate

Solution: 4.0 M NaCl
467.56g NaCl Lot #025149
+ DI water To 2000mls

pH Start: 6.982 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03

pH Adjusted To 3.049 with 480µl of 20% HCl Solution Lot #002564
pH probe # 13-620-296 SN#1160208

pH End:

* Note: Made a Documentation Mistake
And Couldn't Place All Information Needed
For Thermally Aged Specimen

See pg #45

B. K. [Signature]
11/11/02

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

B. K. [Signature]

11/11/02

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimens: C-22 Alloy Crevice Specimen Thermally Aged for 5 min @ 870°C
(See NB#485) with 2 PTFE Crevice Washers Attached At 50 In-Oz
Using Photo 6104 SN#139072 cal 8/28/02 due 2/28/03
And A C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt: 39.21652g Santarions Genius SN#12809699 cal 6/4/02 due 12/4/02
End wt: 39.21011g

Solution: 4.0 M NaCl * Note Solution was spiked
467.56g NaCl Lot #025149 with 250µl of NaOCl
+ DI water To 2000mls 4-6% Lot #0124499

pH Start: 6.982 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03

pH probe # 13-620-296 SN#1160208

pH Adjusted To 3.049 with 480µl of 20% HCl Solution Lot #002564

pH End: 3.556

Potential: EG + G Versatrol SN#20104

Counter Electrode = PT Flag for OC Reading Only

Reference: Fisher 13-620-52 SN#0249090

Temperature: 95°C Hg Thermometer SN#096-833 cal 7/9/02 due 1/9/03

Solution Bubbles with Zero Air - Also bubbles in Vapor phase of Cell

Crevice Specimen Plate
Ecorr = +378 mV Ecorr = +518 mV Keithley 614 SN#0704936
Ept = +878 mV Ept = +878 mV cal 5/26/02 due 5/26/03

* Specimen Examination: No Crevice Corrosion m.h. staining on Surfaces

* Graphs on Pg # 46-47 data NaOCl+2

To Page No. _____

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Date

Invented by

Date

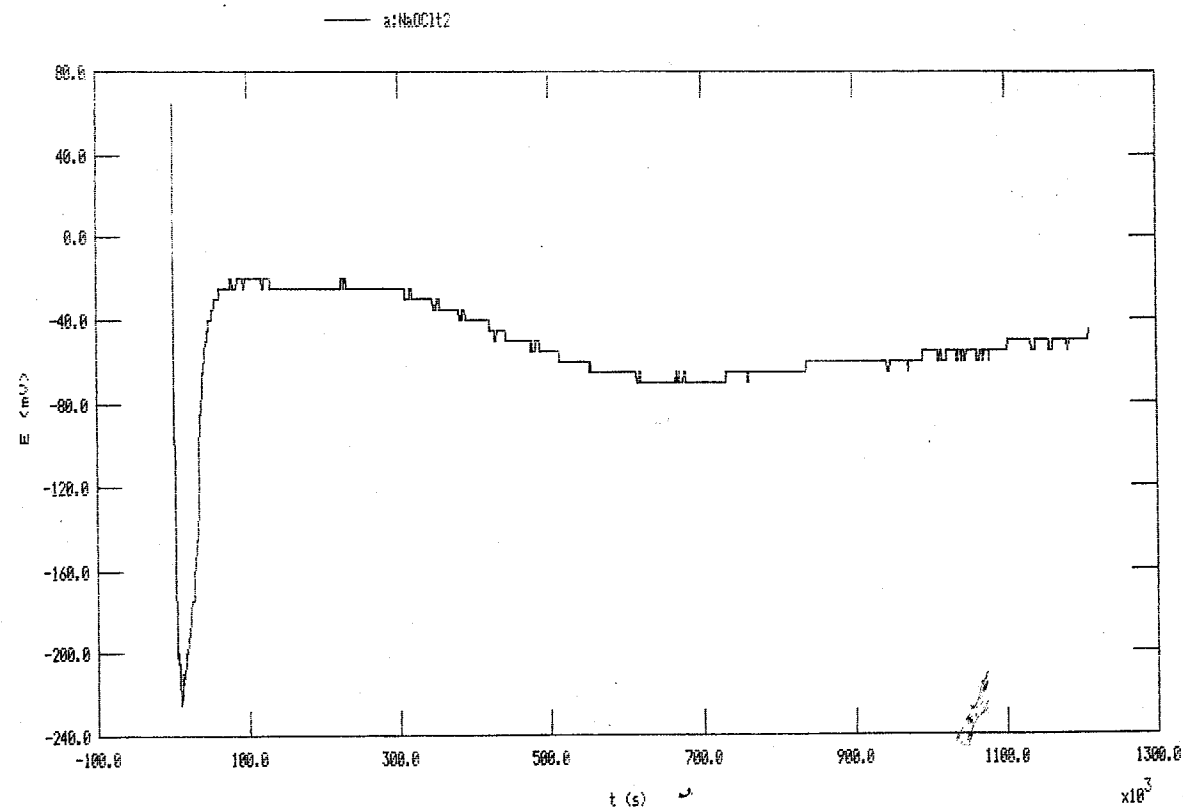
Recorded by

B. K. [Signature]

11/11/02

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-22-02 Time Run: 10:55:32
 TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.690E+00 AU NO OC 0.379



To Page No. _____

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Date _____

Invented by _____

Date _____

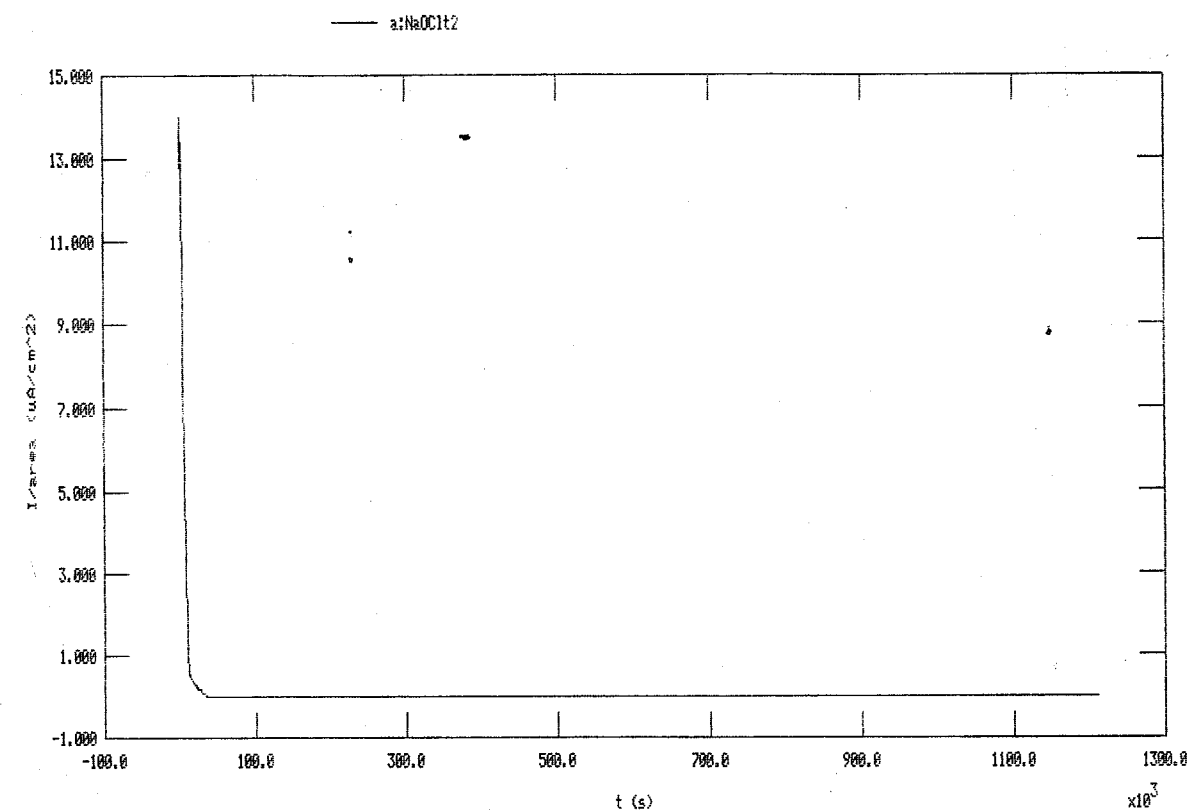
Recorded by _____

11/11/02

TITLE _____

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-22-02 Time Run: 10:55:32
 TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.690E+00 AU NO OC 0.379



Model 352/252 Corrosion Analysis Software, v. 2.30
 Filename: a:NaOClt2
 Pstat: VStat[] Ver 2
 GC GALVANIC CORROSION
 Date Run: 06-22-02

File Status: NORMAL
 Time Run: 10:55:32

Time/Pt.	TP	672.2	s	Time Step 1	T1	1.210E6	s
No. of Points	NP	1800		Curr. Range	CR	Auto	
				Stop On	SO	Pass	

Line Sync.	LS	no	Filter	FL	Off
Rise Time	RT	high stability	Ref. Elec.	RE	SCE 241.5E-3V
Working Elec.	WE	Solid	Equiv. Wt.	EW	26.04 g
Sample Area	AR	15.00 cm²	AUX A/D	AU	no
Density	DE	8.690 g/ml			
Open Circuit	OC	379.0E-3 V			

To Page No. _____

Witnessed & Understood by me, _____

Date _____

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Date _____

Recorded by _____

11/11/02

From Page No. C 22 L 13 R

Specimen: C-22 WGLPCD
 Start wt: 39.49254g Santaricus Genius SN# 12809099 Cal 6/4/02 Due 12/4/02
 End wt: 39.50491g
 with 2 PTFE Crevice Washers Attached At 50 In-O₂ Using
 Paulo 6104 SN# 139072 Cal 8/28/02 Due 2/28/03

Solution: 4 M Cl⁻ + 0.208 M SO₄²⁻ + 0.162 M NO₃⁻
 0.105 M F⁻ + 1.4 M HCO₃⁻ Prepared As Follows

467.57g NaCl Lot# 020814

0.245g NaHCO₃ Lot# 923337A40 ml SO₄20 ml NO₃4 ml F⁻

Stock Solutions

Notebook #366 pg #145

Prepared 5/24/02

+ DI water To 2000 ml

pH Start = 7.415 Fisher Accumet 950 meter SN# 3340 Cal 8/7/02 Due 8/7/03
 pH End = 8.436 Fisher pH probe #13-620-296 SN# 1100208

Temperature: 95°C H_g Thermometer SN# H98-179 Cal 4/22/02 Due 4/22/03

Ecorr: see NB 528

Ept = pg #58

E Applica = +100 mV

Counter Electrode: PT Flag

Reference: Fisher 13-620-52 SN# 0066110

Test started = 11.11.02 @ 10:00 am

Computer shut down 11.25.02 @ 10:27 pm Restart New File C22L13S

Test stopped 1/14/03 @ 2:30 pm

Specimen Examination: No Crevice Corrosion - cleaned specimen
 for further testing

* Note Changes Frit In Lugia Probe Same Solution As Previous Test

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

11/11/02

From Page No. C 22 L 12 S

Specimen: C-22 WGLPCD
 Base Metal 2271-S-3235 Filler = X410430611
 Start wt: 39.40726g Santaricus Genius SN# 12809099 Cal 6/4/02 Due 12/4/02
 End wt: 39.38733g
 with 2 PTFE Crevice Washer Attached At 50 In-O₂ Using
 Paulo 6104 SN# 139072 Cal 8/28/02 Due 2/28/03

Solution: 4 M Cl⁻ + 1.4 M HCO₃⁻ + 0.208 M SO₄²⁻
 0.162 M NO₃⁻ + 0.105 M F⁻ - Prepared As Follows

467.57g NaCl Lot# 020814

0.244g NaHCO₃ Lot# 923337A40 ml SO₄20 ml NO₃4 ml F⁻

Stock Solutions

Notebook #366 pg #145

Prepared 5/24/02

+ DI water To 2000 ml

pH Start = 7.485 Fisher Accumet 950 meter SN# 3340 Cal 8/7/02 Due 8/7/03
 pH End = 8.624 Fisher pH probe #13-620-52 SN# 1100208

Temperature: 95°C H_g Thermometer SN# H96-1090 Cal 7/9/02 Due 7/9/03

Ecorr: see NB 528

Ept = pg #59

E Applica = +150 mV

Counter Electrode: PT Flag

Reference: Fisher 13-620-52 SN# 9756671

Test started = 11.11.02 @ 10:00 am

Computer shut down 11.25.02 @ 10:27 pm Restart New File C22L12S

Test stopped 1/14/03 @ 2:30 pm

Specimen Examination: crevice corrosion on 3/24 feet of crevice washer
 mild staining on specimen

* Note Changes Frit In Lugia Probe Same Solution As Previous Test

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

11/11/02

From Page No. C22L14P
 Specimen: C-22 2277-8-3175
 Start wt = 39.16720 g Santorous Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt = 39.16497 g
 with 2 PTFE Crevice Washer Attaches At 50 In-Oz Using
 Photo 6104 SN#139072 cal 8/28/02 due 2/28/03

Solution: 4 M Cl^- + 1.4 mM HCO_3^- + 0.208 mM SO_4^{2-}
 0.162 mM NO_3^- + 0.105 mM F^- - Prepared As Follows

467.57g NaCl Lot # 020514
 0.245g NaHCO_3 Lot # 923337A
 40 mLs SO_4 } Stock Solutions
 20 mLs NO_3 } Notebook #366 pg #145
 4 mLs F^- } prepared 5/24/02
 + DI water To 2000 mL

Start pH = 7.476 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03
 End pH = 8.608 Fisher pH probe #13-620-296 SN#1100208

Temperature: 95°C Hg Thermometer SN#C96-637 cal 7/9/02 due 1/9/03
 Econ: } See NB 528
 Ept: } Pg #60
 E Applies = +250 mV

Counter Electrode: Pt Flay
 Reference: Fisher 13-620-52 SN#006128

Test Started: 11-11-02 @ 10:00 am
 Computer shutdown 11-25-02 @ 10:27 pm Restart New File C22L14Q
 Test stopped 1/14/03 @ 2:30 pm

Specimen Examination: Crevice Corrosion on 1/24 feet of crevice washer
 mild staining on specimen - will use new specimen for next test

* Note changes Test In Logging Probe Same Solution As Previous Test To Page No. _____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by B. K. J.	

From Page No. C22L3Ab
 Specimen: C-22 2277-8-3175
 Start wt = 47.21329 g Santorous Genius SN#12809099 cal 6/4/02 due 12/4/02
 End wt = 47.21709 g
 with 2 PTFE Crevice Washers Attaches At 50 In-Oz Using
 Photo 6104 SN#139072 cal 8/28/02 due 2/28/03

Solution: 4 M Cl^- + 1.4 mM HCO_3^- + 0.208 mM SO_4^{2-}
 0.162 mM NO_3^- + 0.105 mM F^- - Prepared As Follows

467.54g NaCl Lot # 020814
 0.246g NaHCO_3 Lot # 923337A
 40 mLs SO_4 } Stock Solution
 20 mLs NO_3 } Notebook #366 pg #145
 4 mLs F^- } prepared 5/24/02
 + DI water To 2000 mL

Start pH = 7.469 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03
 End pH = 8.564 Fisher pH probe #13-620-296 SN#1100208

Temperature: 95°C Hg Thermometer SN#C96-833 cal 7/9/02 due 1/9/03
 Econ: } See NB 528
 Ept: } Pg #61
 E Applies: Open Circuit

Solution Bubbles with Zero Air
 Reference: Fisher 13-620-52 SN#9250063

Test Started: 11-11-02 @ 10:00 am
 Computer shutdown 11-25-02 @ 10:27 pm Restart New File C22L3Ac
 Test stopped 1/14/03 @ 2:30 pm

Specimen Examination: No crevice corrosion; cleaned specimen for
 further testing

* Note changes Test In Logging Probe Same Solution As Previous Test To Page No. _____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by B. K. J.	

