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Scientific Notebook # 218



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#218

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Scientific Notebook # 218

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Kim Gruss / NRC

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LIP series

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Initial Scientific notebook entry for Alloy 625 and Alloy C-22 cyclic polarization tests.

Title: CPP and Potentiostatic Tests of Alloy 625 and Alloy C-22

Tests Performed by: Kimberly Ann Gruss (NRC)

Objectives: To determine the initiation and repassivation potentials for localized corrosion of Alloy 625 and Alloy C-22 as a function of chloride concentration and temperature

Equipment: EG&G Versastat Serial Number 20104. EG&G model 352 corrosion software. Keithley Electrometer model 614 Serial Number 555368, or equivalent. ASTM G-5 polarization cell, teflon/glass reaction vessels or vessel meeting the requirements of TOP-008. NEC Powermate V2133 computer.

Materials: Alloy 625 and Alloy C-22

Specimen specifications: 0.250" diameter x 1.915" long (+/- 0.005") specimens polished to a 600 grit finish. Specimens to be weighed before and after exposure.

Measurement Parameters: As described in TOP-008.

Required Level of Accuracy: Potentials +/- 5 mV.

Uncertainty and Sources of Error: Current density calculated as current divided by sample area. Actual current density of corroding areas is not determined.

Kimberly Ann Gruss 4/10/97

4/10/97

Kimberly Ann Gruss

TOP-022 TEST

Objective: verify the performance of the EG+G Versastat (S/N 20104) potentiostat and EG+G Model 352c software, using TOP-022.

Equipment: EG+G Versastat (S/N 20104) potentiostat (S/N 20104) ^{Kag 4/9/97}
Calibrated resistor box (refer to TOP-022) ^{4/9/97}
- Calibration due date: 17 JUN 97.
- $R = 1.000439 \text{ k}\Omega$

Data: saved as Top022.dat onto floppy disk

Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: Atop022.dat

Pstat: VStat[] Ver 2

LP LINEAR POLARIZATION

Date Run: 04-06-97

File Status: NORMAL

Time Run: 11:22:16

Cond. Time	CT	pass	s	Initial Pot.	IP	-20.00E-3	V oc
Cond. Pot.	CP	pass	V	Final Pot.	FP	20.00E-3	V oc
Initial Delay	ID	10	s				

Scan Rate	SR	1.000	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	1.000	mV	Step Time	ST	1.000	s
No. of Points	NP	41					

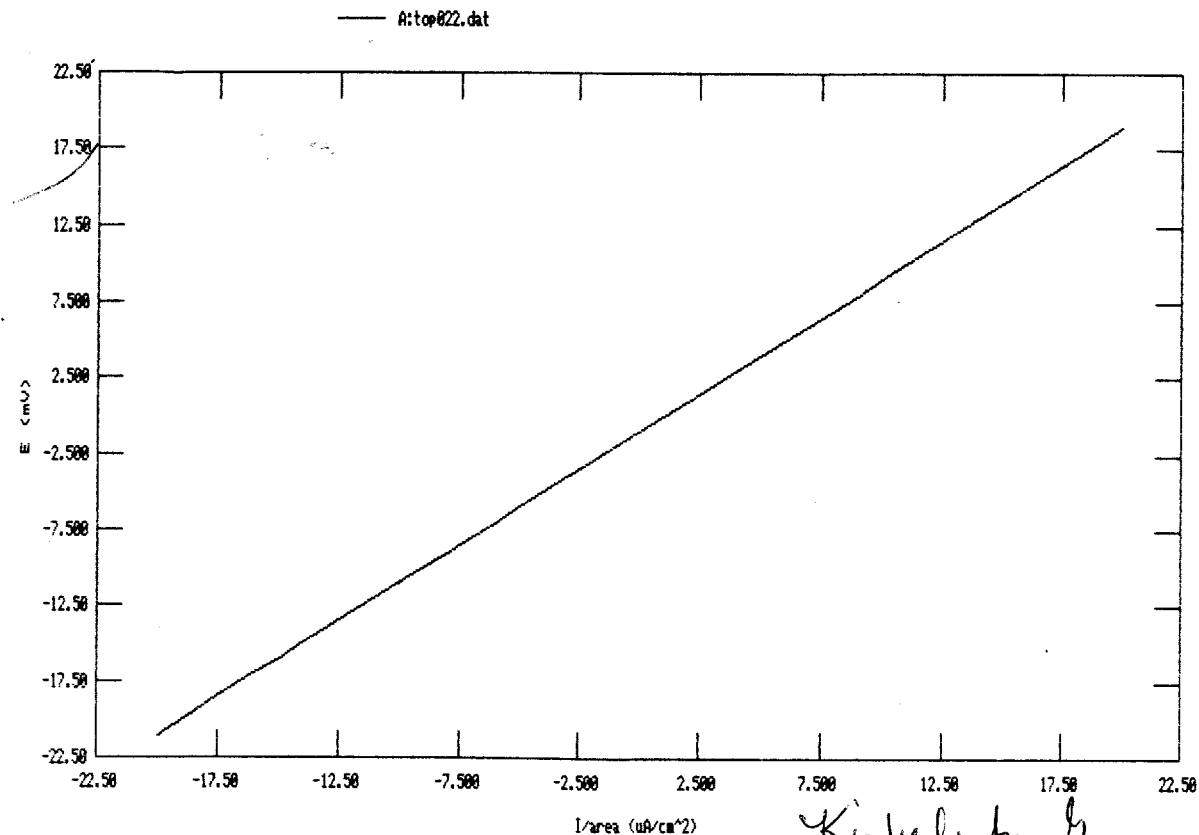
Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	1.000	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-1.000E-3	V

Comment: TOP-022 with 1000 ohm resistor

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Model 352/252 Corrosion Analysis Software, v. 2.01
 LP LINEAR POLARIZATION File Status: NORMAL Date Run: 04-06-97 Time Run: 11:22:16 Pstat: VStat[] Ver 2
 CP PASS vs. R CT PASS IP -0.020 vs. OC ID 10 S FP 0.020 vs. OC SI 1.000E-03
 SR 1.000E-03 ST 1.000E+00 CR AUTO NP 41 IR NONE FL NONE
 RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 1.000E+00 LS YES EM 0.000E+00
 DEN 1.000E+00 OC -0.001
 Comment: TOP-022 with 1000 ohm resistor



TOP-^{key} 4/8/97

Cyclic Polarization test on 316L - 316cp1.dat

Objective: Measure E_p and E_{rp} to ^{gain understanding} ~~familiarize~~ key 4/10/97
 of the operation of electrochemical hardware + software.

Specimen: 316L Ht# T80746

0.250" Diam x 1.915" long
 600 grit finish, exposed area 8.0 cm²
 Start wt. 11.74149 gm
 End wt. 11.71654 gm

NaHCO₃ QD 6/9/97

Solution: 1000 ppm Cl⁻ as NaCl Lot # 960780 (3.297 gm)
 85 ppm HCO₃⁻ as ~~NaHCO₃~~ Lot # 923337A (0.23640 gm)
 key 4/10/97

2000 20ppm SO₄²⁻ Stock Solution, 40 ml

20ml
 10ppm NO₃⁻ Stock Solution NO₃⁻ - 4/97/NB 157, p. 161
 2ppm F⁻, 2ml Stock Solution F⁻ - 4/97/NB 157, p. 161
 + DI water to 2000 ml, Deaerated w/99.999% N₂

2000ml
 Solution

T = 95°C, Hg Thermometer 183301

Start pH = 8.278

End pH = 9.268

Potentiostat: EG+G Versastat S/N 20104 w/ Model 352c software

Reference: Fisher SCE 13-620-51 S/N 3106339

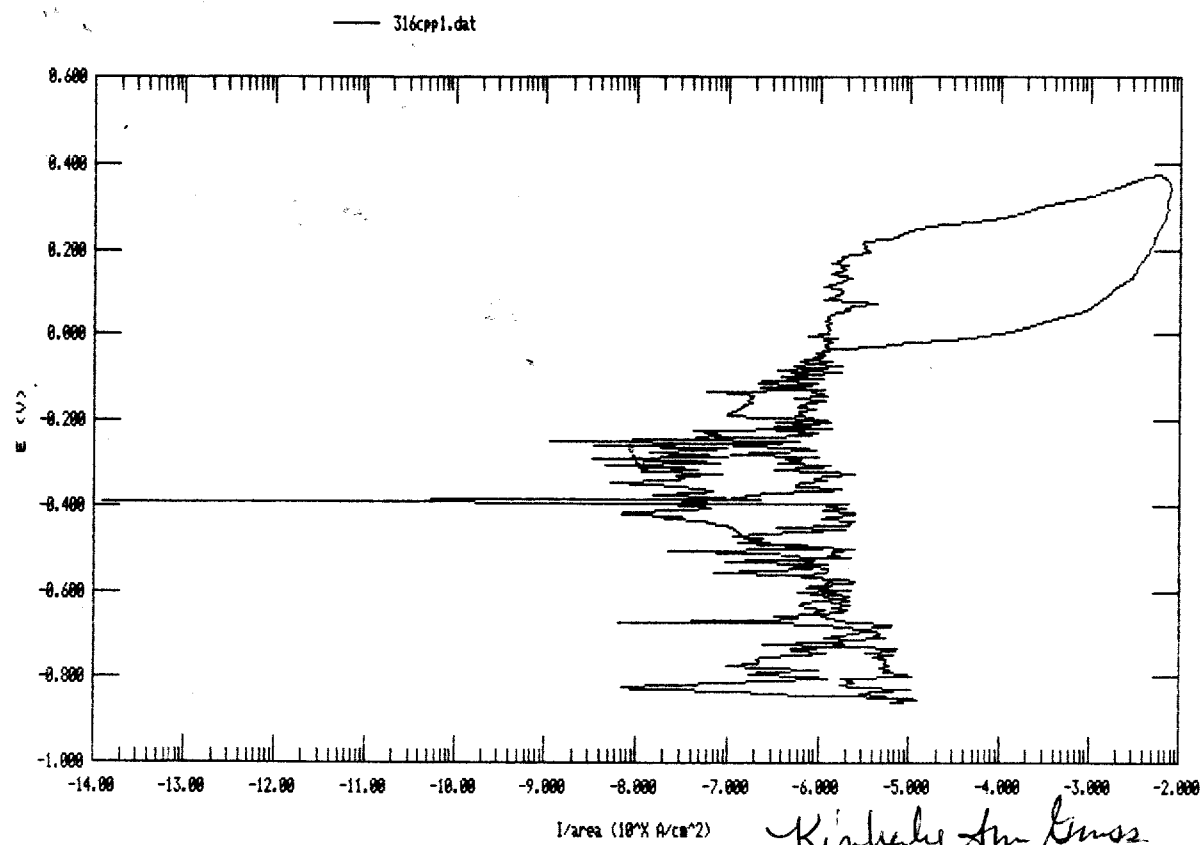
Counter Electrode: Pt. Flag

$E_{cor} = -756$ mV } Keithley ⁶⁴⁴ electrometer S/N
 $E_{pt} =$

Test Started 4/9/97 Test Ended 4/9/97

$E_p = +220$ mV, $E_{rp} = -40$ mV ⇒ Pits were observed on specimen.

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS IP -0.100 vs. OC ID 20 S V1 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO HP 494 IR NONE
 FL NONE RT HIGH STABILITY REF 0.24150 SCE WKK SOLID AR 8.000E+00 LS YES
 IT 4.000E-02 ITA 0.000E+00 EW 0.000E+00 DEN 7.900E+00 OC -0.760
 Comment: 316L P80746 1000 ppm Cl at 95 C



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 4/10/97

Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: A:\316cppl.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-06-97

File Status: NORMAL

Time Run: 14:31:26

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	494					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	7.900	g/ml	Equiv. Wt.	EW	8.0000	g
				Open Circuit	OC	-0.7600	V

Comment: 316L P80746 1000 ppm Cl at 95 C

7/10/97

Kinherly Am Guss

Kinherly Am Guss

CPP of 825 - 825cppl.dat

Objective: Measure E_p and E_{cp}

Specimen: Alloy 825, HT # HH4371FG

0.245" Diam x 1.913" long

600 grit finish. Exposed area 8.0 cm²

Start Wt = 10.78052 gm

End Wt = 10.62283 gm

Solution: 1000 ppm Cl⁻, 85 ppm HCO₃⁻, 20 ppm SO₄⁻, 10 ppm NO₃⁻, 2 ppm F⁻, 2000 ml solution from p. 5.