From Page No. _____ OC 825 CIA Y

Specimen: 825 HH 4371 FG

Start wt = 39.29836g Santorinus Genius SN#12509099 cal 6/4/02 due 12/4/02

End wt = 39.31685g

with 2 PTFE Crevice Washer Attached At 50 In-Oz Using

Proto 6104 SN#139072 cal 8/28/02 due 2/28/03

Solution: 0.028 M Cl^- + 1.4 mM HCO_3^- + 0.208 mM SO_4^{2-}
0.162 mM NO_3^- + 0.105 mM F^- - Prepared As Follows

3.300 g NaCl Lot# 020814
0.244 g $NaHCO_3$ Lot# 9733370
40 mls SO_4 } stock solution
20 mls NO_3 } Notebook #366 p#145
4 mls F^- } Prepared 5/24/02
+ DI water To 2000 mls

pH start = 8.292 Fisher Accumat 950 meter SN#3340 cal 8/7/02 due 8/7/03

pH End = 9.236 Fisher pH probe #13-620-296 SN#1100208

Temperature: 95°C H_g Thermometer SN#C96-377 cal 7/9/02 due 1/9/03

Expt: see NB #528

Ept = #62

E Applied = Open Circuit

Solution Bubbles with Zero Air

Reference: Fisher 13-620-51 SN#8027166

Test started: 11-11-02 @ 10:00 am

Computer shutdown 11-25-02 @ 10:07 pm Restart New File OC825CIAZ

Specimen Examination: No Crevice Corrosion - Cleaned Specimen for further Testing. Mild staining on Specimen * Cleaned specimen with HF slight buildup of material on stem of Specimen. Removed almost all of this material but note minor weight change. See Day 1/20/03

* Note Changes Felt In Cuyin Probe Same solution As Previous Test

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

11/11/02

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Crevice Specimen thermally Aged for 5 min @ 870°C (See NB #488) with 2 PTFE Crevice Washers Attached At 50 In-Oz Using Proto 6104 SN#139072 cal 8/28/02 due 2/28/03

Also A C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt = 39.19794g Santorinus Genius SN#12509099 cal 6/4/02 due 12/4/02

End wt = 39.18726g

Solution 4.0 M NaCl
467.59g NaCl Lot# 025145
+ DI water To 2000 mls

pH start = 6.436 Fisher Accumat 950 meter SN#3340 cal 8/7/02 due 8/7/03

pH End = 2.793 pH probe #13-620-296 SN#1100208

pH Adjusted To 2.922 with 500 µl of 20% HCl solution Lot# 002564

Potentiostat = EG & G Versastat SN#20104

Counter Electrode: Pt Flay for OC measurement only

Reference: Fisher 13-620-52 SN#0249091

Temperature: 95°C H_g Thermometer SN#C96-333 cal 7/9/02 due 1/9/03

Solution Bubbles with Zero Air - Also bubbles in Vapor phase of cell

Crevice Specimen Plate

Ecorr = +105 mV Ecorr = +592 mV Keithley 614 SN#0704936

Ept = +896 mV Ept = +896 mV cal 5/26/02 due 5/26/03

Added 500 µl NaOCl At Beginning of Test (4% - 6% NaOCl Lot# 0124499)

Specimen Examination: Crevice Corrosion on 1/24 feet of Crevice Washer - Mild staining

* Graph pg #54 *

* Graph pg #55 *

Data NaOCl+3 then Continued with Test Data NaOCl+4

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

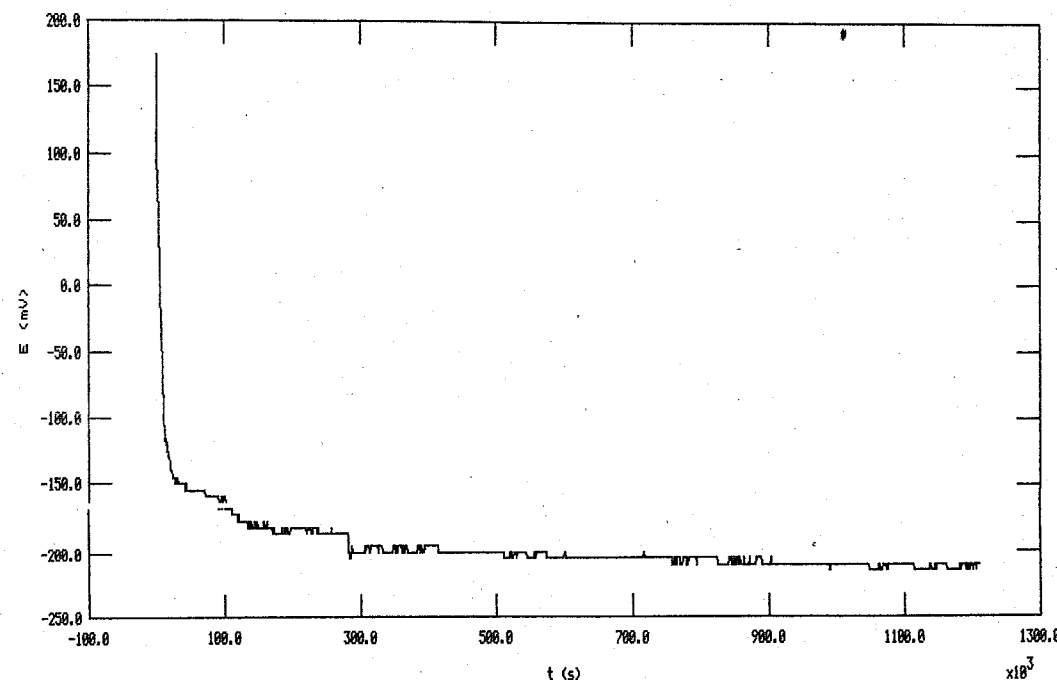
Date

Recorded by

11/25/02

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-25-02 Time Run: 15:07:24
 TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.698E+00 AU NO OC 0.282

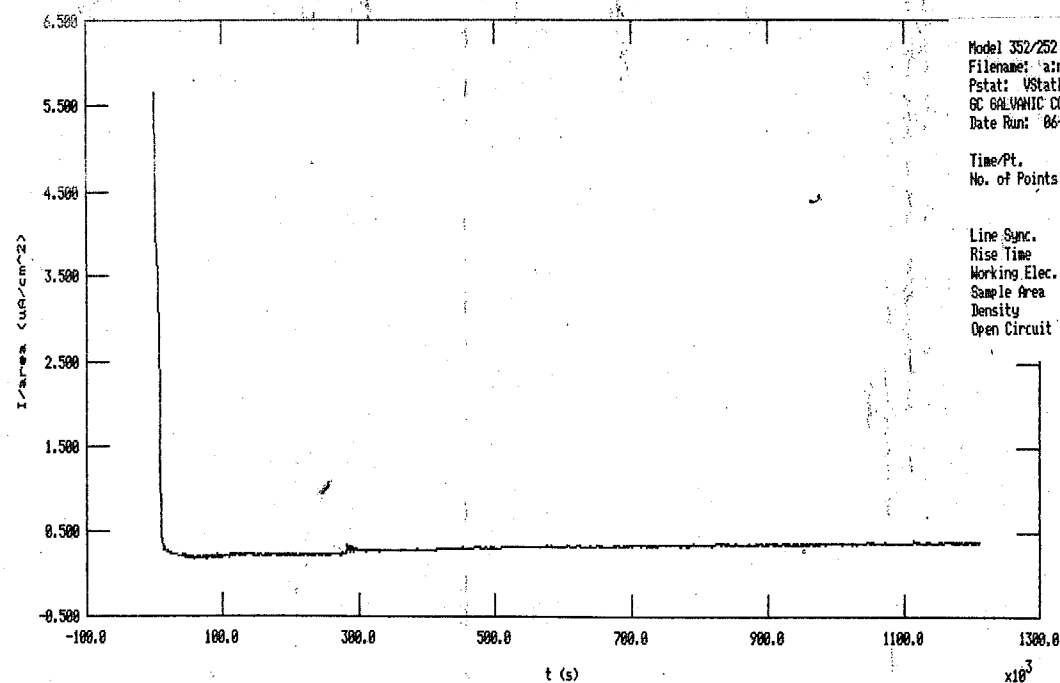
a:naoclt3



Test NaOCl+3

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-25-02 Time Run: 15:07:24
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 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.698E+00 AU NO OC 0.282

a:naoclt3



Model 352/252 Corrosion Analysis Software, v. 2.30
 Filename: a:naoclt4
 Pstat: VStat[] Ver 2 GC GALVANIC CORROSION
 Date Run: 06-26-02
 File Status: NORMAL
 Time Run: 15:38:24
 Time/Pt. TP 672.2 s Time Step 1 T1 1.210E6 s
 No. of Points NP 1800 Curr. Range CR Auto
 Stop On SO Pass
 Line Sync. LS no
 Rise Time RT high stability Filter FL Off
 Working Elec. WE Solid Ref. Elec. RE SCE 241.5E-3V
 Sample Area AR 15.00 cm^2 Equiv. Wt. EN 26.04 g
 Density DE 8.698 g/ml AUX A/D AU no
 Open Circuit OC -204.0E-3 V

To Page No. _____

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Date

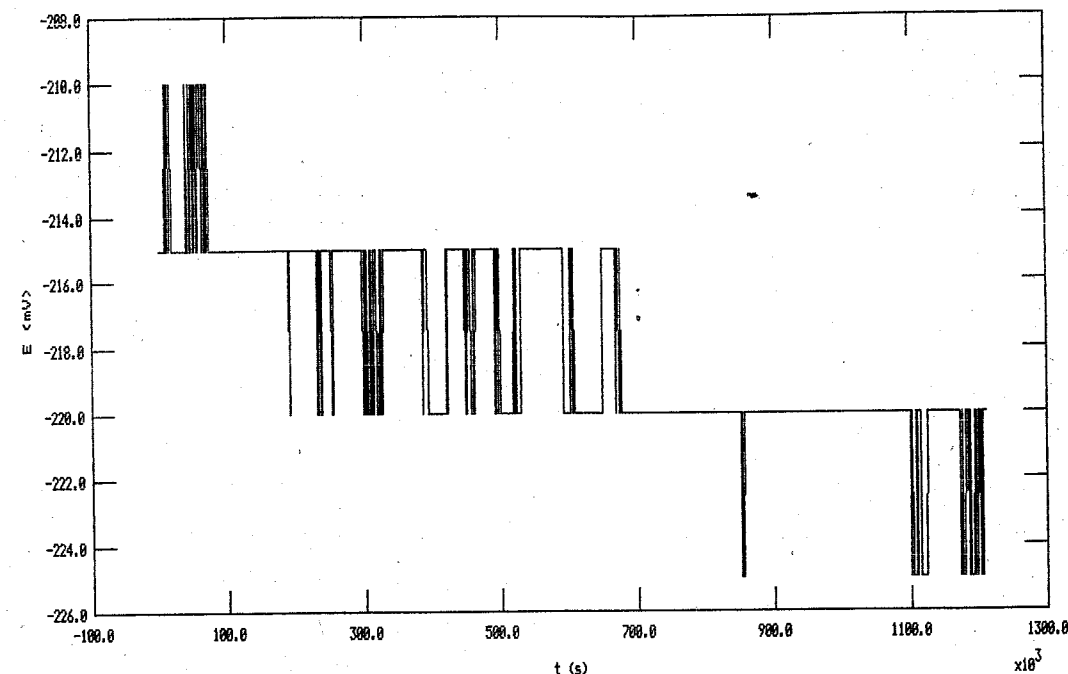
Recorded by

B. J. D.

12/11/02

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-26-02 Time Run: 15:38:24
 TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.698E+00 AU NO OC -0.204

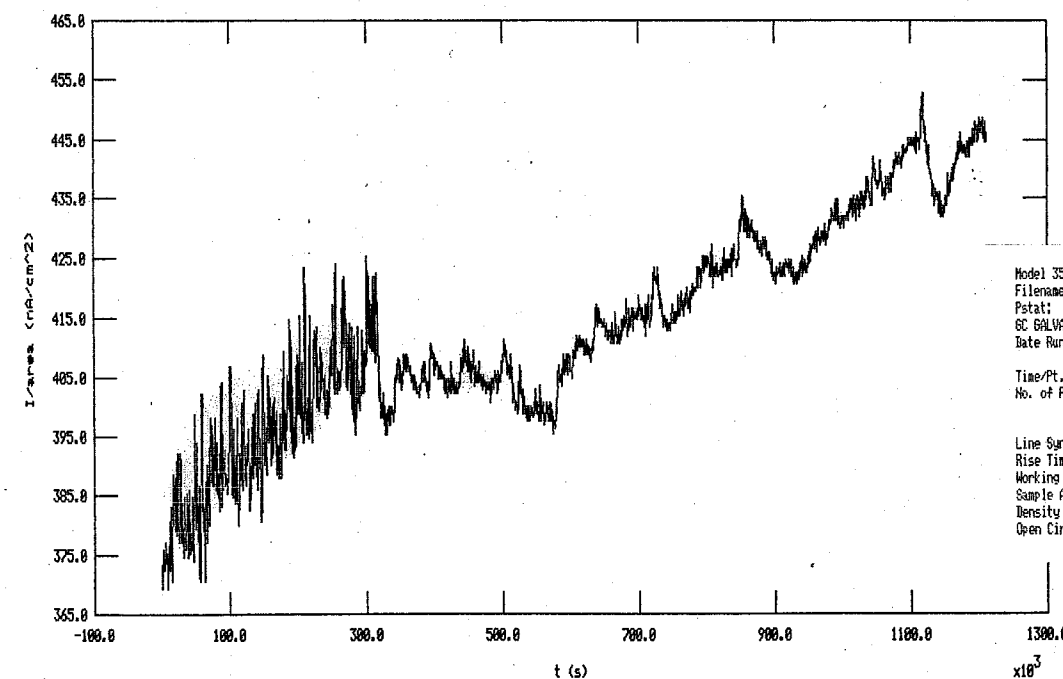
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Test NaOCl+4

Model 352/252 Corrosion Analysis Software, v. 2.30
 File Status: NORMAL Date Run: 06-26-02 Time Run: 15:38:24
 TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WK SOLID AR 1.500E+01 LS NO EN 2.604E+01
 DEN 8.698E+00 AU NO OC -0.204

a:naoclt4



Model 352/252 Corrosion Analysis Software, v. 2.30
 Filename: a:naoclt3
 Pstat: VStat[] Ver 2 GC GALVANIC CORROSION
 Date Run: 06-25-02
 File Status: NORMAL
 Time Run: 15:07:24
 Time/Pt. TP 672.2 s Time Step 1 T1 1.210E6 s
 No. of Points NP 1800 Curr. Range CR Auto
 Stop On SO Pass
 Line Sync. LS no
 Rise Time RT high stability Filter FL Off
 Working Elec. WE Solid Ref. Elec. RE SCE 241.5E-3V
 Sample Area AR 15.00 cm^2 Equiv. Wt. EN 26.04 g
 Density DE 8.698 g/ml AUX A/D AU no
 Open Circuit OC -204.0E-3 V

To Page No. _____

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12/11/02

From Page No. _____

Open Circuit Potential Measurement

Specimens: C-22 #4 + 625 + 825 cylinders - All specimens In Cell #1
C-22 #4 2277-8-3175 600 Grt Finish
start wt = 12.0648g Santorionic Genius sn# 12809099 cal 6/4/02 due 12/4/02
End wt = 12.11292g
625 600 Grt Finish
start wt = 12.16842g - Santorionic Genius sn# 12809099 cal 6/4/02 due 12/4/02
End wt = 12.18609g
825 600 Grt Finish
start wt = 11.54089g Santorionic Genius sn# 12809099 cal 6/4/02 due 12/4/02
End wt = 11.55514g

Solution: 4.0 M NaCl
467.56g NaCl lot# 025149
+ RT water to 2000mls

pH start = 7.138 Fisher Accuret 950 meter sn# 3340 cal 8/1/02 due 8/1/02
pH End = Not Taken pH probe # 13-620-296 sn# 1100208

Reference: Fisher 13-620-52 sn# 8205244
Counter Electrode: Pt Fly

Temperature: 95°C Hg Thermometer sn# F98-393 cal 7/9/02 due 1/9/03

Solution Bubbles with Zero Air

Specimen Examination:

C-22 #4 = No Sign of Corrosion - cleaned for further testing

625 = No Sign of Corrosion - cleaned for further testing

825 = No Sign of Corrosion - cleaned for further testing

Test started 11/20/02

Test Ended 2/3/03

Data Test 8 ASC-9 ASC-10 ASC To Page No. _____

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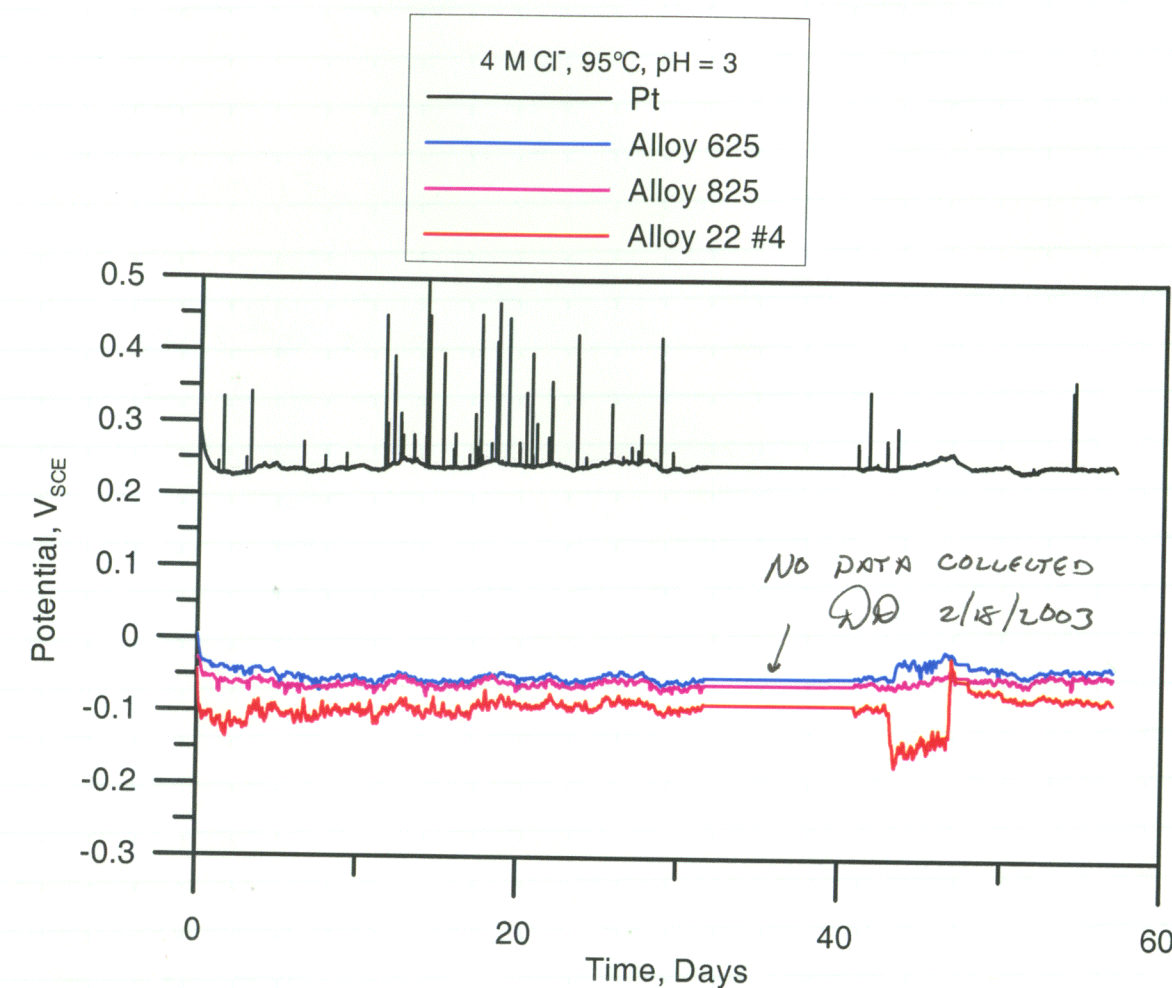
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From Page No. _____



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2/17/2003

David Dunn

From Page No. _____

Open Circuit Potential Measurements

Specimens: C-22 #1 + C-22 #2 + C-22 #3 cylindrical Specimens Cell #2

C-22 #1 2277-8-3175 600 Gr. + Finish
start wt: 12.2791g Santarious Genius SW#12809099 cal 6/4/02 due 12/4/02
End wt: 12.2866g

C-22 #2 2277-8-3175 600 Gr. + Finish
start wt: 12.4315g Santarious Genius SW#12809099 cal 6/4/02 due 12/4/02
End wt: 12.4743g

C-22 #3 2277-8-3175 600 Gr. + Finish
start wt: 12.4775g Santarious Genius SW#12809099 cal 6/4/02 due 12/4/02
End wt: 12.4814g

Solution: 4.0 M NaCl
467.61g NaCl Lot # 025149
+ DI water To 2000mls

pH start: 7.219 Fisher Accuret 950 meter SW#3340 cal 8/7/02 due 8/7/03
pH End: Not Taken pH probe # 13-620-296 SW#1100208

Reference: Fisher 13-620-52 SW#0042119
Counter Electrode: Pt Flag

Temperature: 95°C Hg Thermometer SW#1198-182 cal 5/10/02 due 5/10/03

Solution Bubbled with Zero Air

Specimen Examination

C-22 #1: No Corrosion - Cleaned for further Testing

C-22 #2: No Sign of Corrosion - Cleaned for further Testing

C-22 #3: No Sign of Corrosion - Cleaned for further Testing

Test started > 11/20/02

Test Ended 2/3/03

Data: Test 8 ASC - 9 ASC - 10 ASC

To Page No. _____

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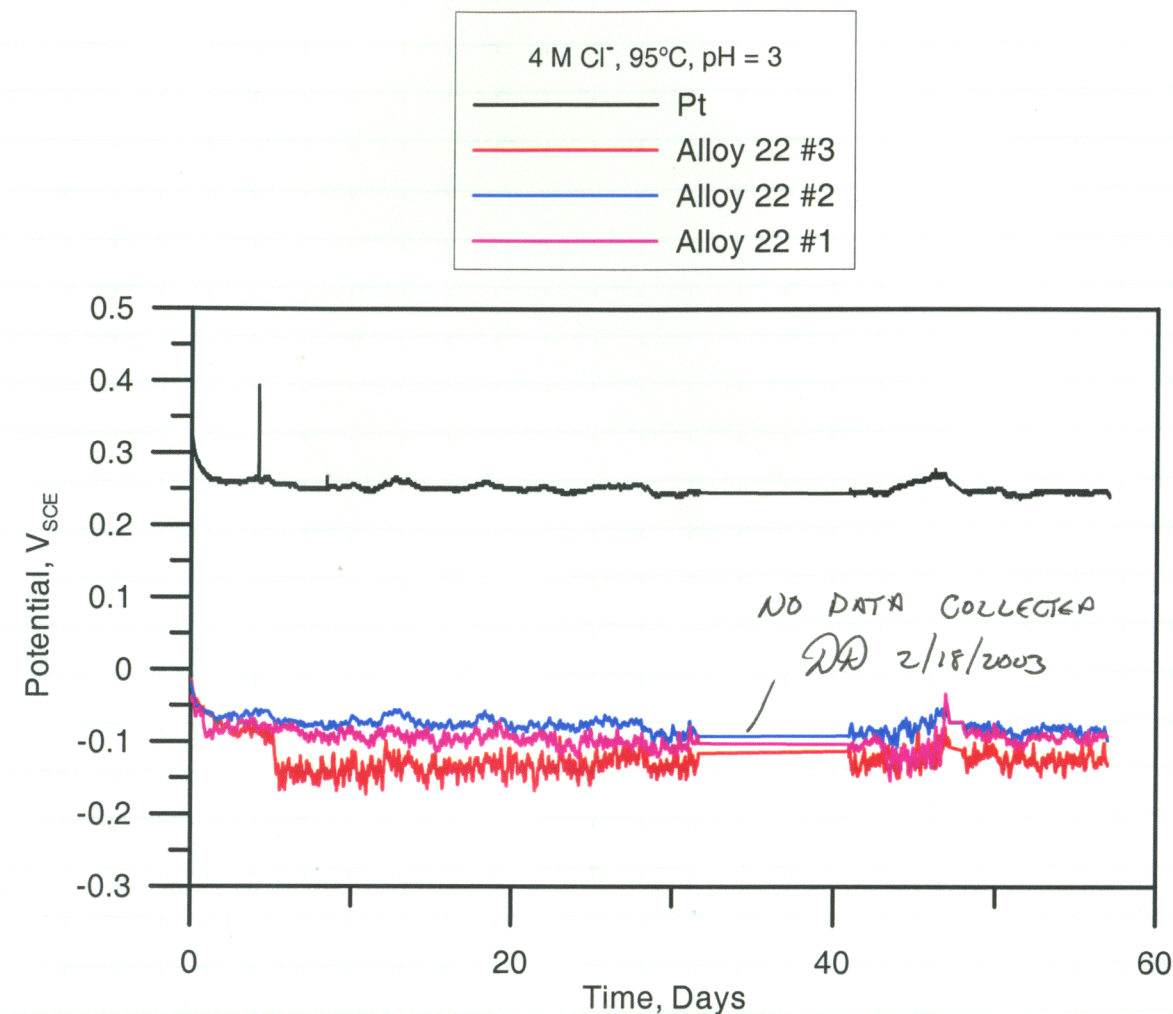
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11/25/02

B. J. J.

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From Page No. _____



To Page No. _____

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Date _____

Recorded by _____

2/17/2003

D. J. J.

From Page No. _____

Thermally Age C-22 Specimens

Used Linberg oven SN# 909172
Model # 51333Oven set point 870°C

Temperature Measurement Taken with

Thermocouple # 332 cal 7/15/02 due 1/15/03

Microprocessor Thermometer Omega SN# J-94140
cal 10/29/02
Due 4/29/03Oven set point
 870°C Meter Reading
 887°C Placed Specimen In Oven for 5 min @ 870°C set pointAll specimens Total Number of 2 were 600 Grit polished
prior to Thermal Age procedure and will be repolished
to A 600 Grit Finish prior to Testing

To Page No. _____

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12/13/02

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From Page No. _____

Electro Chemical Impedance Test for Alloy C-22

objective: Same As pg #3

Specimen: Alloy C-22 Cylinder heat 2277-8-3175
polished To A 600 Grit FinishStart wt = 12.29366g Santarus Genius SN# 12889099 cal 1/15/02 due 5/15/03
End wt = 12.29441gSolution: 2.0 M $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$
588.30g $\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$ lot # 972447
+ DI water To 2000 mlpH Start = 6.561 Fisher Accumet 950 meter SN# 3340 cal 8/7/02 due 8/7/03
pH End = 6.893 pH probe 13-620-296 SN# 1100202Cell Info Area = 8cm^2
Density = 8.69g/cm^3
Equivalent wt = 26.04

Impedance Analyzer = Solarton 1260

Counter Electrode: Pt Flag

Reference: Fisher 13-620-52 SN# 0052132

Temperature $25^{\circ}\text{C} - 95^{\circ}\text{C}$ then back down to 25°C Hg thermometer SN# H98-162
cal 4/22/02 due 4/22/03 $E_{\text{open}} = -228\text{mV}$ Keithley 614 SN# 6704936 cal 5/26/02 due 5/26/03
 $E_{\text{ref}} = +194\text{mV}$ Solution Bubbles with N_2 sparging Also In Vapor phase with O_2 TrapSpecimen Examination: No Signs of Corrosion on Specimen - Some Staining
on All Surfaces - Repolish for Next Test

To Page No. _____

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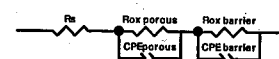
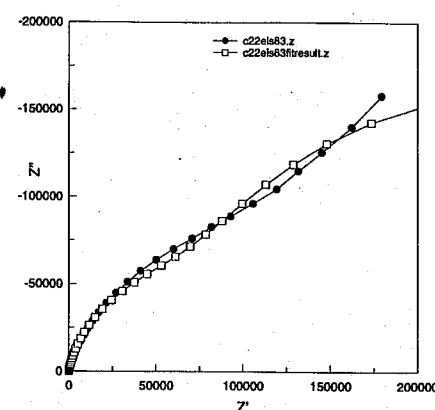
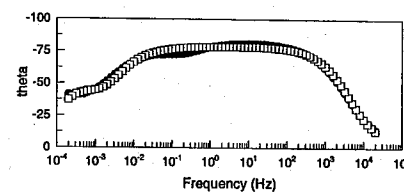
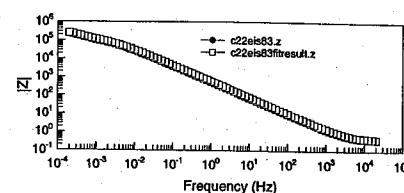
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12/16/02

B. J. D.

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.39151	0.0077795	1.9871
Rpx porous	Free(+)	72067	28538	40.987
CPEporous-T	Free(+)	0.00048051	0.00018707	38.932
CPEporous-P	Free(+)	0.87134	0.042861	4.9305
Rpx barrier	Free(+)	3.8709E5	1.0843E5	29.538
CPEbarrier-T	Free(+)	0.0013919	0.0013769	98.922
CPEbarrier-P	Free(+)	0.88048	0.1392	15.81

Chi-Squared: 0.0080789
Weighted Sum of Squares: 1.2522

Data File: D:\comsolon tests\alloy c-22\impedance\c22els83.z
Circuit Model File: D:\comsolon tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

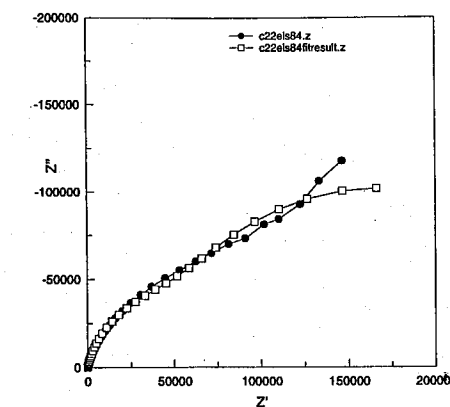
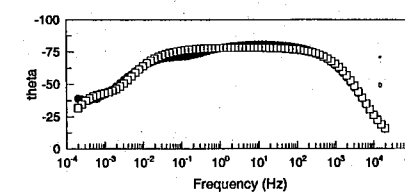
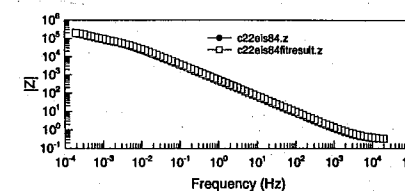
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Date _____

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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.30788	0.0066758	2.1676
Rpx porous	Free(+)	53308	20558	38.568
CPEporous-T	Free(+)	0.00053015	0.00018918	35.884
CPEporous-P	Free(+)	0.86804	0.040183	4.6292
Rpx barrier	Free(+)	2.3849E5	58738	24.629
CPEbarrier-T	Free(+)	0.0015228	0.0013081	85.912
CPEbarrier-P	Free(+)	0.87488	0.12218	13.988

Chi-Squared: 0.0083735
Weighted Sum of Squares: 1.2979

Data File: D:\comsolon tests\alloy c-22\impedance\c22els84.z
Circuit Model File: D:\comsolon tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

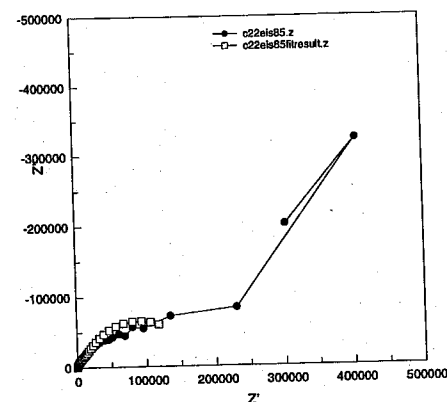
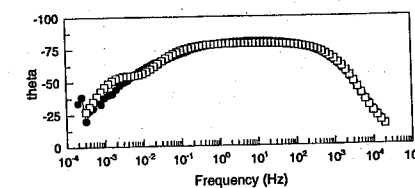
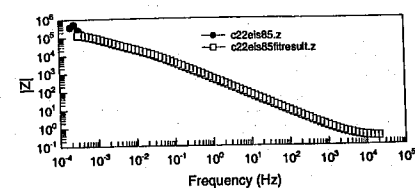
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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.26844	0.0094521	3.5211
Rox porous	Free(+)	12019	5244.6	43.636
CPEporous-T	Free(+)	0.00071102	0.00017957	25.255
CPEporous-P	Free(+)	0.89635	0.024575	2.7728
Rox barrier	Free(+)	1.5733E5	21136	13.434
CPE barrier-T	Free(+)	0.00093848	0.00038881	39.277
CPE barrier-P	Free(+)	0.87413	0.061118	6.9919