T = 95°C, Hg Thermometer 183301

Start pH = 8.278

End pH = 9.223

Potenstat: EG+G Versastat S/N 20104 w/ Model 352C Software

Reference: Fisher SCE 13-620-51 S/N 3108339

Counter Electrode: Pt. Flag

$E_{com} = -545\text{ mV}$ } Keithley 614 Electrometer S/N
 $E_{pt} = -400\text{ mV}$

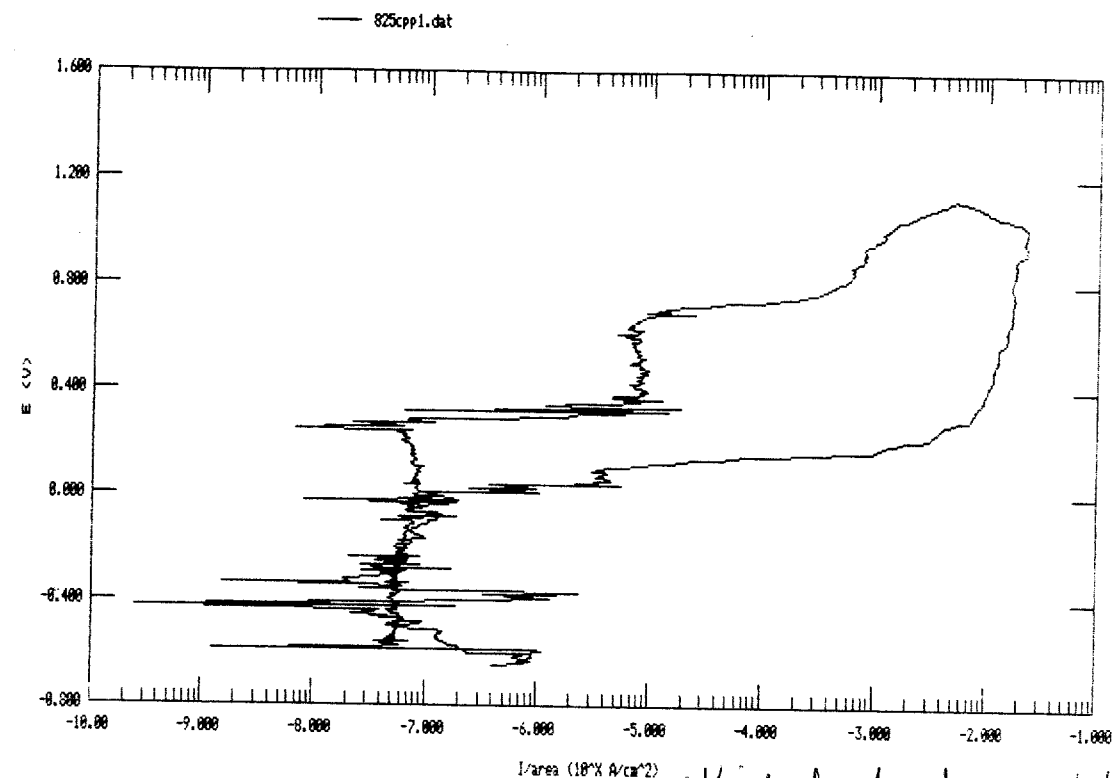
Test Started 4/10/97 Test Ended 4/10/97

$E_{pit} = 705\text{ mV}$

$E_{cp} = 0\text{ mV}$

Specimen shows large pits

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION File Status: NORMAL Date Run: 04-10-97 Time Run: 10:47:52 Pstat: VStat() Ver 2
 CP PASS vs. R CT PASS IP -0.100 vs. OC ID 20 S V1 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO NP 700 IR NONE
 FL NONE RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 8.000E+00 LS YES
 IT 4.000E-02 ITA 8.000E+00 EN 0.000E+00 BEN 8.140E+00 OC -0.545
 Comment: Alloy 825, HT, HH4371FG, 1000 ppm Cl⁻, at 95 C



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Model 352/252 Corrosion Analysis Software, v. 2.01
 Filename: a:\825cpp1.dat
 Pstat: VStat[] Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 04-10-97

File Status: NORMAL
 Time Run: 10:47:52

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	700					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.140	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.5450	V

Comment: Alloy 825, Ht. HH4371FB, 1000 ppm Cl⁻, at 95 C

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 4/11/97

CPP of 625 - 625cpp1.dat

Objective: Measure E_p and E_{cp}

Specimen: Alloy 625, Ht #NX9936AG, $P = 8.44 \text{ g/ml}$
 0.250" dx 1.913" long
 600 grit finish, exposed area 8.0 cm²
 Start wt. = 12.23528 gm
 End wt. = 12.22267 gm

Solution: 1000 ppm Cl⁻, 85 ppm HCO₃⁻, 20 ppm SO₄⁻, 10 ppm NO₃⁻, 2 ppm F⁻, 2000 ml solution from p. 5.
 $T = 95^\circ\text{C}$, Hg thermometer 183301
 Start pH = 8.278
 End pH = 4.839

Potentiostat: EG+G Versastat S/N 20104 w/ Model 352C software

Reference: Fisher SCE 13-620-31 S/N 3106339

Counter Electrode: Pt. Flag

$E_{cor} = 700 \text{ mV}$
 $E_{pt} = -126 \text{ mV}$ } Keithley 614 Electrometer S/N

Test Started ~~7:05~~ 4/10/97 Test Ended
 Kag 4/11/97

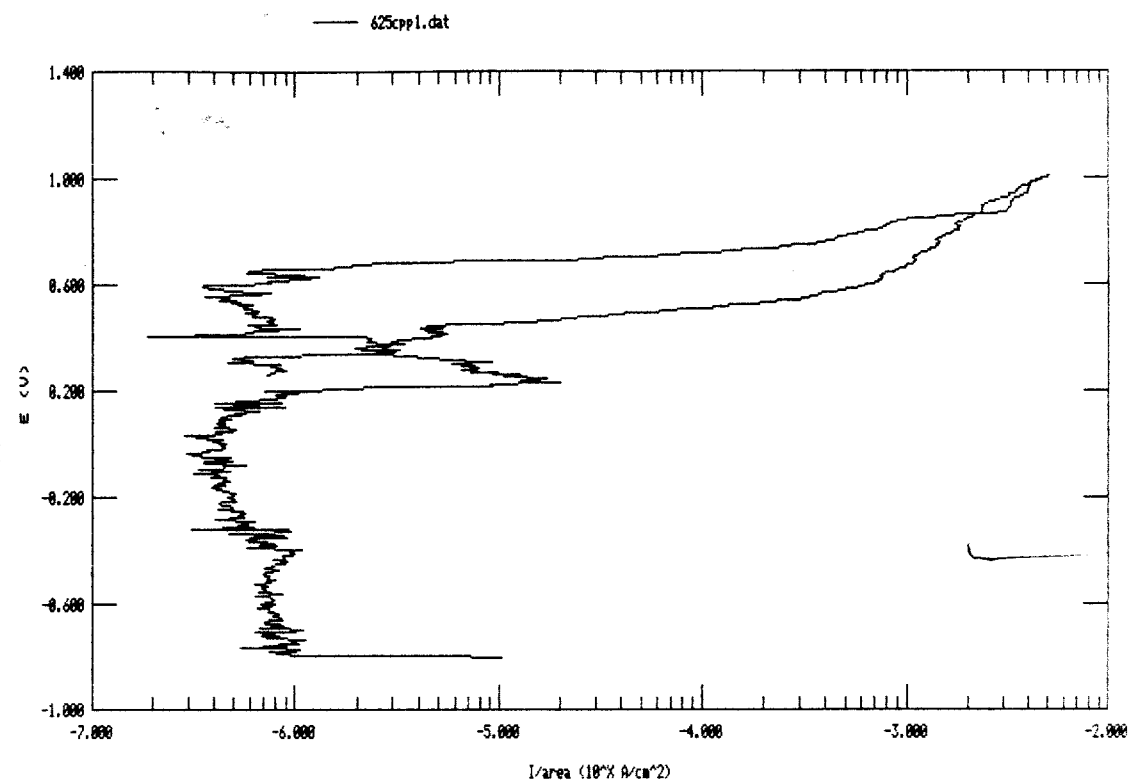
$E_{pit} = +648 \text{ mV}$
 $E_{cp} = 358 \text{ mV}$

Results: No pits were present on specimen.
 Surface was yellow in color up to water level
 after specimen was pulled from the sol'n.

4/11/97
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4/14/97
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Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION File Status: NORMAL Date Run: 04-11-97 Time Run: 08:49:17 Pstat: VStat[] Ver 2
 CP PASS vs. R CT PASS IP -0.100 vs. OC ID 20 S VI 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO HP 512 IR NONE
 FL NONE RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 8.000E+00 LS YES
 IT 4.000E-02 ITA 8.000E+00 EN 0.000E+00 DEN 8.440E+00 OC -0.702
 Comment: Alloy 625, HT #HX993606, 1,000 ppm Cl-, 95 C



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Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cppl.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-11-97

File Status: NORMAL

Time Run: 08:49:17

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm^2
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	512					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm^2	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.7020	V

Comment: Alloy 625, HT #HX993606, 1,000 ppm Cl-, 95 C

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CPP of 625, 4M Cl⁻, 95°C - 625cpp2.dat

Objective: measure E_{pit} + E_{rp}

Specimen: Alloy 625, H# NX9936AG, $P = 8.44 \text{ g}/\text{me}$
 0.250" Diameter x 1.913" long
 600 grit finish, exposed area 8.0 cm^2
 Start Wt = 12.22578 gm
 End Wt = 12.22221 gm

Solution: 4M Cl⁻ as NaCl lot #9160780 (233.76848 gm)
 85 ppm HCO₃⁻ as NaHCO₃ lot #923337A (0.118080 gm)
 20 ppm SO₄²⁻, 20 ml SO₄²⁻ - 4/97 Stock Sol'n, NB 157, p. 161
 10 ppm NO₃⁻, 10 ml NO₃⁻ - 4/97 Stock Sol'n, NB 157, p. 161
 2 ppm F⁻, 2 ml F⁻ - 4/97 Stock Sol'n, NB 157, p. 161
 + DI water to 1000 mL, Deaerated w/ 99.999% N₂
 85 ppm HCO₃⁻ added as NaHCO₃ 4/19/97
 $T = 95^\circ\text{C}$, Hg thermometer, #183301
 Start pH = 7.655 100g/4/14/97
 End pH = 8.705

Potentiostat: EG&G Versastat S/N 20104, w/ Model 352C software

Reference: Fisher SCE 13-620-51 S/N 3106339

Counter Electrode: Pt Flag

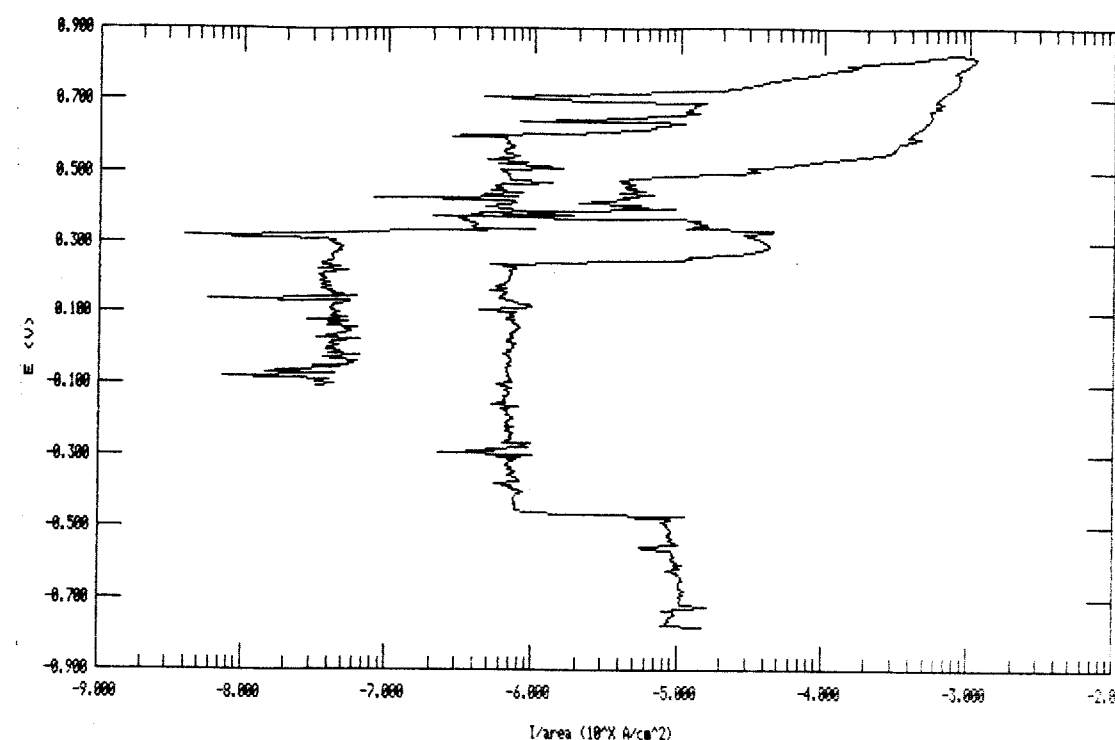
$E_{corr} = -668 \text{ mV}$ - 676 mV
 $E_{pit} = -38 \text{ mV}$

Test Started 4/14/97, 11:05 am

$E_{pit} = 707 \text{ mV}$

$E_{rp} = 387 \text{ mV}$

Localized pitting at top of sample - pits appear to be shallow.
 Specimen surface had black cor. product and in localized areas
 + yellow film in other areas.