Chi-Squared: 0.020654
Weighted Sum of Squares: 3.1187

Data File: D:\corrosion tests\alloy c-22\impedance\c22als85.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / Selected Points (0 - 78)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

Witnessed & Understood by me, _____

Date _____

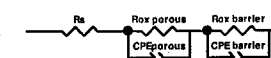
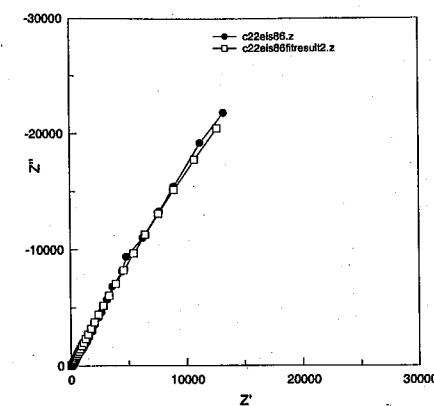
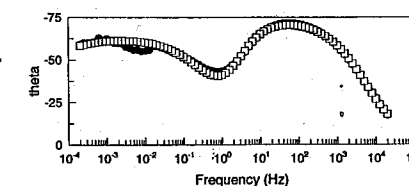
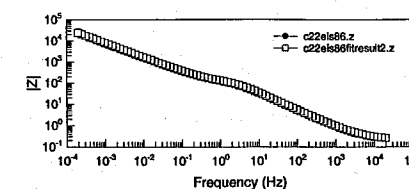
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Date _____

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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.2167	0.0029153	1.3453
Rox porous	Free(+)	84.37	1.594	1.8893
CPEporous-T	Free(+)	0.00098606	2.3977E-5	2.4819
CPEporous-P	Free(+)	0.90904	0.0041851	0.46039
Rox barrier	Free(+)	2.7007E5	53293	19.733
CPE barrier-T	Free(+)	0.0042659	2.48E-5	0.57687
CPE barrier-P	Fixed(X)	0.7	N/A	N/A

Chi-Squared: 0.0016355
Weighted Sum of Squares: 0.29633

Data File: D:\corrosion tests\alloy c-22\impedance\c22als86.z
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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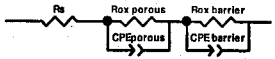
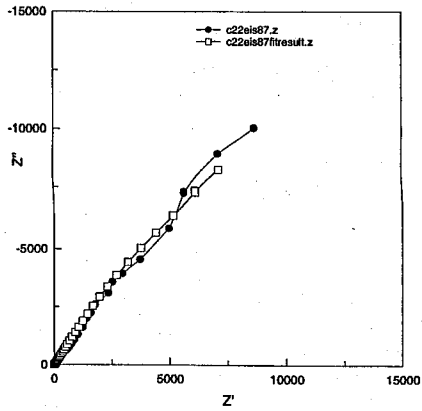
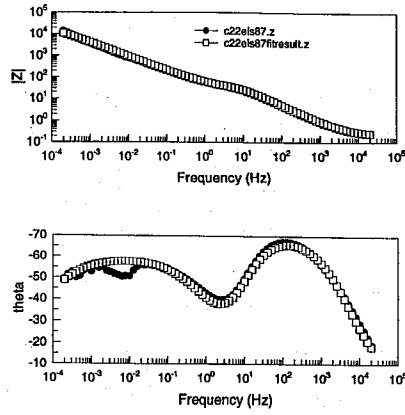
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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
R_s	Free(+)	0.20538	0.0060549	2.9481
R_{porous}	Free(+)	26.79	1.3634	5.0892
$CPE_{porous-T}$	Free(+)	0.0010985	7.7347E-5	7.0411
$CPE_{porous-P}$	Free(+)	0.87959	0.015858	1.8143
$R_{barrier}$	Free(+)	48390	31987	66.103
$CPE_{barrier-T}$	Free(+)	0.0069306	0.00010508	1.5182
$CPE_{barrier-P}$	Free(+)	0.68738	0.0044963	0.67372

Chi-Squared: 0.0055633
Weighted Sum of Squares: 0.86232

Data File: D:\comrosion tests\alloy c-22\impedance\c22e1s87.z
Circuit Model File: D:\comrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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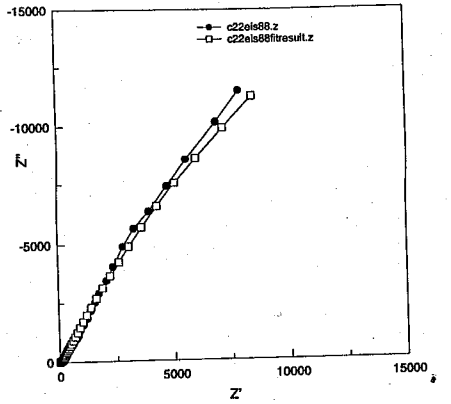
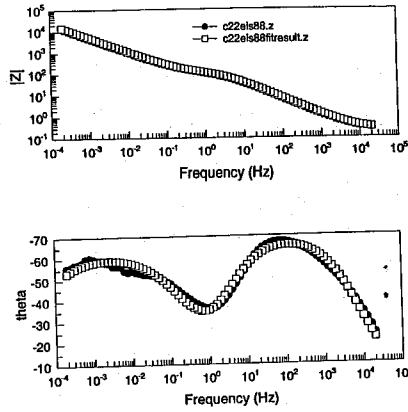
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Date _____

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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
R_s	Free(+)	0.23134	0.0050791	2.1855
R_{porous}	Free(+)	87.48	1.8403	2.1034
$CPE_{porous-T}$	Free(+)	0.0011298	3.1636E-5	2.8001
$CPE_{porous-P}$	Free(+)	0.80329	0.0041219	0.51313
$R_{barrier}$	Free(+)	82074	9396.2	11.448
$CPE_{barrier-T}$	Free(+)	0.0065086	5.2843E-5	0.8119
$CPE_{barrier-P}$	Fixed(0)	0.89	N/A	N/A

Chi-Squared: 0.0031107
Weighted Sum of Squares: 0.48526

Data File: D:\comrosion tests\alloy c-22\impedance\c22e1s88.z
Circuit Model File: D:\comrosion tests\alloy c-22\impedance\porous barrier oxide.mdl
Mode: Run Fitting / All Data Points (1 - 81)
Maximum Iterations: 500
Optimization Iterations: 200
Type of Fitting: Complex
Type of Weighting: Calc-Modulus

To Page No. _____

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Date _____

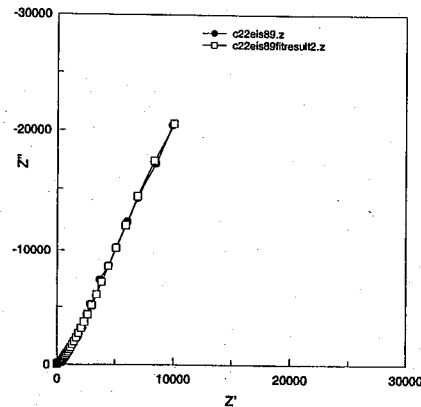
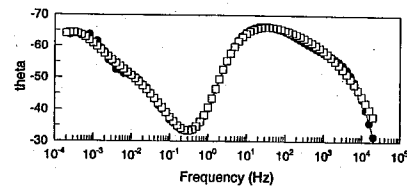
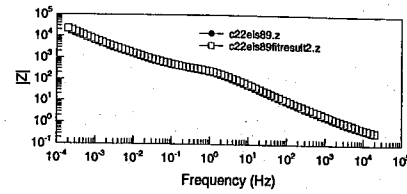
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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.15057	0.0050936	3.3829
Rox porous	Free(+)	2567	183.5	6.8804
CPEporous-T	Free(+)	0.0048567	8.4428E-5	1.7384
CPEporous-P	Free(+)	0.55528	0.0018646	0.31984
Rox mid	Free(+)	228.9	4.2999	1.8785
CPE mid-T	Free(+)	0.0006531	1.1591E-5	1.7422
CPE mid-P	Free(+)	0.87321	0.0050329	0.57537
Rox barrier	Free(+)	1.6907E5	18601	11.002
CPE barrier-T	Free(+)	0.013059	0.00017546	1.3436
CPE barrier-P	Fixed(0)	0.85	N/A	N/A
Chi-Squared: 0.00074589				
Weighted Sum of Squares: 0.11427				
Data File: D:\corrosion tests\alloy c-22\impedance\c22eis89.z				
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide 3 layer.mdl				
Mode: Run Fitting / All Data Points (1 - 81)				
Maximum Iterations: 500				
Optimization Iterations: 200				
Type of Fitting: Complex				
Type of Weighting: Calc-Modulus				

To Page No. _____

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Date _____

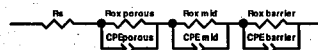
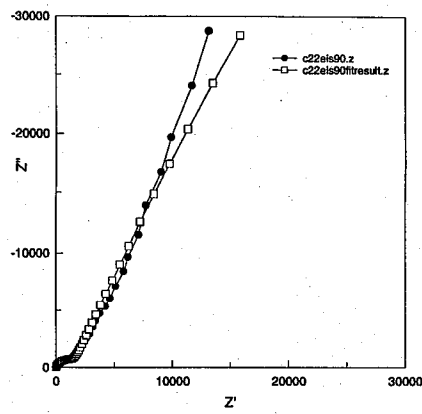
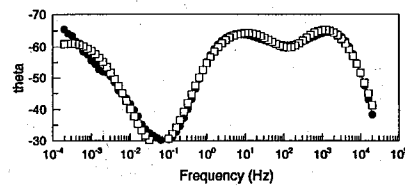
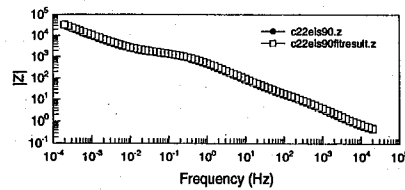
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1/24/03

From Page No. _____



Element	Freedom	Value	Error	Error %
Rs	Free(+)	0.26374	0.0085808	3.2335
Rox porous	Free(+)	1395	18.852	1.3514
CPEporous-T	Free(+)	0.00048239	6.8422E-6	1.4184
CPEporous-P	Free(+)	0.77962	0.003916	0.5023
Rox mid	Free(+)	4.638	0.36552	7.881
CPE mid-T	Free(+)	0.00031746	1.8439E-5	5.8083
CPE mid-P	Fixed(0)	0.9	N/A	N/A
Rox barrier	Free(+)	4.675E5	1.129E5	24.183
CPE barrier-T	Free(+)	0.0042732	3.6807E-5	0.85345
CPE barrier-P	Fixed(0)	0.74	N/A	N/A
Chi-Squared: 0.001855				
Weighted Sum of Squares: 0.30107				
Data File: D:\corrosion tests\alloy c-22\impedance\c22eis90.z				
Circuit Model File: D:\corrosion tests\alloy c-22\impedance\porous barrier oxide 3 layer.mdl				
Mode: Run Fitting / All Data Points (1 - 81)				
Maximum Iterations: 500				
Optimization Iterations: 200				
Type of Fitting: Complex				
Type of Weighting: Calc-Modulus				

To Page No. _____

Witnessed & Understood by me, _____

Date _____

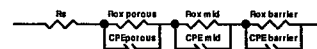
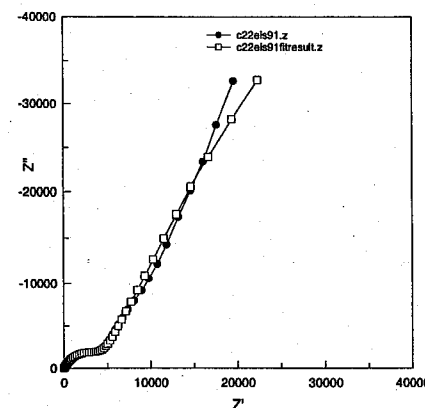
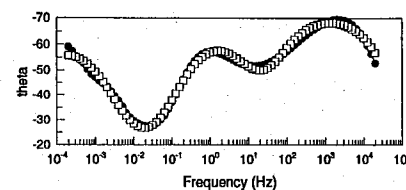
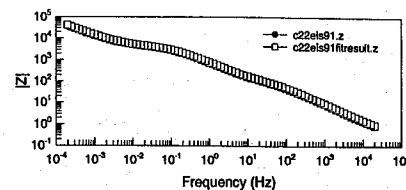
Invented by _____

Date _____

Recorded by _____

1/24/03

From Page No. _____



Element	Method	Value	Error	Error %
R1	Free(1)	0.25137	0.01598	6.3572
R2	Free(1)	4115	57.52	1.3978
CPEporous-T	Free(1)	0.00034272	3.677E-5	1.0729
CPEporous-P	Free(1)	0.7712	0.0064053	0.83056
R2 mid	Free(1)	98.23	3.9609	5.8052
CPE mid-T	Free(1)	0.00013969	7.2734E-6	5.2068
CPE mid-P	Free(1)	0.02335	0.0083509	1.0118
R2 barrier	Free(1)	4.1123E5	70124	17.052
CPE barrier-T	Free(1)	0.0033579	3.3551E-5	0.99917
CPE barrier-P	Fixed(1)	0.73	N/A	N/A
Chi-Squared:		0.0014697		
Weighted Sum of Squares:		0.22487		
Data File:	D:\corrosion test\data\c-22\impedance\c22le91.z			
Circuit Model File:	D:\corrosion test\data\c-22\impedance\porous barrier oxide 3 layer.mtl			
Mode:	Run Fitting / All Data Points (1 - 81)			
Maximum Iterations:	500			
Optimization Iterations:	200			
Type of Fitting:	Complex			
Type of Weighting:	Calc-Modulus			

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

1/24/03

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Crevice Specimen - Thermally Aged for 5 min @ 870°C
(See pg #60) with 2 PTFE Crevice Washer Attachments At 50 In-O₂
Using Probe 6104 SN# 139072 cal 8/28/02 due 2/28/03
And A C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt = 40.7197g

Santoro's Corrosion SN# 12809099 cal 11/15/02 due 5/15/03

End wt = 40.7176g

Solution

4.0 M NaCl

467.54 g NaCl Lot # 025149

+ DI water To 2000ml

pH Start = 8.107

Fisher Accuret 950 meter SN# 3240 cal 8/7/02 due 8/7/03

pH End = 4.487

pH probe # 13-620-296 SN# 2251257P6

pH Adjusted To 3.024 with 430 µl of 20% HCl Solution Lot # 002564

potentiostat: EG & G Versastat SN# 20104

Counter Electrode: Pt Flag - For OC Measurement Only

Reference: Fisher 13-620-52 SN# 0249091

Temperature: 95°C Hg thermometer SN# H00-387 cal Dec/18/02 due 6/18/03

Solution Bubbles with Zero Air - Also bubbles in Vapor phase of cell

Crevice Specimen

Plate

E_{corr} = -66 mVE_{corr} = +14 mV

Keithley 614 SN#

E_{pt} = +37 mVE_{pt} = +37 mV

cal due

Spike Cell with NaOCl Lot # 027661-9 Exp 8/03 (4-6%)

200 µl with 200 ml Test Solution pumped into cell @ 50 ml/hr per hr. 1/21/03

100 µl with 200 ml Test Solution pumped into cell @ 35 ml/hr per hr. 1/22/03

100 µl with 200 ml Test Solution same rate " " 1/23/03

100 µl with 200 ml Test Solution same rate " " 1/24/03

100 µl with 200 ml Test Solution same rate 1/27/03 (Continued pg #12) To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/3/05

From Page No. _____

Continued from pg #71

Specimen Examination: Crevice Corrosion on $\frac{1}{24}$ feet of crevice under
Very mild stain of facial surface of specimen