4/14/97 Kimberly Ann Guss

Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp2.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-12-97

File Status: NORMAL

Time Run: 08:21:45

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NF	510					

Line Snc.	LS	yes		SI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.6830	V

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CPP of 625, ^{1M Cl⁻}~~4M Cl⁻~~, 2.5 pH, 95°C - ~~625~~cpp3.dat
Kag 4/14/97

Objective: measure E_{pit} + E_p

Specimen: Alloy 625, Ht # N9936AG, $\rho = 8.44 \text{ gm/cm}^3$
0.251" Diam x 1.915" long
600 grit finish, exposed area = 8.0 cm²
Start Wt = 12.22173 gm
End Wt = ~~12.23602 gm~~ 12.22216 gm Kag 4/10/97

Solution: 1M Cl⁻ as NaCl lot #960780 (58.44911 gm)
85 ppm HCO₃⁻ as ~~NaHCO₃~~ lot #923337A (0.12095 gm)
20 ppm SO₄²⁻, 20 ml SO₄²⁻ - 4/97 Stock Sol'n, NB 157, p. 161
10 ppm NO₃⁻, 10 ml NO₃⁻ - 4/97 Stock Sol'n, NB 157, p. 161
2 ppm F⁻, 2 ml F⁻ - 4/97 Stock Sol'n, NB 157, p. 161
+ DI water to 1000 ml, Deaerated w/ N₂ (99.999%)
85 ppm NCO₃⁻ added as NaHCO₃ QD 6/9/97
T = 95°C, Hg Thermometer #103304
Start pH = ~~7.899~~ 7.903
End pH = 8.893 Kag 4/14/97

Potentiostat: EG+G Versastat S/N 20104 w/ Model 352C software

Reference Electrode: Fisher SCE #13-620-51 S/N 3106339

Counter Electrode: Pt. Flag

$E_{corr} = -685 \text{ mV}$

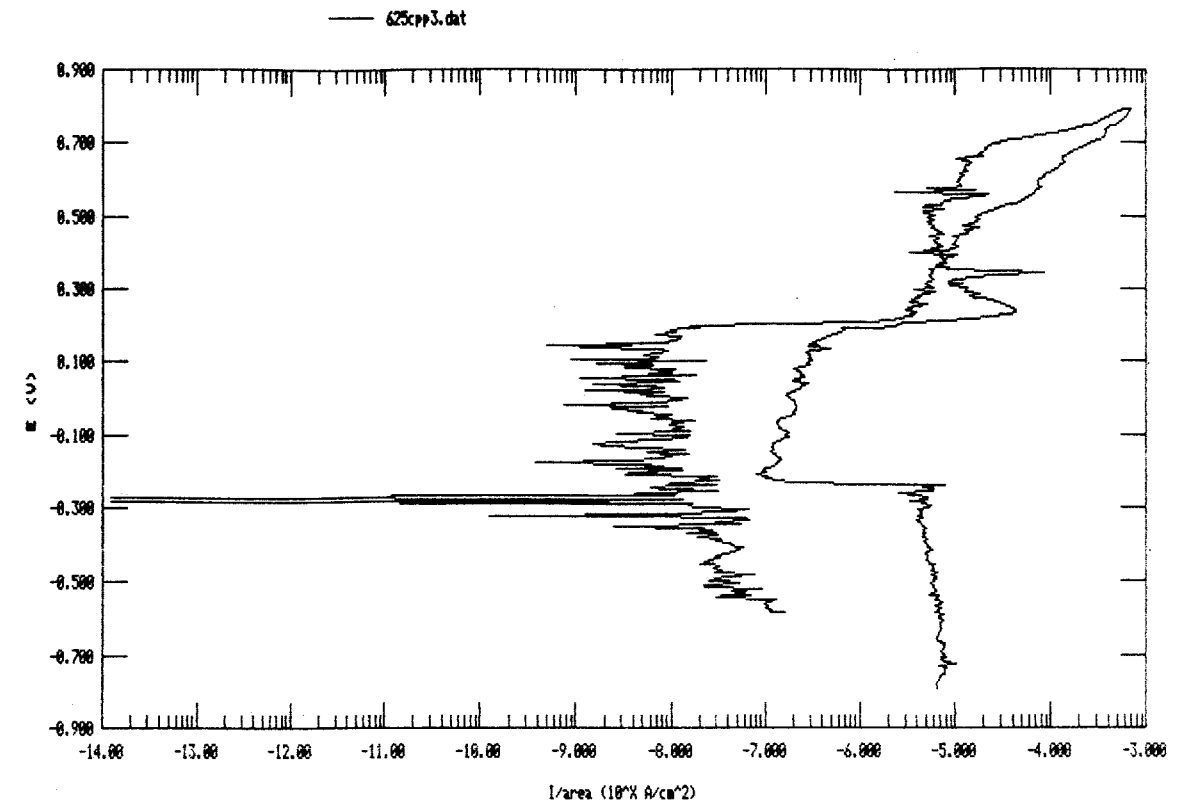
$E_{Pt} = -400 \text{ mV}$ -379 mV
Kag 4/14/97

Test Started 4/14/97

$E_{pit} = 655 \text{ mV}$

$E_p = 405 \text{ mV}$

No pitting - yellow surface layer after test.



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp3.dat

Pstat: VStat[1] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-12-97

File Status: NORMAL

Time Run: 14:36:47

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	594					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.6990	V

Kendall, Am. 4/14/97

4/16/97

Kendall, Am. 4/16/97

CPP of 625, 4M Cl⁻, 95°C, 2.4 pH ~ 625cpp4.dat

Objective: Measure E_{pit} + E_{cp}

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44 \text{ gm/ml}$
 0.250" x 1.915" long
 600 grit finish, exposed area 8.0 cm²
 Start wt = 12.17461 gm
 End wt = 12.16980 gm

Solution: 4M Cl⁻ as NaCl lot #960780 (233.75768 gm)
 20ppm SO₄²⁻, 20ml SO₄²⁻ - 4/97 Stock Sol'n, NB157, p.161
 10ppm NO₃⁻, 10ml NO₃⁻ - 4/97 Stock Sol'n, NB157, p.161
 20ppm F⁻, 2ml F⁻ - 4/97 Stock Sol'n, NB157, p.161
 7.1 ml 0.1M HCl, Stock Sol'n LB 218, p.20 (prep. 4/15/97)
 + DI water to 1000 ml, Deaerated w/ N₂ (99.999%)

Start pH = 2.572

End pH = 2.692

T = 95°C, Hg Thermometer 183304

EGTG

Potentiostat = Versastat S/W 20104 w/ Model 352C Software

Ref. Electrode = Fisher SCE # 13-620-S1 S/N 3106339

Counter Electrode = Pt. Flag

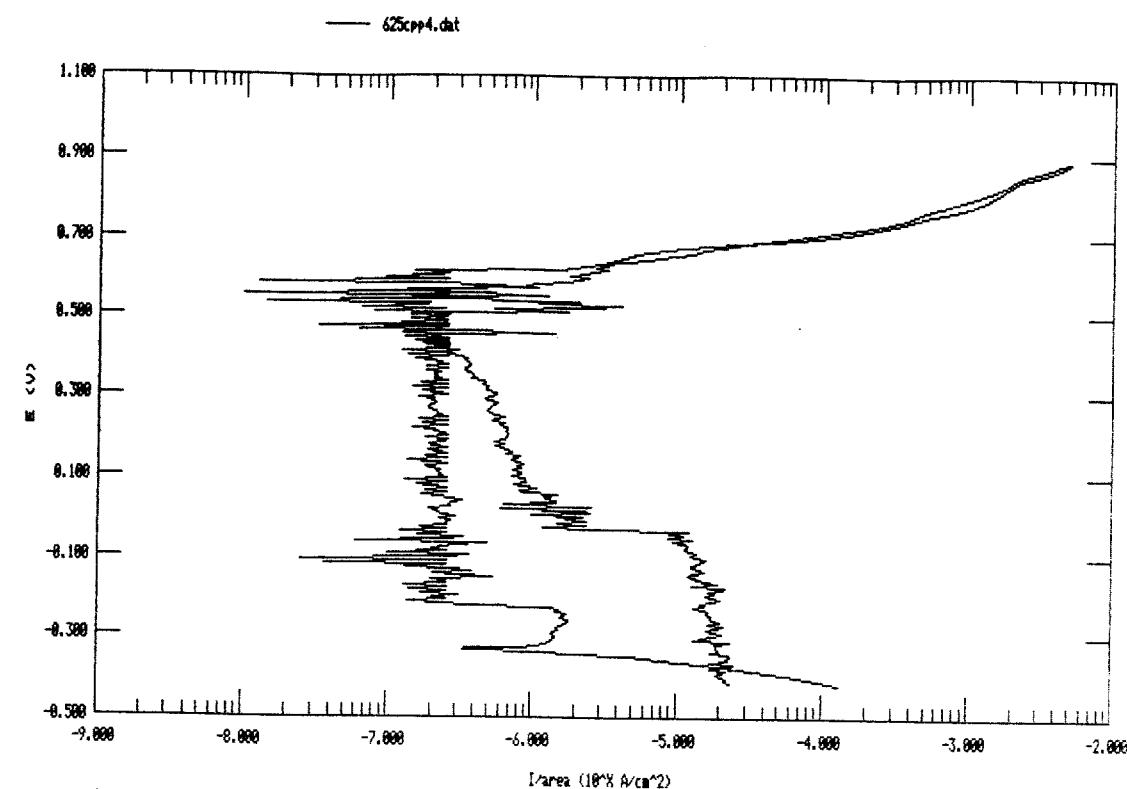
$E_{cor} = -320 \text{ mV}$

$E_{PE} = +420 \text{ mV}$

No pits observed - yellow film on surface

$E_{cp} = 589 \text{ mV}$

$E_{pit} = 569 \text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp4.dat

Pstat: VStat Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-16-97

File Status: NORMAL

Time Run: 10:34:41

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93 s
No. of Points	NP	524				

Line Sync.	LS	yes		GI Time Const.	TC	Off
Rise Time	RT	high stability		IR Mode	IR	none
Working Elec.	WE	Solid		Filter	FL	Off
Sample Area	AR	8.000	cm²	Ref. Elec.	RE	SCE 0.2415 V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000 g
				Open Circuit	OC	-0.3210 V

Comment: Alloy 625, 4M Cl⁻, pH=2.5, T=95 C

Stock Solutions

~~0.1M~~ 1.0M NaOH, 8.02161 gm NaOH + DI water to
200ml, NaOH lot # 883164,
prepared 4/15/97, expires 6/15/97

1.0M HCl, 8.34ml HCl lot # 95615B + DI water to 200ml
prepared 4/15/97, expires 6/15/97

(0.80216 gm)
0.1M NaOH, 20ml 1.0M NaOH Stock Sol'n as
described above + DI water to 200ml
prep. 4/15/97, expires 6/15/97

0.1M HCl, 10ml 1.0M HCl Stock Sol'n as
described above + DI water to 100ml
prep. 4/15/97, expires 6/15/97

(0.08021 gm)
0.01M NaOH, 10ml 0.1M NaOH Stock Sol'n as
described above + DI water to 100ml
prep. 4/15/97, expires 6/15/97

0.01 HCl, 10ml 0.1M HCl Stock Sol'n as
described above + DI water to 100ml
prep. 4/15/97, expires 6/15/97

Kimberly Ann Davis 4/16/97

CPP of 304

Objective: to measure E_{rep} + E_{pit} to check out the system

Specimen: 304, Ht # T0954, $\rho = 7.94 \text{ gm/ml}$
0.251" x 1.912" long
220 grit finish, exposed area
Start wt = 11.32539 gm
End wt = 11.29975 gm

Solution: 1000 ppm Cl^- , 85 ppm HCO_3^- , 20 ppm SO_4^{2-} , 10 ppm NO_3^- ,
2 ppm F^- , 2000ml solution from p.5
 $T = 95^\circ\text{C}$, Hg thermometer 18330,
Start pH = 8.278
End pH = 9.688

Potentiostat: EG+G Versastat S/N 20104 w/Model 352C Software

Reference Electrode: Fisher SCE #13-620-51 S/N 3106339

Counter Electrode: Pt. Flag

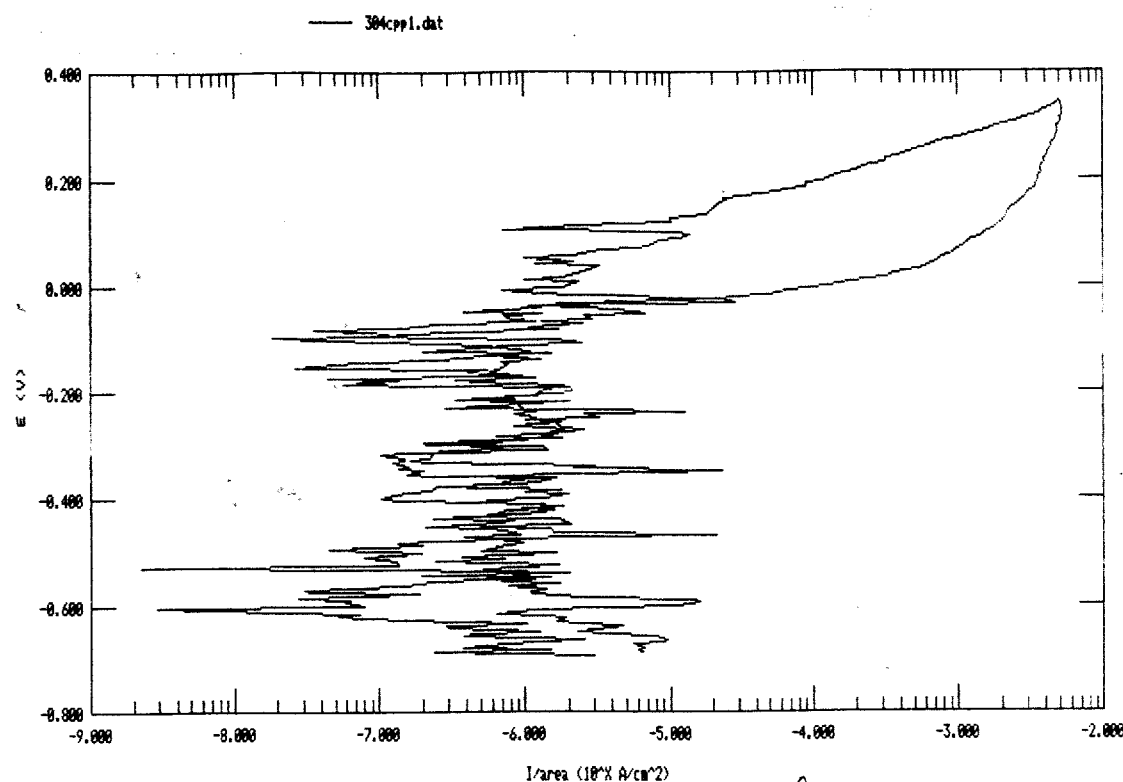
$E_{\text{corr}} = -591 \text{ mV}$
 $E_{\text{Pt}} = +80 \text{ mV}$

Test Started 4/16/97

$E_{\text{pit}} = 107 \text{ mV}$
 $E_{\text{rep}} = -33 \text{ mV}$

Many, many pits!

Kimberly Ann Davis 4/16/97



Kimberly Ann Guss 4/18/97

Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\304cp1.dat

Pstat: VStat II Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-16-97

File Status: NORMAL

Time Run: 05:11:35

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	414					
Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	8.000	cm²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	7.940	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.5930	V

Comment: 304, 1000 ppm Cl-, 95 C

Kimberly Ann Guss 4/16/97

CPP of 625 w/ a crevice, 4 M Cl-, 2.5 pH, 95°C

625cpp5.dat

Objective: Measure E_{pit} + E_{oc} with a Crevice Corrosion geometry

Specimen: Alloy 625, Ht # NX9936AG, P = 8.44 g/mL

Specimen dimensions - see dwg. on page 24

600 grit finish, exposed area 20 cm²

Start wt = 31.19536 gm

End wt = 31.09686

Solution: 4 M Cl- as NaCl lot # 960780 (233.72479 gm)

20 ppm SO_4^{2-} , 20 mL SO_4^{2-} - 4/97 Stock Sol'n, NB 157, p.161

10 ppm NO_3^- , 10 mL NO_3^- - 4/97 Stock Sol'n, NB 157, p.161

2 ppm F^- , 2 mL F^- - 4/97 Stock Sol'n, NB 157, p.161

5.5 mL 0.1 M HCl Stock Sol'n, NB 218, p.20

+ DI water to 1000 mL, Deaerated w/ N_2 (99.999%)

T = 95°C, Hg Thermometer, 183301

Start pH = 2.499

End pH = 7.463

Potentiostat: EG+G Versastat S/N 20104 w/ Model 352C Software

Ref. Electrode: Fisher SCE #13-620-51 S/N 3106339

Counter Electrode - Pt flag

$E_{oc} = -320$ mV

$E_{pit} = +462$ mV

Test Started 4/16/97

$E_{pit} = 177$ mV

$E_{oc} = -253$ mV

Large, fairly deep pits observed w/ black Cor. product in + around pit.

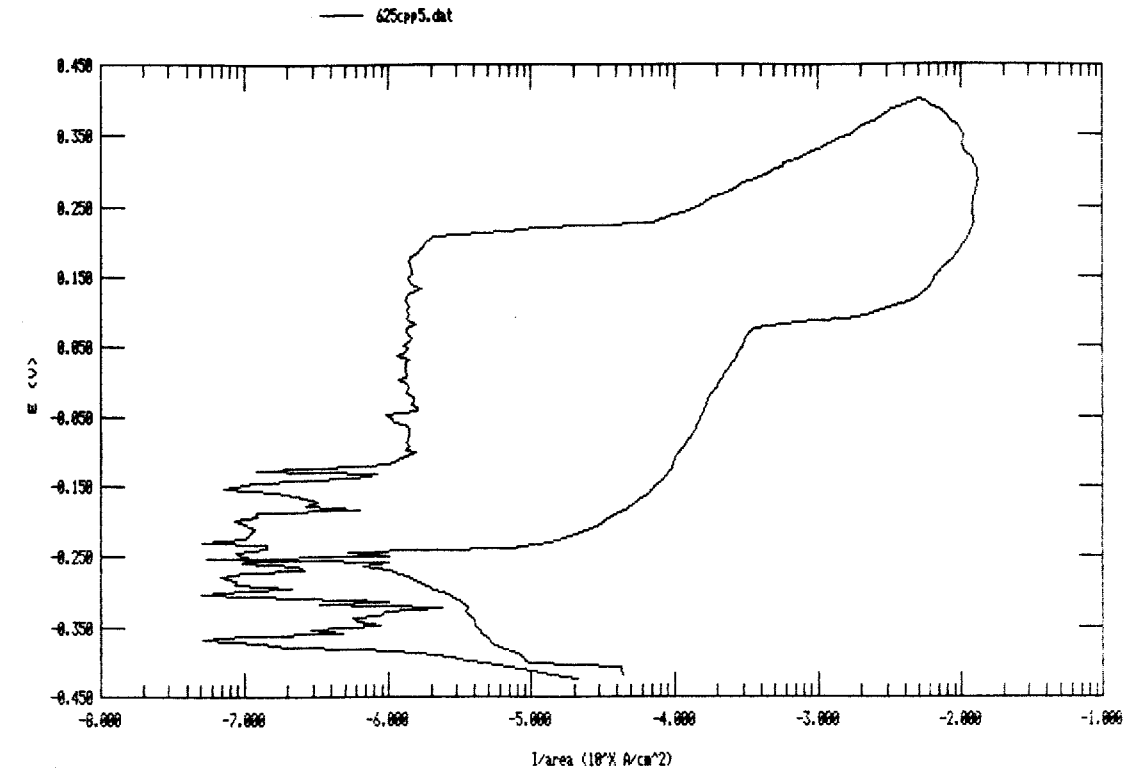
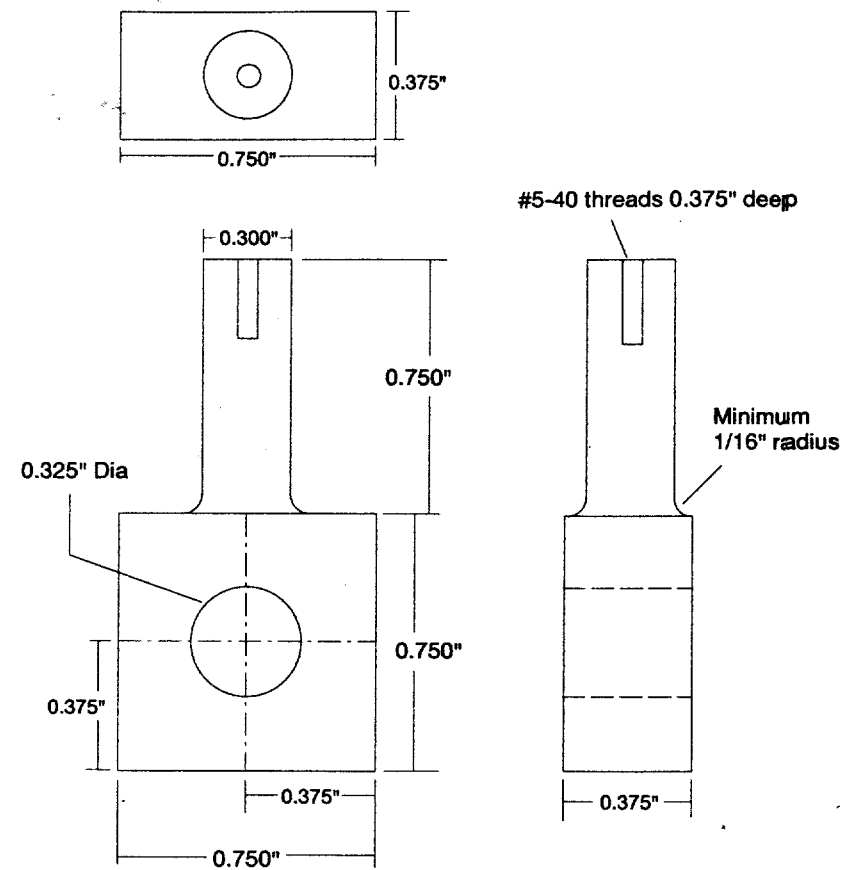
4/16/97