Model 352/252 Corrosion Analysis Software, v. 2.30

Filename: a:NaOClt5

Pstat: VStat[] Ver 2

GC GALVANIC CORROSION

Date Run: 12-12-02

File Status: NORMAL

Time Run: 09:26:56

Time/Pt. TP 672.2 s

No. of Points NP 1800

Time Step 1 T1 1.210E6 s

Curr. Range CR Auto

Stop On SO Pass

Line Sync. LS no

Rise Time RT high stability

Working Elec. WE Solid

Sample Area AR 15.00 cm²

Density DE 8.690 g/ml

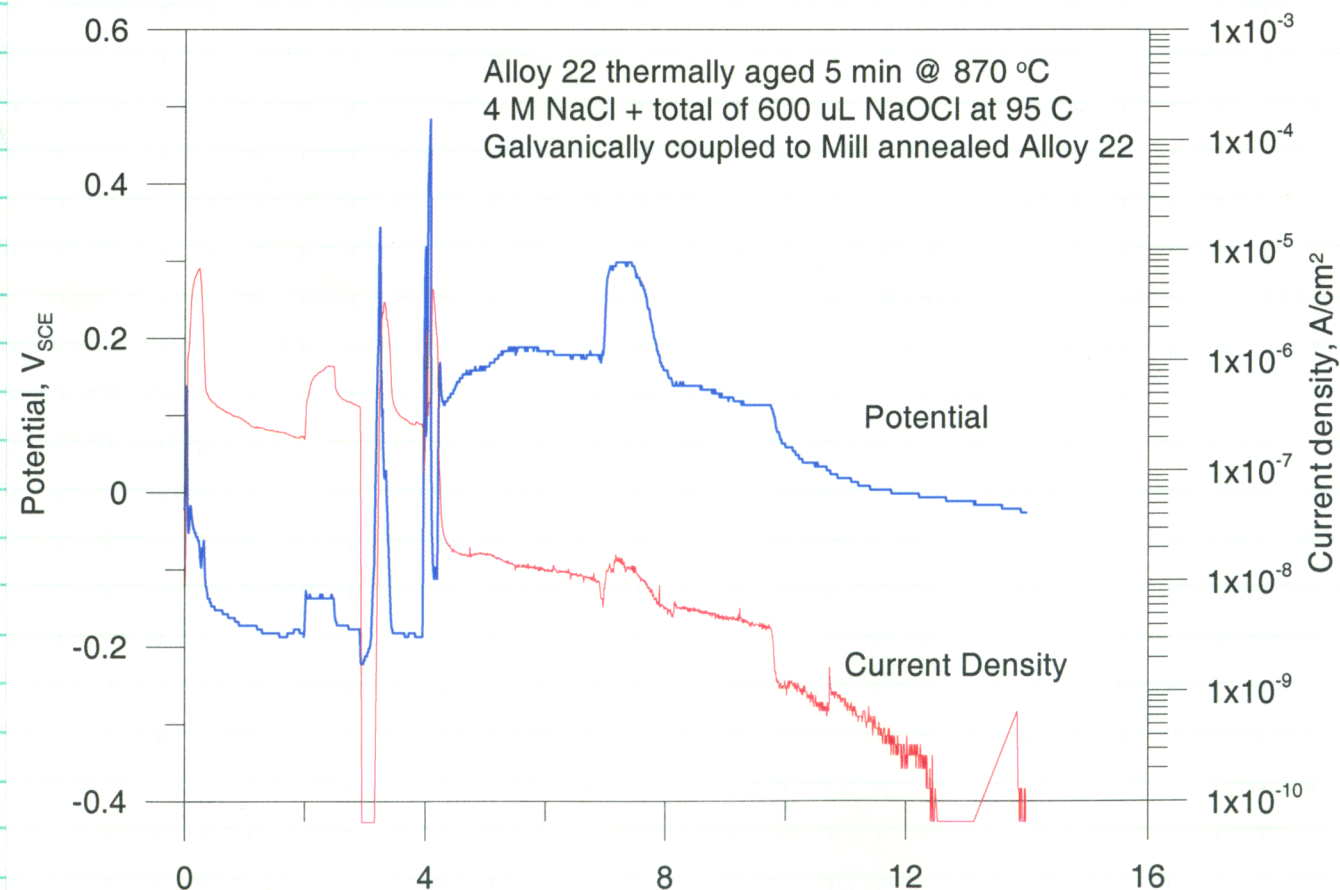
Open Circuit OC -9.000E-3 V

Filter FL Off

Ref. Elec. RE SCE 241.5E-3V

Equiv. Wt. EW 26.04 g

AUX A/D AU no



Data NaOCl+5

Witnessed & Understood by me, _____

Date _____

Invented by _____

Recorded by _____

Date _____

2/3/03

To Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30

File Status: NORMAL Date Run: 12-12-02 Time Run: 09:26:56

TP 6.722E+02 T1 1.210E+06 CR AUTO

RT HIGH STABILITY REF 0.24150 SCE WPK SOLID

DEN 8.690E+00 AU NO OC -0.009

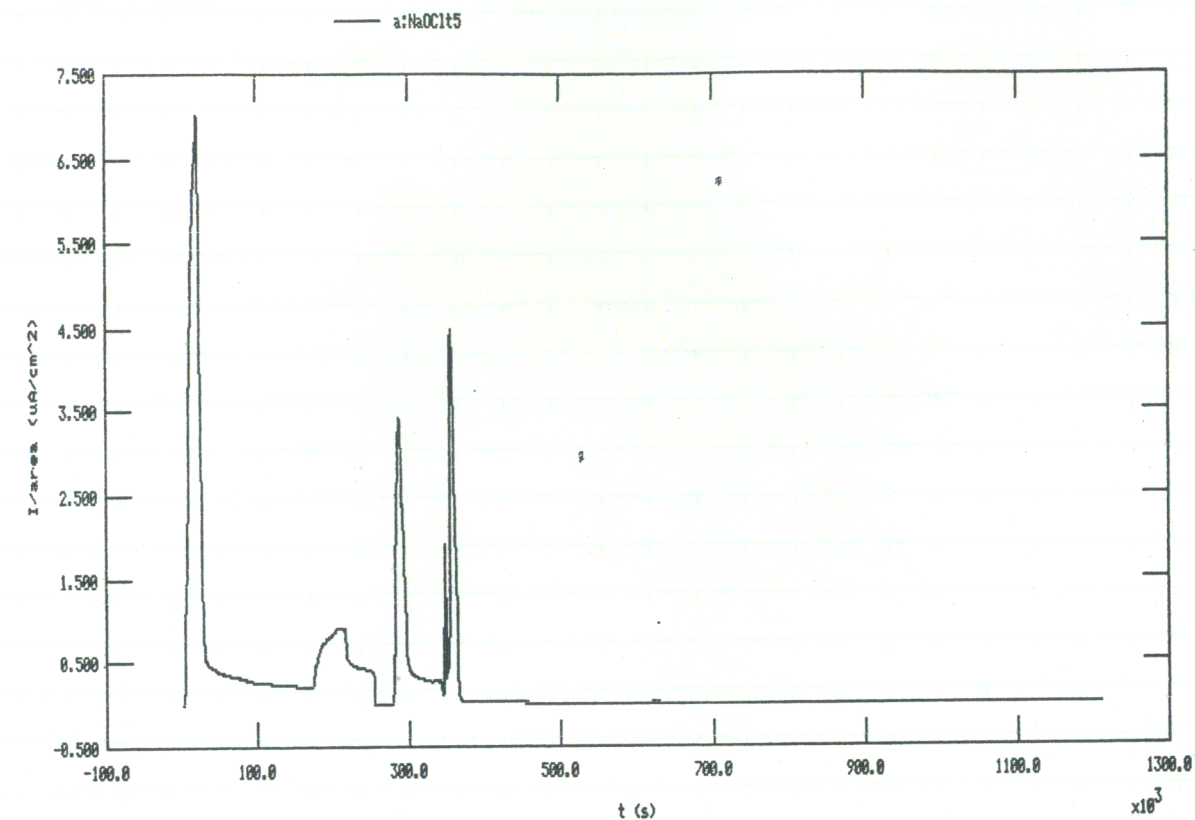
Filename: a:NaOClt5 Pstat: VStat[] Ver 2 GC GALVANIC CORROSION

NP 1800 SO Pass

AR 1.500E+01 LS NO

FL NONE

EW 2.604E+01



Model 352/252 Corrosion Analysis Software, v. 2.30

File Status: NORMAL Date Run: 12-12-02 Time Run: 09:26:56

TP 6.722E+02 T1 1.210E+06 CR AUTO

RT HIGH STABILITY REF 0.24150 SCE WPK SOLID

DEN 8.690E+00 AU NO OC -0.009

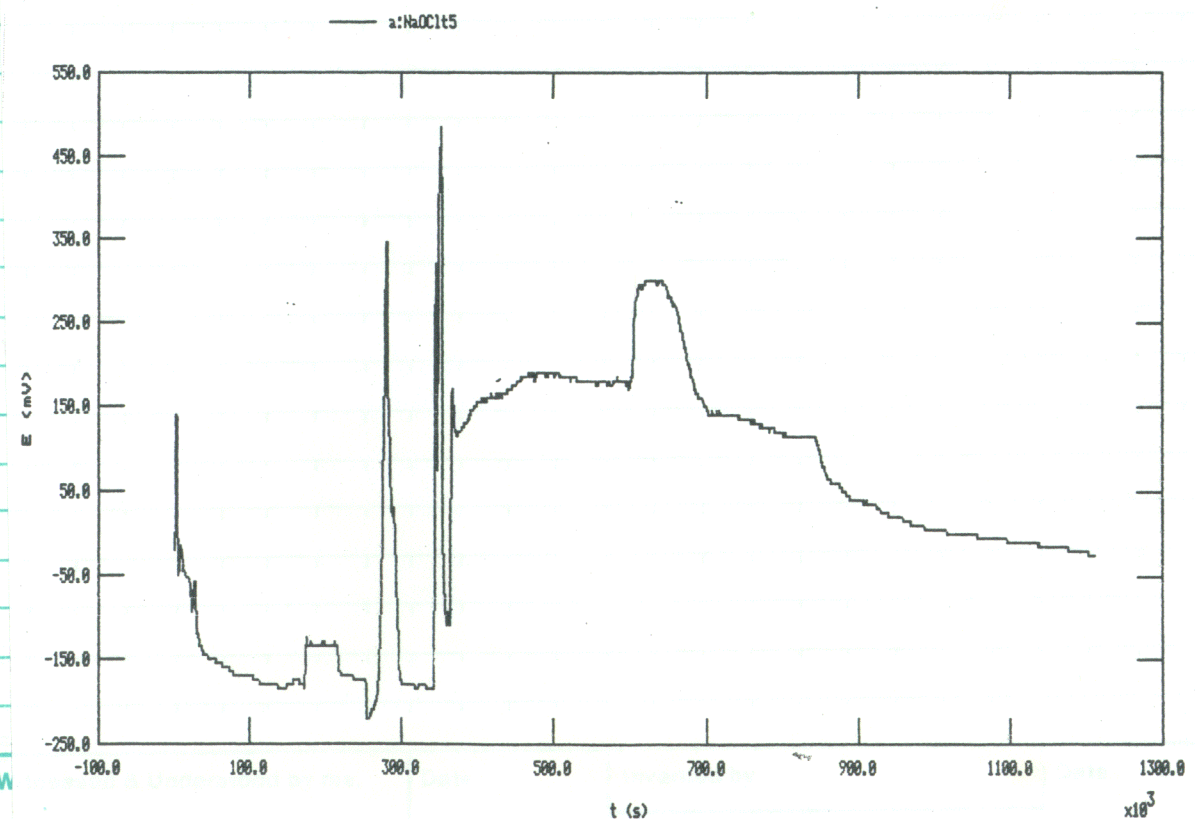
Filename: a:NaOClt5 Pstat: VStat[] Ver 2 GC GALVANIC CORROSION

NP 1800 SO Pass

AR 1.500E+01 LS NO

FL NONE

EW 2.604E+01



Recorded by _____

2/3/03

2/3/03

To Page No. _____

From Page No. _____

Repassivation Potential of Alloy C-22

Objective: See pg #1

Specimen: C-22 2277-8-3175 polished To A 600 Grit Finish
 with 2 PTFE Crevice Washers Attached At 50 In. Oz.
 Using Probe 6104 SN# 139072 cal 8/28/02 due 2/28/03

Start wt: 40.45795g Santarous Genius SN# 12809099 cal 11/15/02 due 5/15/07
 End wt: 40.45769g

Solution: 0.5 M NaCl + 0.178 M $\text{Na}_2\text{S}_2\text{O}_3$
 58.44g NaCl Lot# 027168
 56.29g $\text{Na}_2\text{S}_2\text{O}_3$ Lot# 923931A
 + DI water To 2000 mL

pH Start: 7.994 Fisher Accuвет 950 meter SN# 3340 cal 8/7/02 due 8/7/03
 pH End: 8.184 pH probe # 13-620-296 SN# 2291257 Pb

Potentiostat: EG & G model # 273 SN# 10120

Counter Electrode: Pt Flg

Reference: Fisher 13-620-52 SN# 192121

Temperature: 95°C Hg Thermometer SN# 06-387 cal 5/14/02 due 5/14/03

Ecorr: -421 mV Keithley 614 SN# 0764524 cal 5/26/02 due 5/26/03
 Ept: -178 mV

Solution Deaerated with 99.999% N_2

Test Specimen: No Crevice Corrosion. 1/4 feet of crevice washer
 mld surface staining

* Note: will Repolish Specimen for further Testing

Data C22R136

To Page No. _____

Witnessed & Understood by me, _____

Date _____

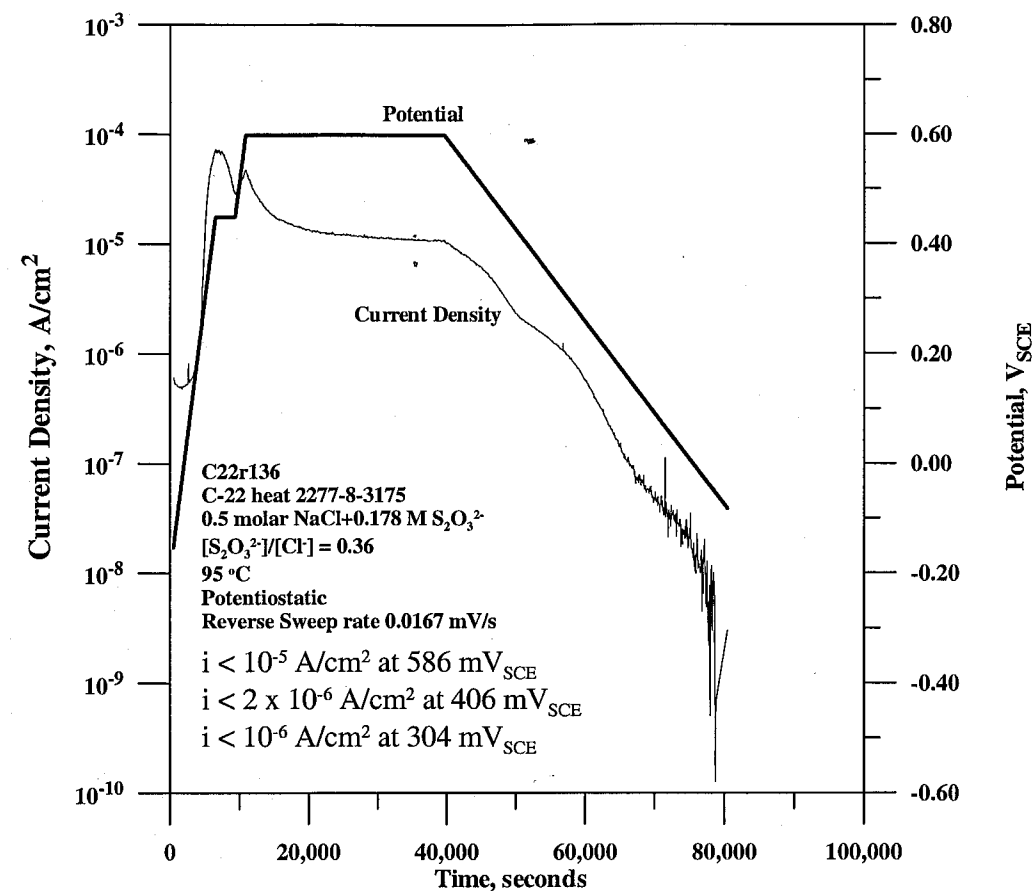
Invented by _____

Date _____

Recorded by _____

1/24/03

From Page No. _____



Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

1/24/03

From Page No. _____

Repassivation Potential of Alloy C-22

Objective: See pg #1

Specimen: C-22 2277-8-3175 polishes To A 600 Grit Finish
with 2 DTFE Crevice Washer Attachments At 50 In./Oz
Using Pasta 6104 SN# 139071 cal 8/28/02 due 2/28/03

Start wt = 40.40903g Satorious Genius SN# 12809099 cal 11/15/02 due 5/17/03
End wt = 40.40522g

Solution: 0.5 M NaCl + 0.018 M $\text{Na}_2\text{S}_2\text{O}_3$
58.47g NaCl Lot# 02716R
5.634g $\text{Na}_2\text{S}_2\text{O}_3$ Lot# 923931A
+ DI water To 2000ml

pH Start = 8.447 Fisher Accumet 950 meter SN# 3340 cal 8/7/02 due 8/7/03
pH End = 8.223 pH probe #13-620-296 SN# 2291257 PL

Potentiostat = PT Flag 12103 EG & G model # 273 SN# 10120

Counter Electrode = PT Flag

Reference: Fisher 13-620-52 SN# 192121

Temperature: 95°C Hg Thermometer SN# 00-3571 cal 5/19/02 due 5/19/03

Ecorr = -347 mV Keithley 614 SN# 0704934 cal 5/26/02 due 5/26/03
Ept = -189 mV

Solution Degassed with 99.999% N_2

Specimen Examination: No Crevice Corrosion 24 feet of Crevice Washer
n/a staining on All Surfaces

Data C22R137

To Page No. _____

Witnessed & Understood by me, _____

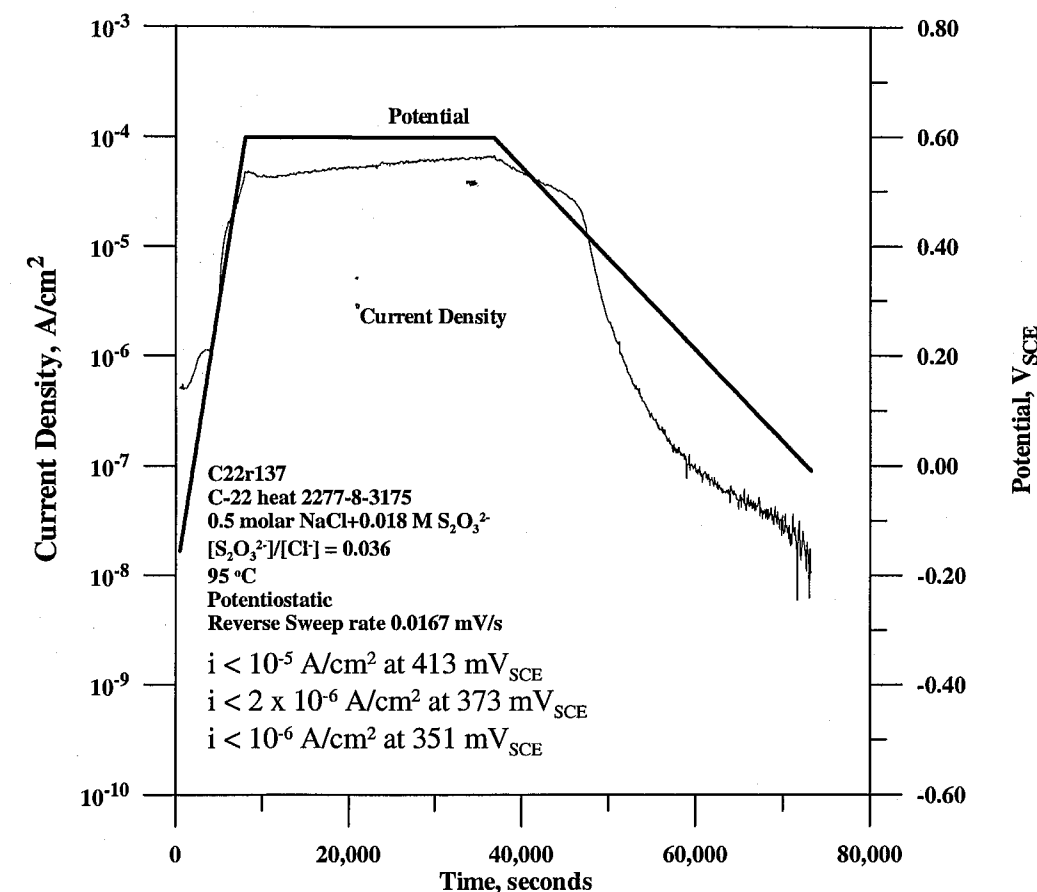
Date _____

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Date _____

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Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/3/2003

From Page No. _____

Repassivation Potential of Alloy C-22

Objective: See pg #1

Specimen: C-22 2277-8-3175 polished To A 600 Grit Finish
 with 2 PTFE Crevice Washers Attached At 5.0 In.-Oz
 Using Paulo SN#139072 cal 8/28/02 Due 2/28/03

Start wt: 40.08078g ^{Blk 7/15/02} 40.08078g Santonix Genius SN#12609099
 End wt: 40.06185g cal 11/15/02 Due 5/15/03

Solution: 0.5 M NaCl + 0.890 M Na₂S₂O₃
 58.44g NaCl #027168
 281.43g Na₂S₂O₃ Lot#973931A
 + DI Water To 2000 ml

pH Start: 8.504 Fisher Accumet 950 meter SN#3340 cal 8/7/02 Due 8/7/03
 pH End: pH probe #13-620-296 SN#2291257 Pl

Potentiostat: EG & G Model#273 SN#10120

Counter Electrode: Pt Flag

Reference: Fisher 13-620-52 SN#192121

Temperature: 95°C Hg Thermometer SN#00-387 cal 5/10/02 Due 5/10/03

Ecorr: -386 mV Keithley 614 SN#0704934 ⁰⁷⁰⁴⁹³⁴
 Ept: -226 mV SN#467374 ⁴⁶⁷³⁷⁴ cal 10/4/02 ^{10/4/02} Due 5/26/03

Solution Deaerated with 99.999% N₂

Specimen Examination: No Crevice Corrosion 0/24 feet of crevice washer

Data C22R138

To Page No. _____

Witnessed & Understood by me,

Date

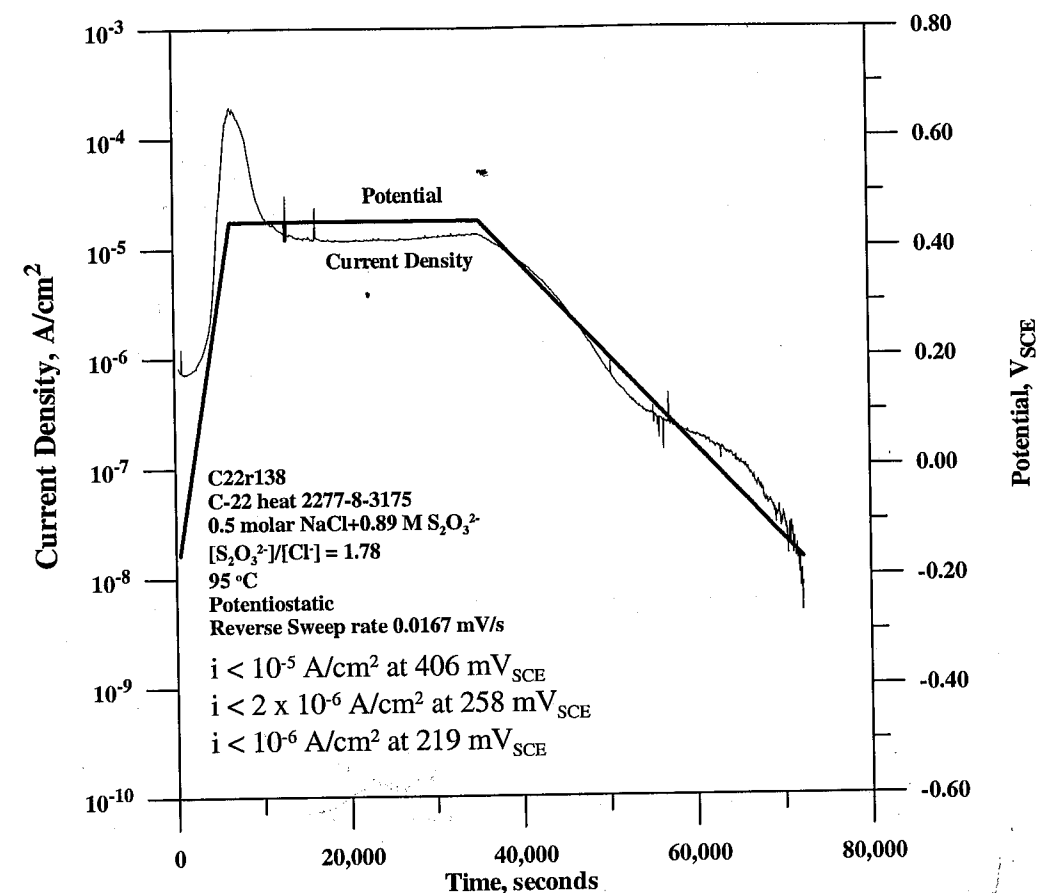
Invented by

Date

Recorded by

1/30/03

From Page No. _____



Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

2/3/2003

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Crevice Specimen thermally Age for Sn @ 870°C
(See NB #541 pg #60) with 2 PTFE Crevice Washers Attached AT
50 In O2 Using Photo 6164 SN# 139672 cal 8/28/02 Due 2/25/03
App A C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt = 40.70734g Sartorius Genius SN# 12909099
End wt = 40.70629g cal 11/15/02 Due 5/15/03

Solution: 400 ml NaCl
467.56g NaCl
+ DI Water To 2000 ml

pH Start = 6.756 Fisher Accumet 950 meter SN# 2346 cal 8/7/02 Due 8/2/03
pH End = 3.051 pH probe # 13-620-296 SN# 1100205
pH Adjuster To 2.983 with 325 ml of 20% HCl Solution Lot # 062564

potentiostat = EG + G Versastat SN# 20104

Counter Electrode = Pt Flay for OC measurement only

Reference = Fisher #13-620-52 SN# 0249091

Temperature = 95°C Hg Thermometer SN# 1100-387 cal 12/14/02 Due 6/15/03

Solution Bubbles with Zero Air - Also bubble in Vapor phase
Crevice Specimen Plate

Ecorr = -110 mv

Ecorr = +144 mv

Keithley 614 SN# 0704931

Ept = +22 mv

Ept = +22 mv

cal 5/26/02 Due 5/26/03

Area 500 ml 200 ml See pg #81

Specimen Examination: Crevice Corrosion on 1/24 feet of Crevice Washer
Mild Surface staining

Test NaOCl6

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

2/12/03

From Page No. _____

2/5/03 pumped 200 ml Test solution with 50 ml of NaOCl (4-6%) Lot 027664
Exp Date 8/2003 - Very slow rate About 1 Drop every 15 sec

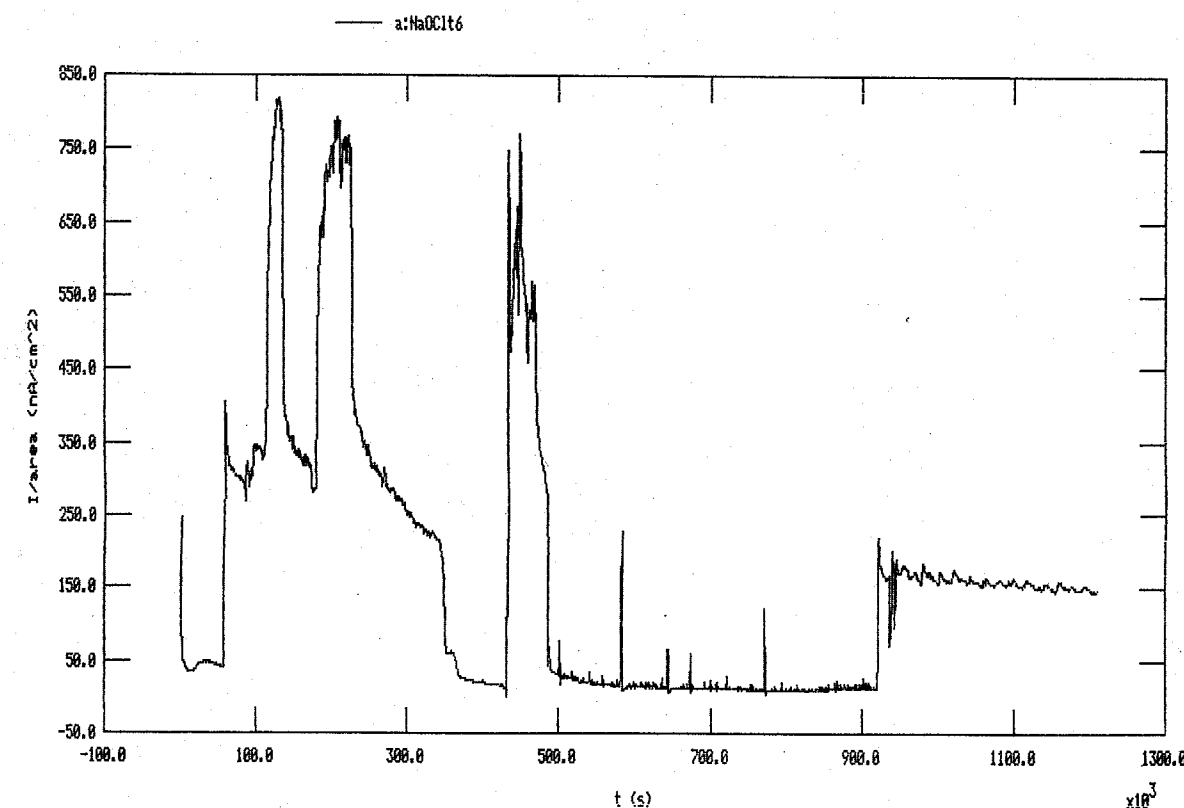
2/6/03 pumped 200 ml Test solution with 50 ml of NaOCl

2/7/03 pumped 200 ml Test solution with 50 ml of NaOCl

2/10/03 pumped 200 ml Test solution with 50 ml of NaOCl

Total of NaOCl is 200 ml in Test solution

Model 352/252 Corrosion Analysis Software v. 2.30
File Status: NORMAL Date Run: 12-14-02 Time Run: 08:32:55
TP 6.722E+02 T1 1.210E+06 CR AUTO NP 1800 SO Pass FL NONE
RT HIGH STABILITY REF 0.24150 SCE HRK SOLID AR 1.500E+01 LS NO EN 2.604E+01
DEN 8.690E+00 AU NO OC 0.000
Comment: NaOCl6



To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

2/19/02

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30

Filename: a:\NaOC1t6

Pstat: VStat11 Ver 2

GC GALVANIC CORROSION

Date Run: 12-14-02

File Status: NORMAL

Time Run: 08:32:55

Time/Pt. TP 672.2 s
No. of Points NP 1800Time Step 1 T1 1.210E6 s
Curr. Range CR Auto
Stop On SO Pass