Kimberly Ann Guss

4/20/97

Kimberly Ann Guss

CREVICE REPASSIVATION SPECIMEN
All Dimensions +/- 0.003"



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp5.dat

Pstat: UStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-17-97

File Status: NORMAL

Time Run: 10:07:00

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	330					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	ME	Solid		Filter	FL	Off	
Sample Area	AR	20.00	cm ²	Ref. Elec.	RE	SCE	0.2415 V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.3230	V

Kimberly Ann Bruns 4/20/97

Kimberly Ann Bruns 4/20/97

CPP of C-22 w/ a crevice, 4M Cl⁻, pH=2.5, T=95°C

C22cpp1.dat

Objective: measure E_{cp} & E_{pit} with a crevice corrosion geometry

Specimen: Alloy C-22, HT # 2277-8-3175

Specimen Dimensions - see page 24

600 grit finish, exposed area = 20 cm²

Start wt: 31.59458 gm

End wt: ~~31.67581 gm~~ 31.59100 gm
Kag 4/21/97

Solution: 4M Cl⁻ as NaCl lot # 960780 (233.77446 gm)

20 ppm SO₄²⁻ - 20 ml SO₄²⁻ - 4/97 Stock Sol'n

10 ppm NO₃⁻, 10 ml NO₃⁻ - 4/97 Stock Sol'n } NB157, p.161

2 ppm F⁻, 2 ml F⁻ - 4/97 Stock Sol'n

5.4 ml 0.1M HCl Stock Sol'n, NB218, p.20

+DI water to 1000 ml, deaerated w/ N₂ (99.999%)

Start pH = 2.514

End pH = 3.555

T=95°C, Hg thermometer, 183304

Potentiostat: EG+G Versastat S/N 20104 w/ Model 352C Software

Ref. Electrode: Fisher SCE #13-620-51 S/N 3106339

Counter Electrode: Pt. Flag

E_{corr} = -267 mV

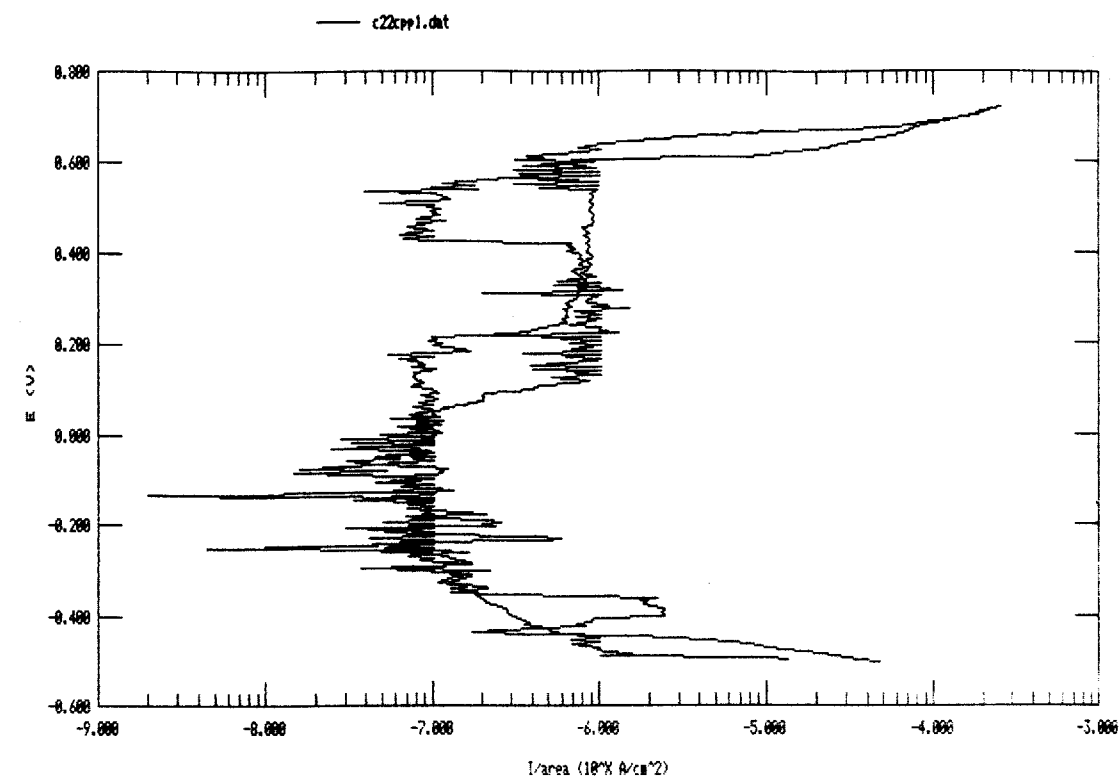
E_{pit} = 400 mV

Test started 4/19/97

E_{cp} = 585 mV

E_{pit} = 615 mV

No pits, yellow-brown surface film.



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\c22cpp1.dat

Pstat: VStatII Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-17-97

File Status: NORMAL

Time Run: 18:11:32

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	498					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	20.00	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.690	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4050	V

Kimberly Ann Jones 4/21/97

Kimberly Ann Jones 4/21/97

CPP of Alloy 625, 1MCl⁻, pH=2.5, 95°C - w/ Crevice

625cpp6.dat

Objective: Measure E_{cp} + E_{pit} with a crevice corrosion geometry

Specimen: Alloy 625, Ht # NX9936 AG, $\rho = 8.44 \text{ gm/ml}$

Specimen Dimensions - See page 24

600 grit finish, exposed area 20 cm^2

Start wt = 31.31584 gm

End wt = 31.30621 gm

Solution: 1M NaCl⁻ as NaCl lot #960700, $58.44 \times 100 \text{ gm}$
~~58.44221 gm~~ } kg 4/13/97

20ppm SO₄²⁻, 20ml SO₄²⁻ - 4/17 Stock Sol'n

10ppm NO₃⁻, 10ml NO₃⁻ - 4/97 Stock Sol'n

2ppm F⁻, 2ml F⁻ - 4/97 Stock Sol'n

21.5 ml 0.1M HCl Stock Sol'n - NB218, p. 20

+ DI water to 1000 ml, Deaerated 99.999% N₂

T=95°C, Hg thermometer, 183301

Start pH = 2.500

End pH = 2.586

Potentiostat = EG&G Versastat S/N 20104 w/ Model 352c Software

Ref. Electrode: Fisher SCE # 13-620-51 S/N 3106339

Counter Electrode: Pt. Flag

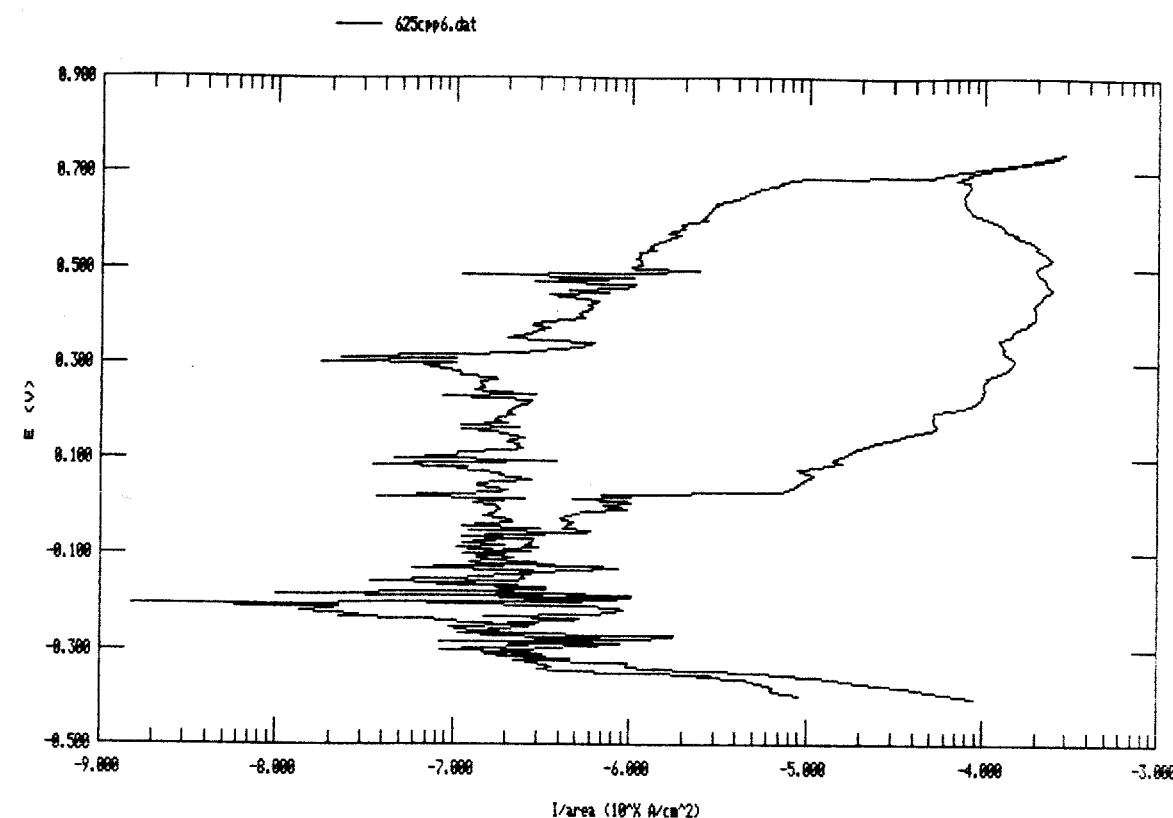
$E_{corr} = -301 \text{ mV}$

$E_{pit} = +526 \text{ mV}$

Test Started 4/18/97

$E_{pit} = 515 \text{ mV}$

$E_{cp} = -60 \text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp6.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-18-97

File Status: NORMAL

Time Run: 09:47:40

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm^2
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	458					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	Off	
Sample Area	AR	20.00	cm^2	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.3050	V

Kimberly Ann Gmms 4/21/97

Kimberly Ann Gmms 4/21/97

CPP of Alloy 625, 4M Cl⁻, pH ~ 8.5, 95°C - w/ Crevice

625cpp7.dat

Objectives: Measure E_{pit} + E_{rp} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44 \text{ g/cm}^3$

Specimen Dimensions - see page 24

600 grit finish, exposed area 20 cm^2

Start Wt = 31.24796 gm

End Wt = ~~31.25375 gm~~ 31.23832 gm kay 4/22/97

Solution: 4M Cl⁻ as NaCl lot # 960780 (233.76329 gm)

20ppm Sb³⁺ - 804-4/97 Stock Sol'n

10ppm NO₃⁻ - 4/97 Stock Sol'n

2ppm F⁻ - 4/97 Stock Sol'n

85ppm HCO₃⁻ as NaHCO₃ lot # 923337A (0.11685 gm)