Line Sync. LS no

Rise Time RT high stability

Working Elec. WE Solid

Sample Area AR 15.00 cm²

Density DE 8.690 g/ml

Open Circuit OC 0.0000 V

Filter FL OFF

Ref. Elec. RE SCE 241.5E-3V

Equiv. Wt. EW 26.04 g

AUX A/D AU no

Comment: NaOC1t6

Model 352/252 Corrosion Analysis Software, v. 2.30

File Status: NORMAL Date Run: 12-14-02 Time Run: 08:32:55

TP 6.722E+02 T1 1.210E+06 CR AUTO

RT HIGH STABILITY REF 0.24158 SCE WEK SOLID

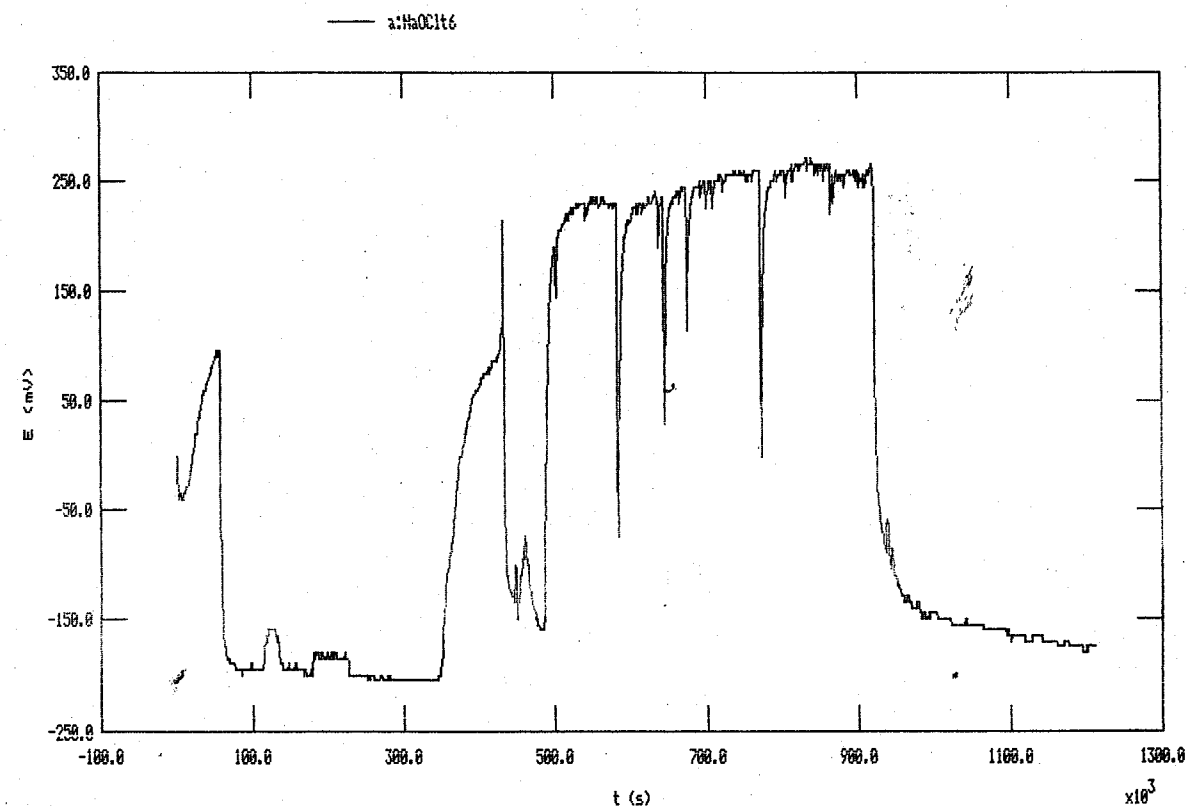
DEN 8.690E+00 AU NO OC 0.000

Comment: NaOC1t6

Filename: a:\NaOC1t6 Pstat: VStat11 Ver 2 GC GALVANIC CORROSION

NP 1800 SO Pass FL NONE

AR 1.500E+01 LS NO EW 2.604E+01



To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/19/02

TITLE _____

From Page No. _____

Thermally Age of C-22 Specimens

Used Linoberg oven SN# 909172

Model # 51333

Oven Set Point 880°C

Temperature Measurement Taken with

Thermocouple # 332 Cal 1/14/03 Due 7/14/03
7/5/02 Due 1/15/03 2/12/03

Microprocessor Thermometer Omega SN# T-94140

Cal 10/29/02 Due 4/29/03

Oven Set Point
880°CMeter Reading
874.6°C

Placed Specimen In Oven for 5 min @ Set Point

All Specimens Total Number of 2 were 600 Grit
polished prior to thermal Aging Procedure And will be
prepared To Be Repolished To 600 Grit prior to Testing

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/12/03

From Page No. _____

Open Circuit Potential Measurement

Specimen: C-22 #4 + 625 + 825 cylinders - All specimens In Cell #1

C-22 #4 2277-8-3175 600 Grit Finish

Start wt = 12.11292g Santarious Genius SN#12809099 cal 11/15/02 due 5/15/03

End wt = 12.06923g

625 600 Grit Finish

Start wt = 12.18609g Santarious Genius SN#12809099 cal 11/15/02 due 5/15/03

End wt = 12.17628g

825 600 Grit Finish

Start wt = 11.55514g Santarious Genius SN#12809099 cal 11/15/02 due 5/15/03

End wt = 11.54739g

Solution: 4.0 M NaCl + 1.78 M NaHCO₃

467.55g NaCl Lot # 027168

0.305g NaHCO₃ Lot # 025478

+ DI Water To 2000mls

pH Start = 7.587 Fisher Accumet 950 meter SN#3340 cal 8/7/02

pH End = 8.846 pH probe #13-620-296 SN#1160208 Due 8/7/03

Reference: Fisher 13-620-52 SN# 8205244

Counter Electrode: Pt Flg

Temperature: 95°C Hg Thermometer SN#115749 Cal 1/13/03 Due 1/13/04

Solution Bubbles with Zero Air

Specimen Examination

C-22 #4 = No Sign of Corrosion staining At Solution level

625 = No Sign of Corrosion staining At Solution level

825 = No Sign of Corrosion staining At Solution level

Test started 2/4/03

Test Ended 2/18/03 - Solution Change Data File

To Page No. _____

Witnessed & Understood by me,

Date

Invented by

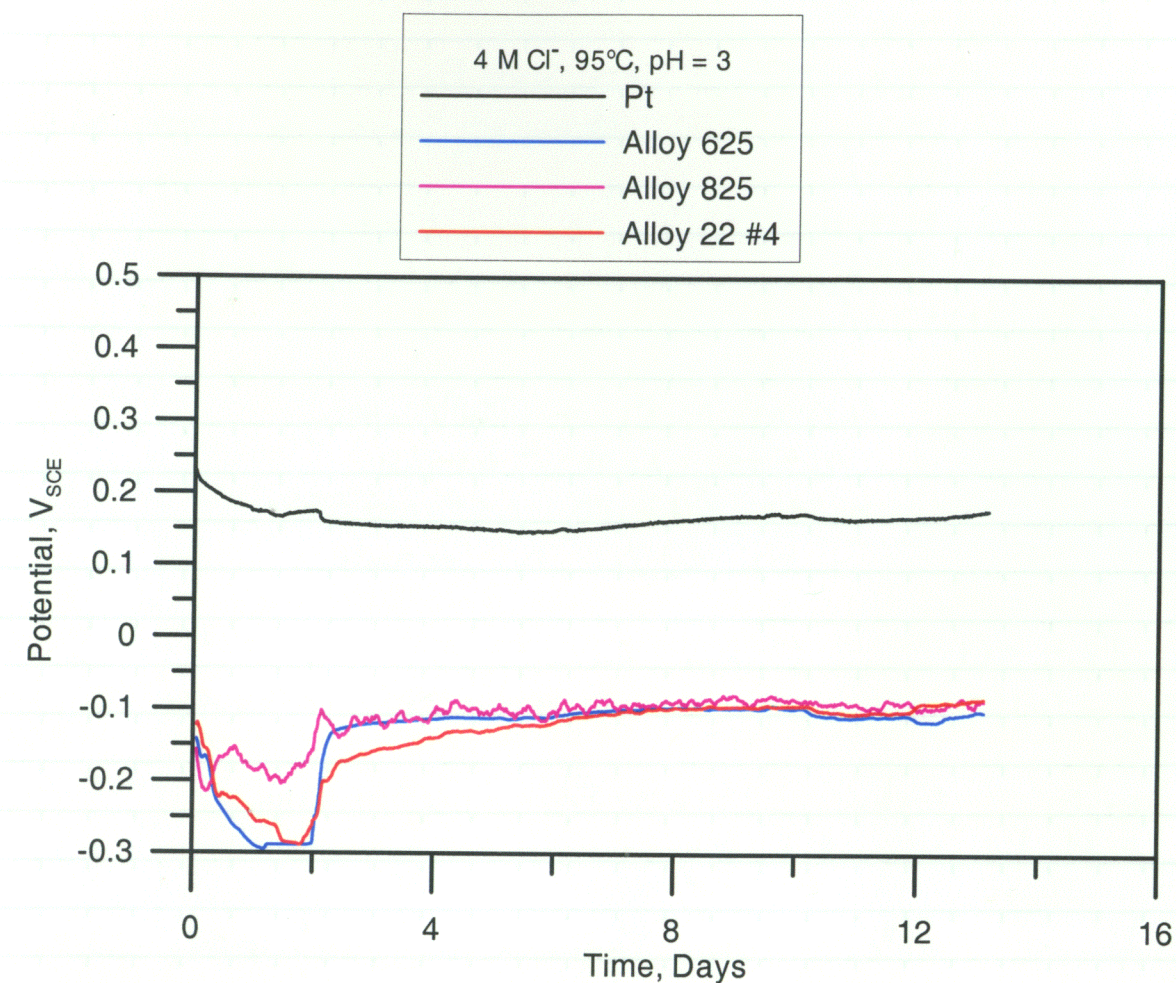
Date

Recorded by

2/12/03

TITLE _____

From Page No. _____



To Page No. _____

Witnessed & Understood by me,

Date

Invented by

Date

Recorded by

2/18/2003

From Page No. _____

Open Circuit Potential Measurements

Specimen: C-22 #1 + C-22 #2 + C-22 #3 Cylinders Specimens Cell #2
 C-22 #1 2277-8-3175 600 Grit Finish
 Start wt: 12.2866g Santaricus Genius SN#12809099 cal 11/15/02 due 5/15/03
 End wt: Not Taken
 C-22 #2 2277-8-3175 600 Grit Finish
 Start wt: 12.4743g Santaricus Genius SN#12809099 cal 11/15/02 due 5/15/03
 End wt: Not Taken
 C-22 #3 2277-8-3175 600 Grit Finish
 Start wt: 12.4814g Santaricus Genius SN#12809099 cal 11/15/02 due 5/15/03
 End wt: Not Taken

Solution 4.0 M NaCl + 1.78M NaHCO₃
 467.55g NaCl # 027168
 0.302g NaHCO₃ lot # 625478
 + DI water To 2000mls

pH Start = 7.561 Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03
 pH End = 9.107 pH probe # 13-620-296 SN#160268

Reference: Fisher 13-620-52 SN#0042119
 Counter Electrode: Pt Flag

Temperature: 95°C Hg Thermometer SN#1498-182 cal 5/10/02 due 5/10/03

Solution Bubbles with Zero Air

Specimen Examination

C-22 #1 = No Sign of Corrosion

C-22 #2 = No Sign of Corrosion

C-22 #3 = No Sign of Corrosion

All Specimens Wiped down with Acetone After DI Flush will Continue Testing with Different Solution

Test Starts = 2/4/03

Test Ends = 2/18/03 - Solution change - PH level Keeping All Specimens In Cell #2

Data File

To Page No. _____

Witnessed & Understood by me, _____

Date _____

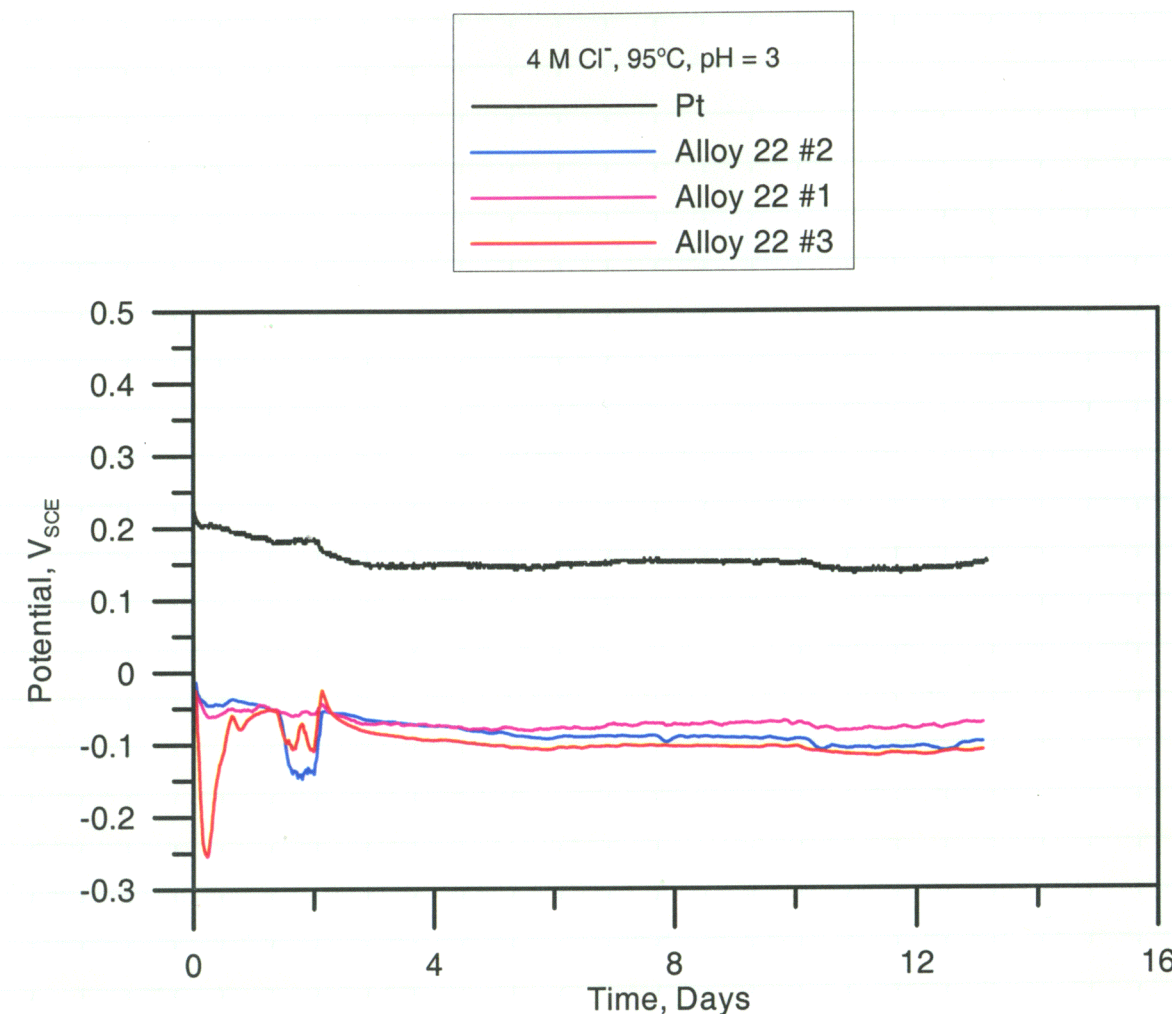
Invented by _____

Date _____

Recorded by _____

2/12/03

From Page No. _____



Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/19/03

From Page No. _____

C22L13 T

Specimen: C-22 welo 60

Start wt = 39.3297g Sandorpus Genies SN#12509099 cal 11/17/02 due 5/15/03

End wt = 39.4077g

2 PTFE Crevice Washers Attached At 50 In. Oz Using

Photo 6104 SN#139072 cal 8/28/02 due 2/28/03

Solution: 4 M Cl⁻ + 0.208 mM SO₄²⁻ + 0.162 mM NO₃⁻
0.105 mM F⁻ + 1.4 mM HCO₃⁻ Prepared As Follows

467.55g NaCl Lot# 027168

0.243g NaHCO₃ Lot# 923337A40 mL SO₄ } Stock Solution20 mL NO₃ } Notebook #366 pg #1454 mL F⁻ } Prepared 1/20/03

+ DI water To 2000 mL

Start pH = 7.249

Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03

End pH = 8.606

Fisher pH probe #13-620-296 SN#2291257 Pb

Temperature: 95°C

Hg Thermometer SN#H98-179 cal 4/22/02 due 4/22/03

Ecorr = -128 mV

Keithley 614 SN#0704934

Ept = -22 mV

cal 5/26/02 due 5/26/03

E Applied = +100 mV

Counter Electrode: PT Flag

Reference: Fisher 13-620-52 SN#0066110

Test started: 1/24/03 @ 8:50 am

Computer Stepper 3/5/03 Restart New File C22L13V - Power shut off 6-2-03

Restart New File C22L13X - Power shut off Restart 6-19-03 File C22L13Y

Specimen Examination: Test Ends 7/11/03

No Crevice Corrosion / slight Buildup of Material on all surfaces of stem
M.L. staining on All Surfaces