+ DI water to 1000 ml, Deaerated w/ 99.999% N₂

85ppm HCO₃⁻ added as NaHCO₃ QD 6/9/97

T = 95°C, Hg Thermometer 183304

Start pH = 7.529

End pH = 8.728

Potentiostat = EG&G Versastat S/N 20104 w/ Model 352c Software

Ref. Electrode = Fisher SCE #13-601-51 S/N 3106339

Counter Electrode = Pt. Flag

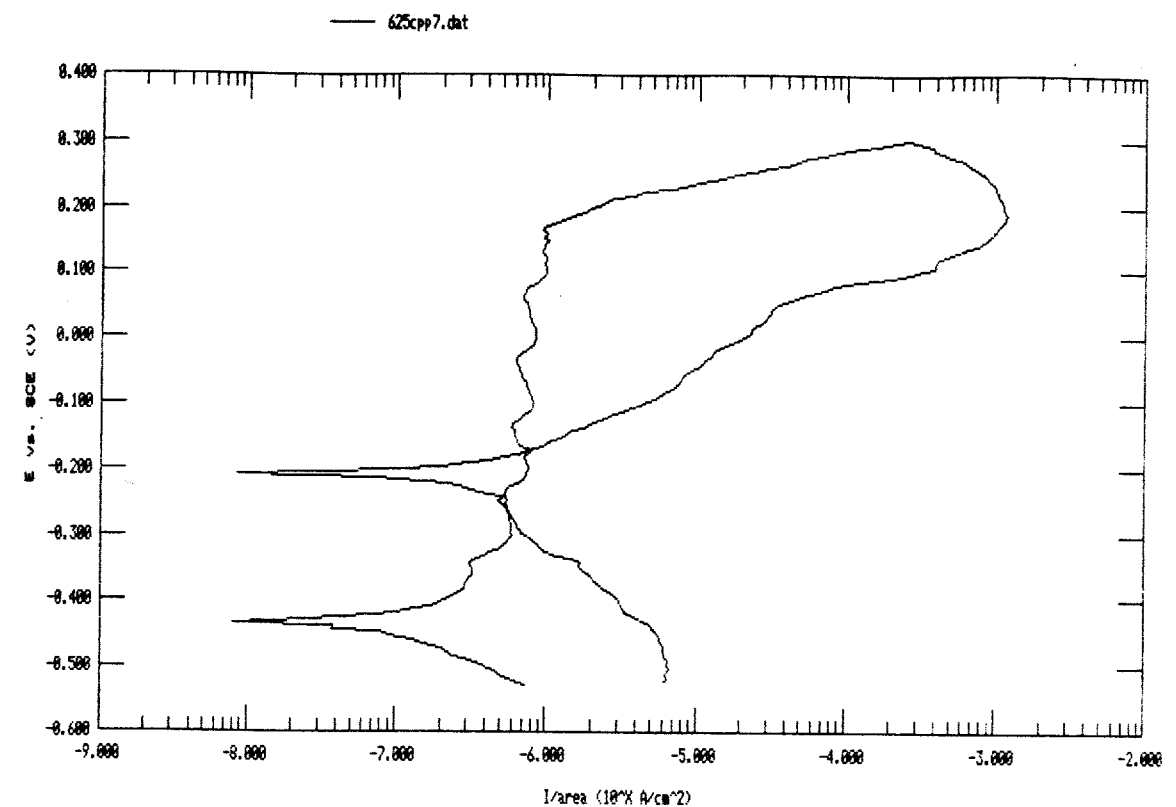
$E_{cor} = -431 \text{ mV}$

$E_{pit} = -371 \text{ mV}$

Test Date: 4/18/97

$E_{pit} = 168 \text{ mV}$

$E_{rp} = -177 \text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: A:\625cpp7.dat

Pstat: VStat[1] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-18-97

File Status: NORMAL

Time Run: 14:46:32

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	5.000E-3	A/cm ²
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	332					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	15.3Hz	
Sample Area	AR	20.00	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4270	V

Kimberly Ann Dumas 4/21/97

Kimberly Ann Dumas 4/21/97

CPP of Alloy 625, 1000 ppm Cl^- , 95°C - w/Crevice

625cpp8.dat

Objectives: Measure E_{pit} + E_{pp} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht # NX9936AG, P= 8.44 g/ml

Specimen Dimensions - see page 24

600 grit finish, exposed area 20cm^2

Start wt = 30.79735 gm

End wt = 31.16451 gm

Solution: 1000ppm Cl^- as NaCl lot # 9160780 (1.64961 gm)

20ppm SO_4^{2-} as SO_4^{2-} - 4/97 Stock Sol'n

10ppm NO_3^- - NO_3^- - 4/97 Stock Sol'n } NB 157, p. 161

2ppm F^- - F^- - 4/97 Stock Sol'n

85ppm HCO_3^- as NaHCO_3 lot # 923337A (0.11366 gm)

+ DI water to 1000ml, deaerated w/ 99.999% N_2

85ppm NCO_3^- added as NaHCO_3 6/9/97

$T=95^\circ\text{C}$, Hg thermometer, 183304

Start pH = 8.181

End pH = 9.410

Potentiostat = EG&G Versastat S/N 20104 w/ Model 352C Software

Ref. Electrode: Fisher SCE #13-601-51 S/N 3106339

Counter Electrode: Pt flag

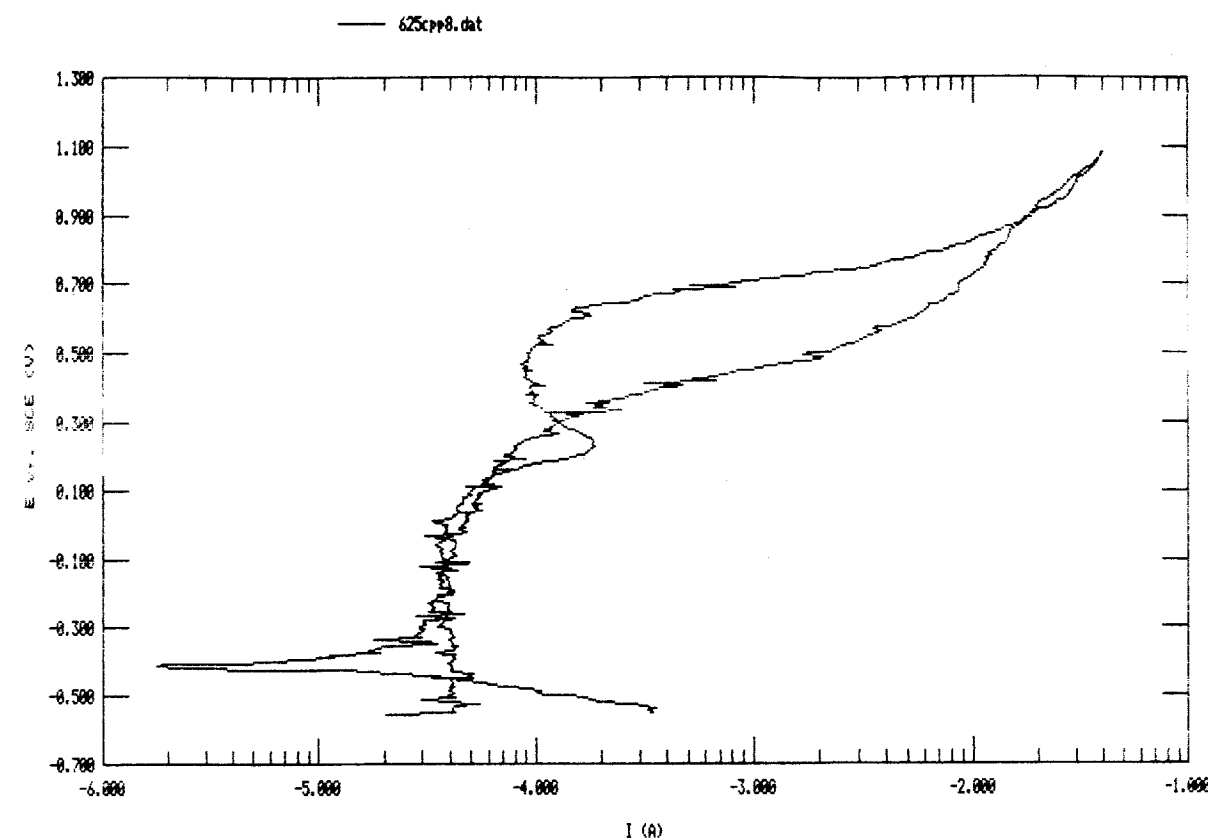
$E_{\text{cor}} = -456\text{ mV}$

$E_{\text{pt}} = -390\text{ mV}$

Test Date 4/22/97

$E_{\text{pit}} = 509\text{ mV}$

$E_{\text{pp}} = 299\text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp8.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-21-97

File Status: NORMAL

Time Run: 16:01:36

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	10	s	I Threshold	IT	40.00E-3	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	654					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	I 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4560	V

Should be 100E-3 A

Kimberly Ann Grinde 4/24/97

CPP of Alloy 625, 1000 ppm Cl⁻, pH=2.5, T=95°C - w/crevice

625cpp9.dat

Objectives: Measure E_{pit} + E_{rp} w/ a crevice corrosion geometry

Specimen: Alloy 625, H# NX9936AG, ρ = 8.44 g/cm³
 Specimen Dimensions - see page 24
 600 grit finish, exposed area 20.0 cm²
 Start wt = 31.19385 gm
 End wt = 30.78469 gm

Solution = 1000 ppm Cl⁻ as NaCl lot #960780 (1.65614 gm)
 20 ppm SO₄²⁻ as SO₄ 4/97 Stock Sol'n
 10 ppm NO₃⁻ as NO₃ 4/97 Stock Sol'n
 2 ppm F⁻ as F⁻ 4/97 Stock Sol'n
 85 ppm HCO₃⁻ as NaHCO₃ lot #923337A (0.11883 gm)
 42.9 ml 0.1M HCl as Stock Sol'n - NB218 p. 20
 + DI water to 1000 ml, Deaerated w/ 99.999% N₂

T=95°C, Hg thermometer, 183304
 Start pH = 2.500
 End pH = 2.745

Potentiostat = EG&G Versastat S/N 20104 w/ Model 352C Software

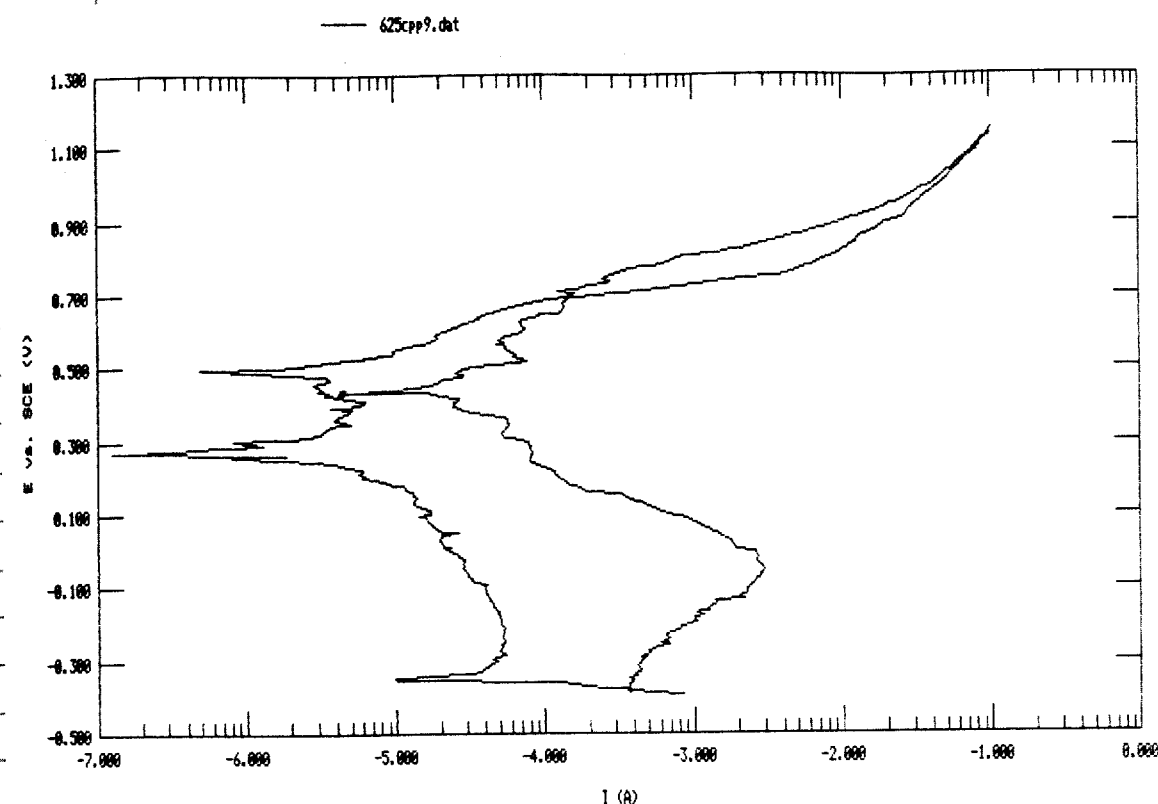
Ref. Electrode = Fisher SCE # 13-601-SI S/N 3106339

Counter Electrode = Pt. Flag

E_{corr} = -289 mV
 E_{pc} = +480 mV

Test Date 4/22/97

E_{pit} = 497 mV
 E_{rp} = 692 mV



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp9.dat

Rstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-22-97

File Status: NORMAL

Time Run: 00:58:54

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	618					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.2370	V

Kimberly Ann Gmoser 4/24/97

Kimberly Ann Gmoser 4/24/97

CPP of Alloy 625, 1M Cl⁻, pH=8.5, T=95°C

625cpp10.dat

Objectives: Measure E_{pit} + E_{cp} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht[#] NX9936AG, $f=8.448\%$ ne
 Specimen Dimensions - see page 24
 600 grit finish, exposed area 20.0 cm²
 Start wt: 31.26404 gm
 End wt: 31.15856 gm

Solution: 1M Cl⁻ as NaCl lot #960780 (58.4422 gm)
 20ppm SO₄²⁻ as SO₄²⁻ 5/97 Stock Sol'n
 10ppm NO₃⁻ as NO₃⁻ 4/97 Stock Sol'n } N. 157, p. 161
 2ppm F⁻ as F⁻ 4/97 Stock Sol'n
 85 ppm HCO₃⁻ as ~~NaHCO₃~~ lot #9233371 (0.117485 gm)
 + DI water to 1000 ml, Deaerated w/ 9.999% N₂
 85 ppm HCO₃⁻ ~~NaHCO₃~~ as NaHCO₃ 6/9/97
 T=95°C, Hg thermometer 183301
 Start pH = 7.829
 End pH = 8.739
 8.763 tag 4/24/97

Potentiostat: EG&G Versastat S/s 20104 w/ Model 352c Software

Ref. Electrode: Fisher SCE #13-601-51 S/N 3106339

Counter Electrode: Pt-Flag

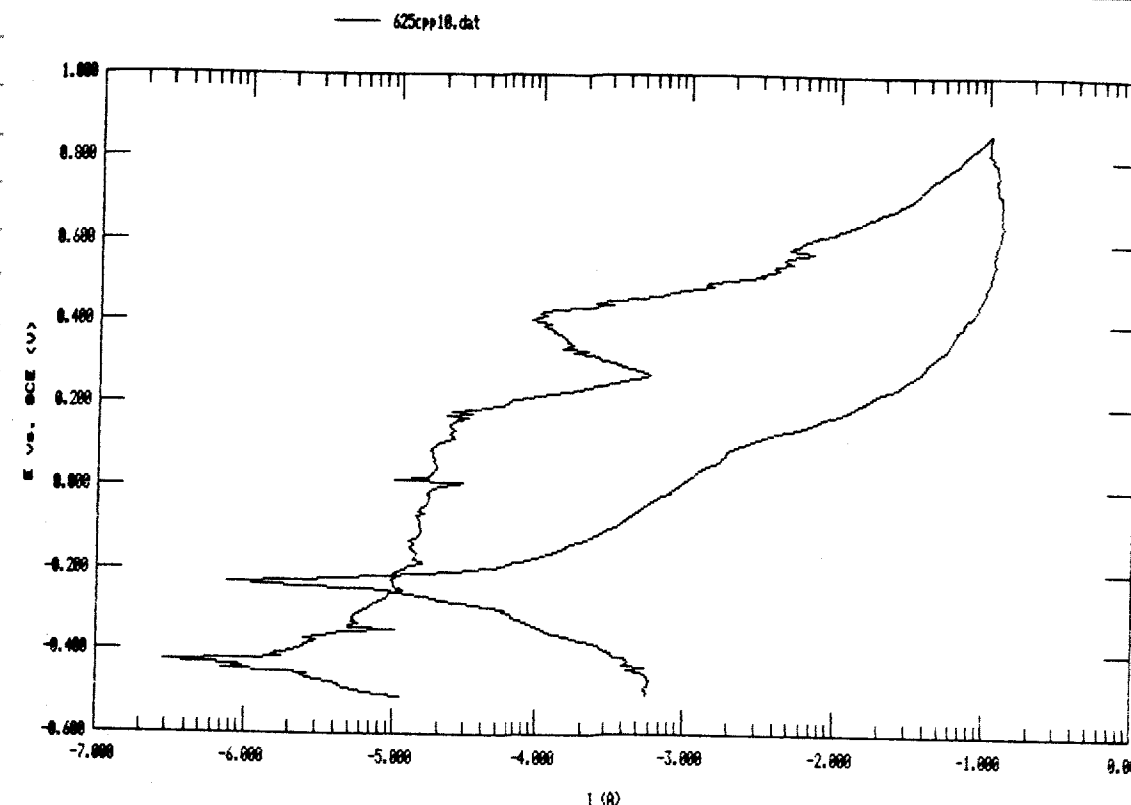
$E_{corr} = -409$ mV

$E_{pe} = -107$ mV

Test Date 4/22/97

$E_{pit} = -424$ mV

$E_{cp} = -216$ mV



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp10.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-22-97

File Status: NORMAL

Time Run: 14:39:28

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	548					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	15.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4110	V

CPP of Alloy 625, 4M Cl⁻, pH=7.5, T=95°C

625cpp12.dat

Objective: to measure E_{pr} + E_{pit} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44 \text{ g/cm}^3$
 Specimen Dimensions - see p. 24
 600 grit finish, exposed area 20.0 cm^2
 Start wt: 31.17334 gm
 End wt: 31.11881 gm

Solution: 4M Cl⁻ as NaCl Lot #960780 (233.7649 gm)
 20 ppm SO₄²⁻ - SO₄²⁻ 4/97 Stock Sol'n (20 ml)
 10 ppm NO₃⁻ as NO₃⁻ 4/97 Stock Sol'n (40 ml)
 2 ppm F⁻ as F⁻ 4/97 Stock Sol'n (2 ml)
 + DI water to 1000 ml, Deaerated w/ 99.999% N₂
 85 ppm HCO₃⁻ as Na₂CO₃ Lot #923337A (0.11840 gm)
 T=95°C, Hg thermom 183301

Start pH = 8.395

End pH = 8.543

85 ppm HCO₃⁻ approx as NaHCO₃ DD 6/9/97

Potentiostat: EG&G Versastat w/ Model 352C Software

Ref. Electrode: Fisher SCE # 13-601-51 3106339
 1/2 N 200 ml kay 4/24/97

Counter Electrode: Pt. Flag

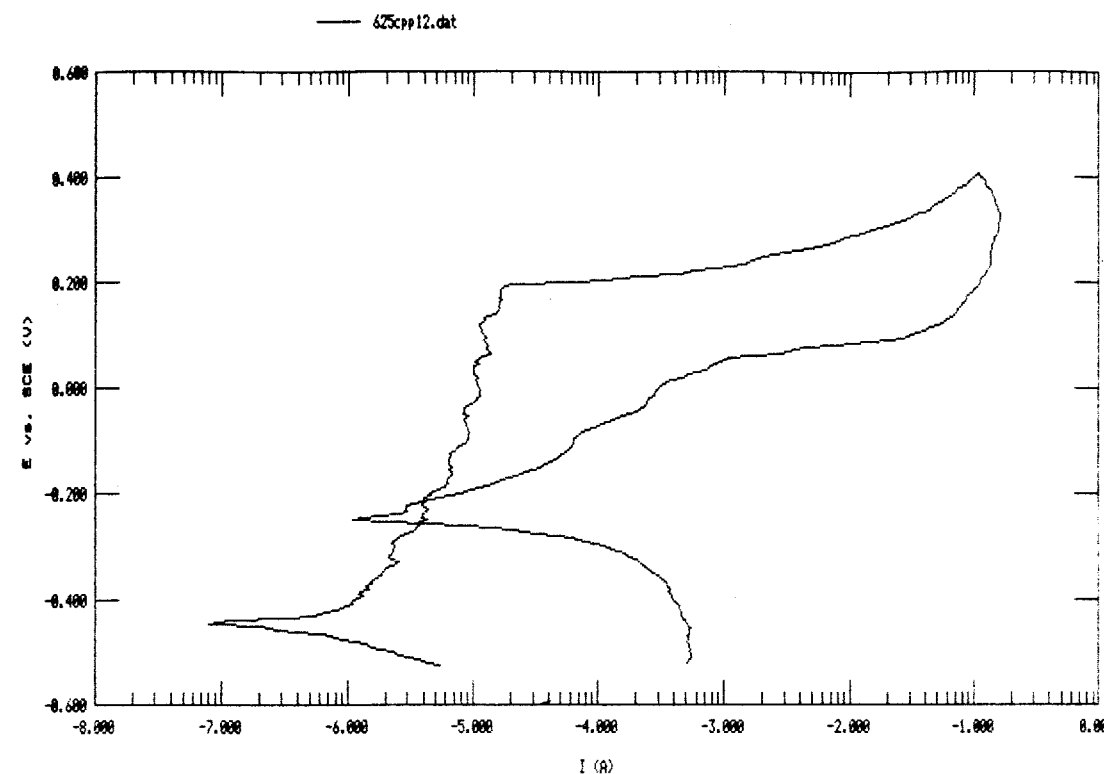
$E_{\text{corr}} = -292 \text{ mV}$ kay 4/28/97 -427 mV

$E_{\text{pr}} = -545 \text{ mV}$ kay 4/28/97 -219 mV

Test Date = 4/28/97

$E_{\text{pit}} = 191 \text{ mV}$

$E_{\text{pr}} = -214 \text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp12.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-24-97

File Status: NORMAL

Time Run: 14:10:41

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	372					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4240	V

Comment: Alloy 625, 4 M Cl⁻, pH=7.5, 95 C

Kishelby Ann Guss 4/28/97

Kishelby Ann Guss 4/29/97

CPP of Alloy 625, 1MCl⁻, pH=2.5, T=95°C

625cpp11.dat

Objective: to measure $E_{pit} + E_{rp}$ w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht # NX99364G, $\rho = 8.44 \text{ g/ml}$
 Specimen Dimensions - See p. 24
 600 grit finish, exposed area ~~20.0~~ ^{20.0} cm^2
 Start wt: 31.21035 gm
 End wt:

Solution: 1M Cl⁻ as NaCl lot #960780 (58.44315 gm)
 20ppm SO₄ as SO₄ - 4/97 Stock Soln
 10ppm NO₃ as NO₃ - 4/97 Stock Soln
 2ppm F⁻ as F⁻ - 4/97 Stock Soln
 + DI water to 1000 ml, Deaerated w/ 99.999% N₂
 18.4 ml 0.1M HCl as Stock Soln - NB218 p. 42

T=95°C, Hg thermometer 183304
 Start pH = 2.500
 End pH = 5.278

Potentiostat: EG&G Versastat w/ Model 352C Software

Ref. Electrode: Fisher SCE # 13-601-51 S/N 3106339

Counter Electrode: Pt. Flag

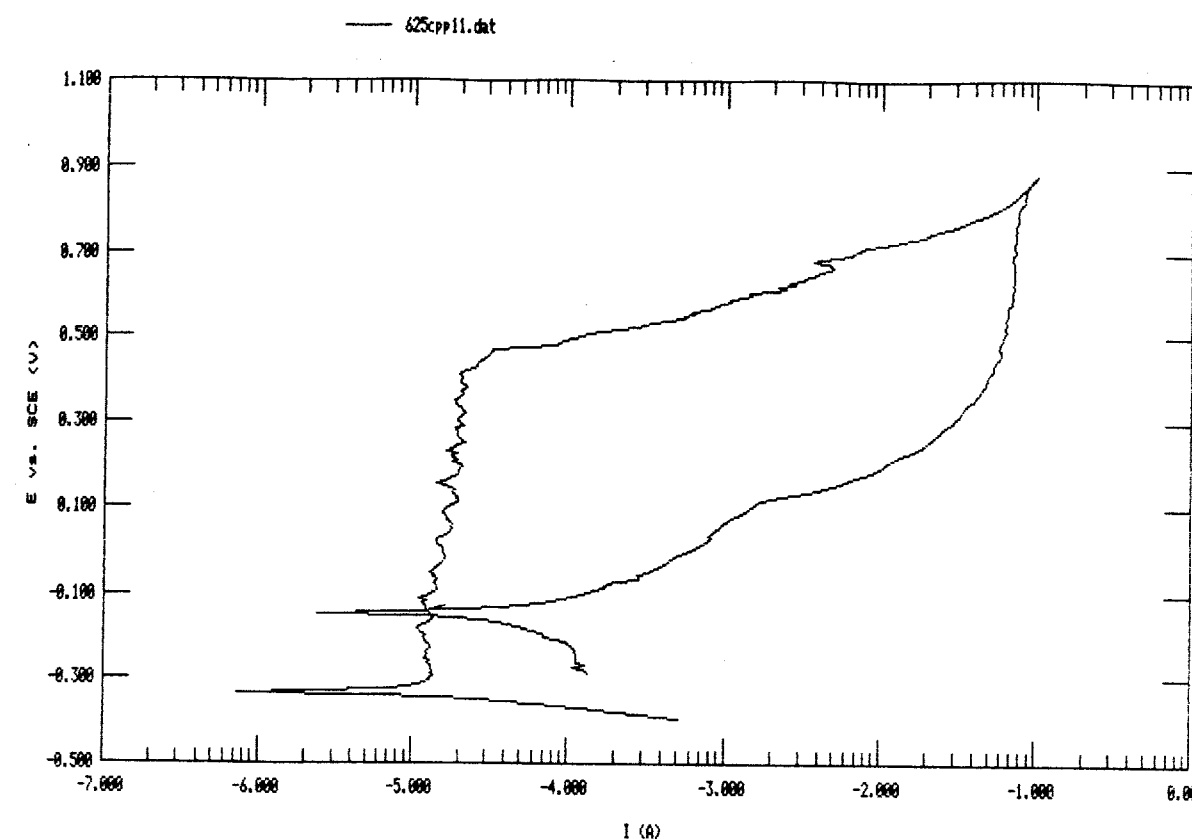
$E_{corr} = -292 \text{ mV}$

$E_{pit} = +545 \text{ mV}$

Test Date = 4/29/97

$E_{pit} = 413 \text{ mV}$

$E_{rp} = -142 \text{ mV}$



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp11.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-24-97