* Note: Reattached Lugger on 5/6/03 Test was C22L13 w New File

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/12/03

From Page No. _____

C22L14 R

Specimen: C-22

2277-8-3175

start wt = 40.52572

(New Specimen)

Start wt = 39.16497g Sandorpus Genies SN#12509099 cal 11/17/02 due 5/15/03

End wt = 40.52815g

2 PTFE Crevice Washers Attached At 50 In. Oz Using

Photo 6104 SN#139072 cal 8/28/02 due 2/28/03

Solution: 4 M Cl⁻ + 1.4 mM HCO₃⁻ + 0.208 mM SO₄²⁻
0.162 mM NO₃⁻ + 0.105 mM F⁻ Prepared As Follows

467.57g NaCl Lot# 027168

0.245g NaHCO₃ Lot# 923337A40 mL SO₄ } Stock Solution20 mL NO₃ } Notebook #366 pg #1454 mL F⁻ } Prepared 1/20/03

+ DI water To 2000 mL

pH start = 7.458

Fisher Accumet 950 meter SN#3340 cal 8/7/02 due 8/7/03

pH End = 8.523

Fisher pH probe #13-620-296 SN#2291257 Pb

Temperature: 95°C

Hg thermometer SN#C96-783 cal 10/18/02 due 4/18/03

Ecorr = -27 mV

Keithley 614 SN#0704934 cal 5/26/02 due 5/26/03

Ept = -184 mV

E Applied = +250 mV

Counter Electrode: PT Flag

Reference: Fisher 13-620-52 SN#006128

Test started: 1/24/03 @ 8:50 am

Computer Stepper 2/5/03 Restart New File C22L14S - Power shut off 6-2-03

Restart New File C22L14U - Power shut off Restart 6-19-03 File C22L14V

Specimen Examination: Test Ends 7/11/03

No Crevice Corrosion / slight Buildup of Material on all surfaces of stem
M.L. staining on All Surfaces

* Note: Reattached Lugger on 5/6/03 Test was C22L14 T New File

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

2/12/03

From Page No. _____ C22L3 Ad

Specimen: C-22 2277-8-3175

Start wt: 47.21704g Santarions Genius SN# 12809099 Cal 11/15/02 Due 5/15/03

End wt: 47.23138g

2 PTFE Crevice washers Attached At 50 In-Oz Using

Photo 6104 SN# 139072 Cal 8/28/02 Due 2/28/03

Solution: 4 M Cl⁻ + 1.4 M HCO₃⁻ + 0.208 mM SO₄²⁻
0.162 mM NO₃⁻ + 0.105 mM F⁻ Prepared As Follows

467.57g NaCl Lot # 027168
0.245g NaHCO₃ Lot # 923287A
40 ml SO₄²⁻ stock solution
20 ml NO₃⁻ Notebook # 366 pg #145
4 ml F⁻ Prepared 1/20/03
+ DI water To 2000 ml

Start pH = 7.482 Fisher Accuret 950 meter SN# 3340 Cal 8/7/02 Due 8/7/03

End pH = 8.491 Fisher pH probe # 13-620-296 SN# 2291257 P6

Temperature: 95°C Hg thermometer SN# E98-273 Cal 9/17/02 Due 5/17/03

Ecorr = -59mV Keithley 614 SN# 0704934
EPT = -155mV Cal 5/26/02 Due 5/26/03

E Applic = Open Circuit

Solution Bubbled with Zero Air

Reference: Fisher # 13-620-52 SN# 9250063

Test startup 1/24/03 @ 8:50 A.M.

Computer shutdown 3/5/03 Restart New File C22L3Ad - Power shut off 6-2-03

Restart New File C22L3AG - Power shut off Restart 6-19-03 File C22L3AH

Specimen Examination: Test Failed 7/11/03

No Crevice Corrosion 9/24 mls surface staining on Specimen

Slight Bulbup of material on stem of Specimen

* Note - Retitled Logon Probe 5/6/03 - Test was C22L3Ad New File

Witnessed & Understood by me,

Date

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Date

Recorded by

B. K. D.

2/12/03

From Page No. _____ OC 825 C1AAA

Specimen: 825 HH 4371 FG

Start wt: 39.81685g Santarions Genius SN# 12809099 Cal 11/15/02 Due 5/15/03

End wt: 39.30819g

2 PTFE Crevice washers Attached At 50 In-Oz Using

Photo 6104 SN# 139072 Cal 8/28/02 Due 2/28/03

Solution: 0.028 M Cl⁻ + 1.4 M HCO₃⁻ + 0.208 mM SO₄²⁻
0.162 mM NO₃⁻ + 0.105 mM F⁻ Prepared As Follows

3.300g NaCl Lot # 027168
0.246g NaHCO₃ Lot # 025478
40 ml SO₄²⁻ stock solution
20 ml NO₃⁻ Notebook # 366 pg #145
4 ml F⁻ Prepared 1/20/03
+ DI water To 2000 ml

Start pH = 8.247 Fisher Accuret 950 meter SN# 3340 Cal 8/7/02 Due 8/7/03

End pH = 9.144 Fisher pH probe # 13-620-296 SN# 2291257 P6

Temperature: 95°C Hg thermometer SN# A2000-123 Cal 9/17/02 Due 5/17/03

Ecorr = -44mV Keithley 614 SN# 0704934
EPT = -242mV Cal 5/26/02 Due 5/26/03

E Applic =

Solution Bubbled with Zero Air

Reference: Fisher 13-620-51 SN# 8027166

Test startup 1/24/03 @ 8:50 A.M.

Computer shutdown 3/5/03 - Restart New File OC825C1AAb - Power shut off 6-2-03

Restart New File OC825C1AAd - Power shut off Restart 6-19-03 File OC825C1AAE

Specimen Examination: Test Failed 7/11/03

No Crevice Corrosion 9/24 feet - M.L.S. surface staining on Specimen

x Note: Retitled Logon Probe 5/6/03 Test was OC825C1AAA New File

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Date

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B. K. D.

2/12/03

From Page No. _____

Galvanic Corrosion Test

Objective: See pg #4

Specimen: C-22 Alloy Crevice Specimen thermally Aged 5 min @ 820°C
(See pg #83) with 2 PTFE Crevice Washers Attached At 50
In-O₂ Using Photo 6104 SN# 139072 cal 8/28/02 due 2/28/03
And A C-22 Alloy Plate Specimen

(Crevice Specimen)

Start wt = 40.89225, Santarinas Genius SN# 12809099 cal 11/15/02 due 5/15/03
End wt = Not Taken

Solution = 4.0 M NaCl
467.58g NaCl lot # 027878
+ DI water to 2000 ml

pH Start = 8.659 Fisher Accumet 950 meter SN# 3340 cal 8/7/02 due 8/7/03
pH End = 2.793 pH probe # 15-620-296 SN# 1100208
pH Adjusted to 2.957 with 235 ml of 20% HCl solution lot # 062564

Potentiostat = EG+6 Versastat SN# 20104
Counter Electrode = Pt Flag for OC measurements only

Reference = Fisher # 13-620-52 SN# 0249091
Temperature 95°C Hg Thermometer cal 12/18/02 due 6/18/03 SN# 60-387

Solution Bubbles with zero Air - Also bubbler in Vapor phase
Crevice Specimen Plate

E_{corr} = -163 mV E_{corr} = -196 mV
E_{pt} = +76 mV E_{pt} = +76 mV

Kentley 614 SN# 0704934 cal 5/24/02 due 5/24/03

Specimen Examination: No Sign of Corrosion Repolish for Next Test

Data NaOClt7

To Page No. _____

Witnessed & Understood by me, _____

Date _____

Invented by _____

Date _____

Recorded by _____

Date _____

2/20/03

From Page No. _____

Complete Check 3/3/03

Restart Test

pH Recheck 2.898 (See pg #92 for meter) PM End = 2.793
Start wt 40.86220 (See pg #92 for Scale - Repolished 600 Grit)

End wt 40.86157

(Crevice Specimen)

(Plate)

E_{corr} -118 mV

+26 mV

E_{pt} +266 mV

+206 mV

Spike Cell with 5ml NaOCl lot # 027661-9 Exp 8/2003
places NaOCl with 200 ml of Test solution @ 1.5GE+5

specimen Examination: No sign of Crevice Corrosion. No Strain
will Repolish specimen for further testing

Model 332/252 Corrosion Analysis Software, v. 2.30
Filename: a1naoclt7
Pstat: VStat11 Ver 2
Date Run: 12-19-02

Time Run: 13:58:36

Time/Pt.	TP	336.0	s	Time Step 1	T1	604.853	s
No. of Points	NP	1800		Curr. Range	CR	Auto	
				Stop On	SO	Pass	

Line Sync.	LS	no	Filter	FL	OFF
Rise Time	RT	high stability	Ref. Elec.	RE	SEE 241.5E-3V
Working Elec.	WE	Solid	Equiv. Wt.	EW	26.04 g
Sample Area	AR	15.00 cm ²	AUX A/D	AU	no
Density	DE	8.690 g/ml			
Open Circuit	OC	-58.00E-3 V			

Comment: rerun of NaOClt7

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Date _____

Invented by _____

Date _____

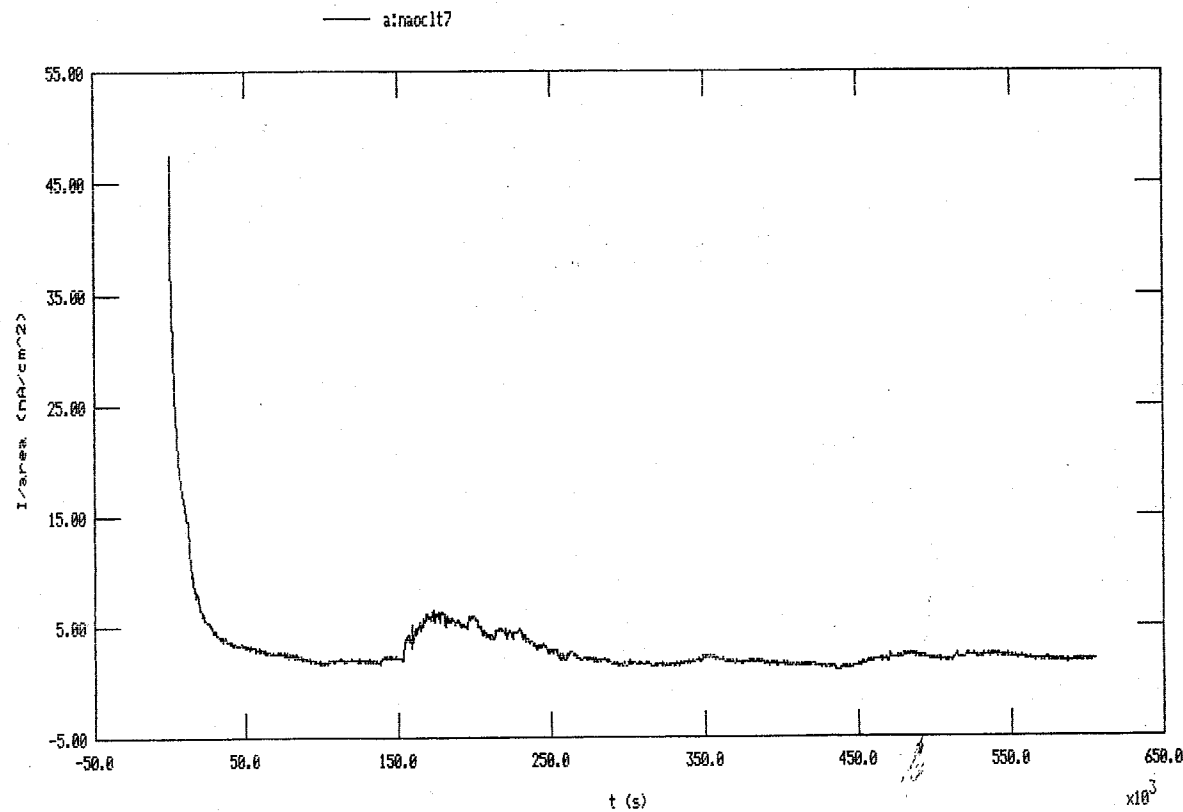
Recorded by _____

Date _____

3/12/03

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30
File Status: NORMAL Date Run: 12-19-02 Time Run: 13:50:36
TP 3.360E+02 T1 6.048E+05 CR AUTO NP 1000 SO Pass FL NONE
RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 1.500E+01 LS NO EN 2.604E+01
DEN 8.690E+00 AU NO OC -0.050
Comment: rerun of NaOCl7



To Page No. _____

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Date

Invented by

Date

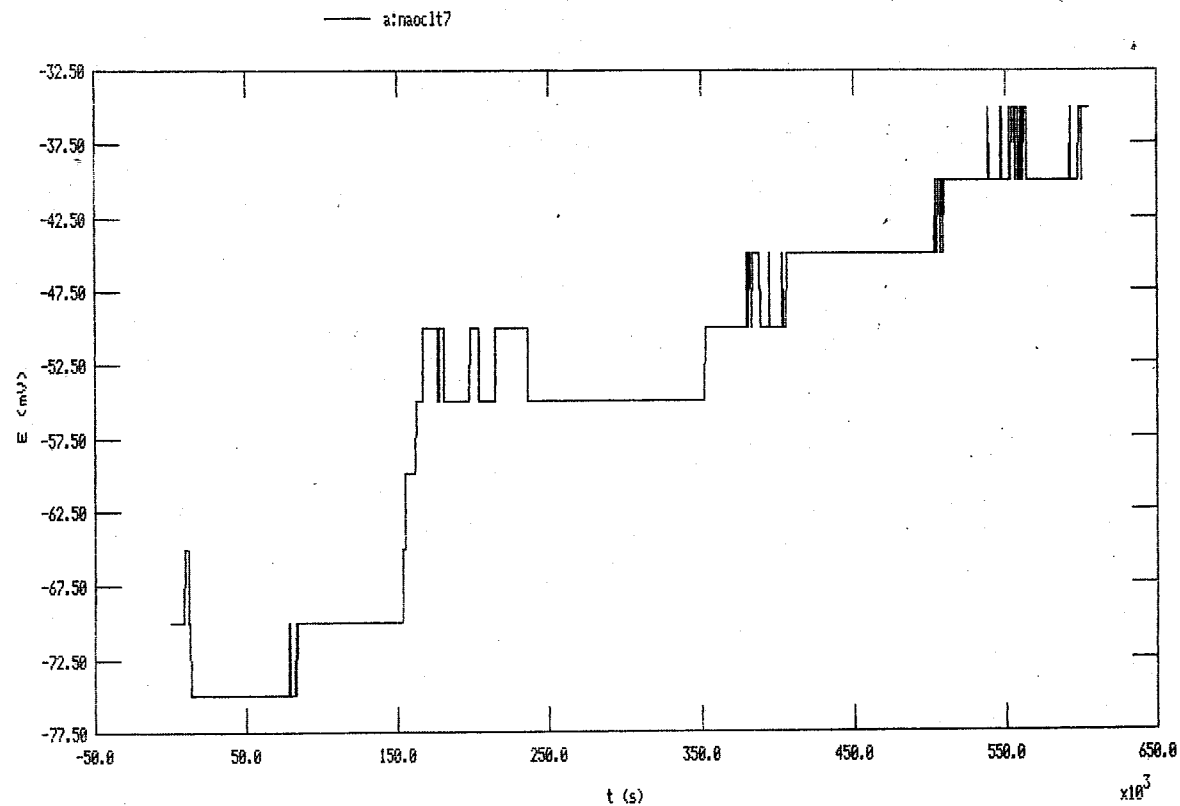
Recorded by

[Signature]

3/12/03

From Page No. _____

Model 352/252 Corrosion Analysis Software, v. 2.30
File Status: NORMAL Date Run: 12-19-02 Time Run: 13:50:36
TP 3.360E+02 T1 6.048E+05 CR AUTO NP 1000 SO Pass FL NONE
RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 1.500E+01 LS NO EN 2.604E+01
DEN 8.690E+00 AU NO OC -0.050
Comment: rerun of NaOCl7



To Page No. _____

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3/12/03

From Page No. _____

Continue Testing In Notebook
577

I have reviewed this scientific notebook and find it in compliance with QAP-001. There is sufficient information regarding procedures used for conducting tests, acquiring and analyzing data so that another qualified individual could repeat the activity.

[Signature]

4/1/03

To Page No. _____

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3/12/03