File Status: NORMAL

Time Run: 07:12:04

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	0.0000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	400					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	15.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.2928	V

Kimberly Ann Lusa 4/29/97

Kimberly Ann Lusa 4/29/97

Stock Solutions

0.1 M HCl, 10 ml 1.0 M HCl Stock Sol'n as described
on p.20 (NB218) + DI water to 100 ml
prepared 4/24/97, Expires 6/24/97

4/29/97

Kimberly Ann Dwyer

Lead-in-Pencil of Alloy 625, 4 M Cl⁻, pH = 8.5, T = 95°C

62SLIP1.dat

Objectives: To measure E_{exp} of a single pit

Specimen: Alloy 625, Ht # NX9936 AG, $\rho = 8.44 \text{ g/cm}^3$

Specimen Dimensions - see p. 46

~~600 grit finish~~ kay 4/29/97

Start wt: 6.29789 gm

End wt: 6.27276 gm

Solution: 4 M Cl⁻ as NaCl lot # 960780 (467.51438 gm)

20 ppm SO₄²⁻ as SO₄²⁻ Stock Sol'n

10 ppm NO₃⁻ as NO₃⁻ Stock Sol'n

2 ppm F⁻ as F⁻ Stock Sol'n

Start pH = 8.637

+ DI water to 2000 ml

4 M Cl⁻ as NaCl lot # 960780 (233.76866 gm)

20 ppm SO₄²⁻ as SO₄²⁻ Stock Sol'n

10 ppm NO₃⁻ as NO₃⁻ Stock Sol'n

2 ppm F⁻ as F⁻ Stock Sol'n

+ DI water to 1000 ml

Start pH = 8.271

3 L of sol'n needed for experiment - mixed both solutions
pH = 8.738 for mixed solution

T = 95°C, Hg thermometer Hg Thermometer # 0323008
Deaerated w/ 99.999% N₂

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE # 13-620-51 S/N 5129169

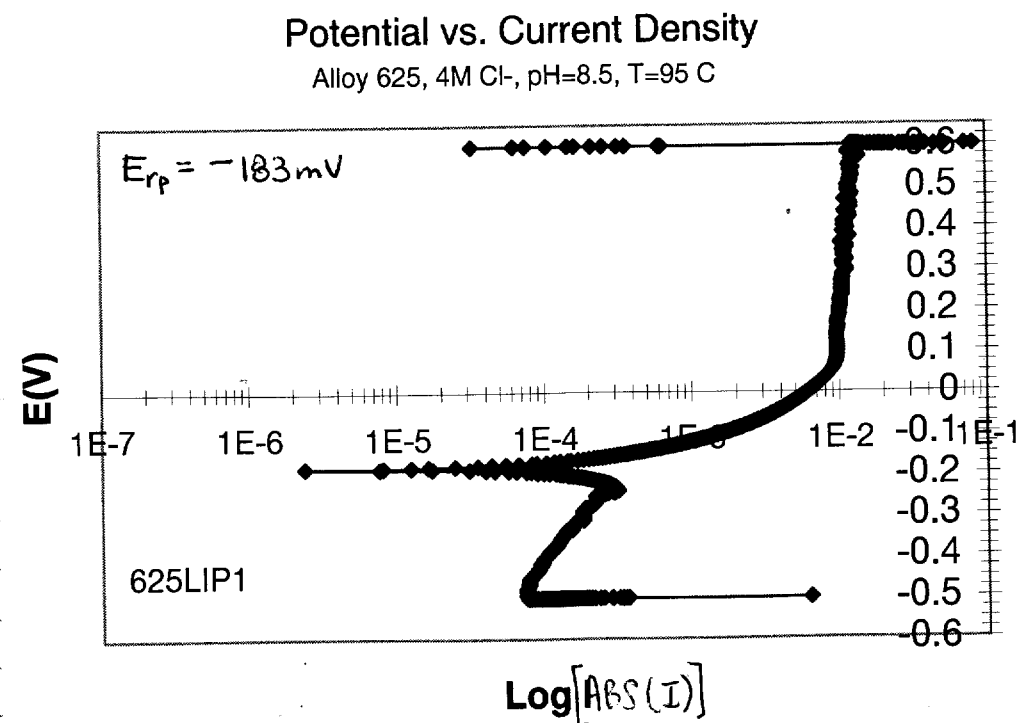
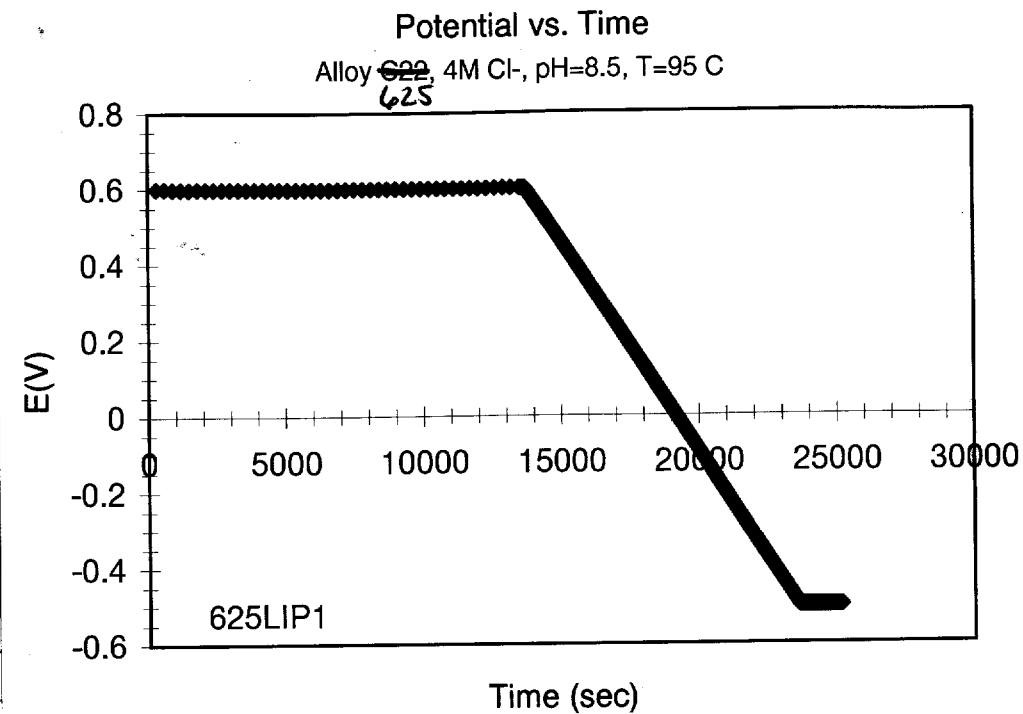
Counter Electrode: Pt. Flag

4/29/97

Kimberly Ann Dwyer

$E_{cor} = -558 \text{ mV}$
 $E_{pt} = -322 \text{ mV}$

Specimen appears to be corroded around the sides + at the top of the specimen.



Kim 5/14/97

Initial Scientific Notebook Entry for Alloy 625 and Alloy C-22 Lead-In-Pencil Tests

Title: Lead-in-pencil tests of Alloy 625 and Alloy C-22

Tests Performed by: Kimberly Ann Gruss (NRC)

Objective: To measure the repassivation potential of a single corroding pit.

Equipment: Pine Model AFRDE5 Bi-Potentiostat S/N 6091 with Workbench Software; Keithley Electrometer model 617 S/N 0579628, or equivalent; right cylindrical polarization cell meeting the requirements of TOP-008; and, Austin 386-SX computer.

Materials: Alloy 625 and Alloy C-22

Specimen Specifications: Dimensions and geometry of specimens are illustrated on p. 46. Specimens to be weighed before and after exposure.

Measurement Parameters: As described in TOP-008.

Required Level of Accuracy: Potentials +/- 5 mV.

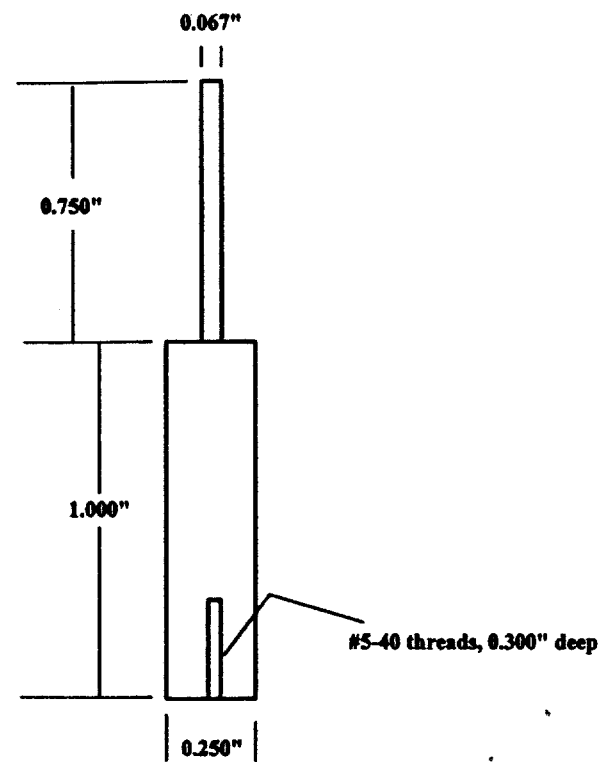
Uncertainty and Sources of Error: Measurement of the pit depth. Level of accuracy in depth is estimated to be +/- 0.5 mm.

Kimberly Ann Gruss 5/19/97

Kimberly Ann Gruss 5/17/97

Darrell S. Dunn
SwRI-CNWRA
BLDG 57
Ext 6090

Lead in pencil specimen
All dimensions +/- 0.001"



Machine perpendicular to rolling direction

Kennedy Lane Lane 5/1/77

Lead-in-Pencil of Alloy 625, 4 MCl, pH=8.5, T=95°C

6251p1b.dat

Objectives: to measure E_{rp} of a single pit + reproduce E_{rp} from experiment on p. 43

Specimen: Alloy 625, Ht[#] NX9936AG, $\rho = 8.44 \text{ gm/cc}$
Specimen Dimensions - see p. 48 (same specimen used as
Start wt / End wt - see p. 43 in experiment on p. 43)

Solution: Same mixture of Solutions as on p. 43.

Start pH = 7.819

End pH = 7.683

$T = 95^{\circ}\text{C}$, Hg Thermometer # 0323008

Deaerated sol'n w/ 99.999% N_2

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE #13-620-51 S/N 5129169

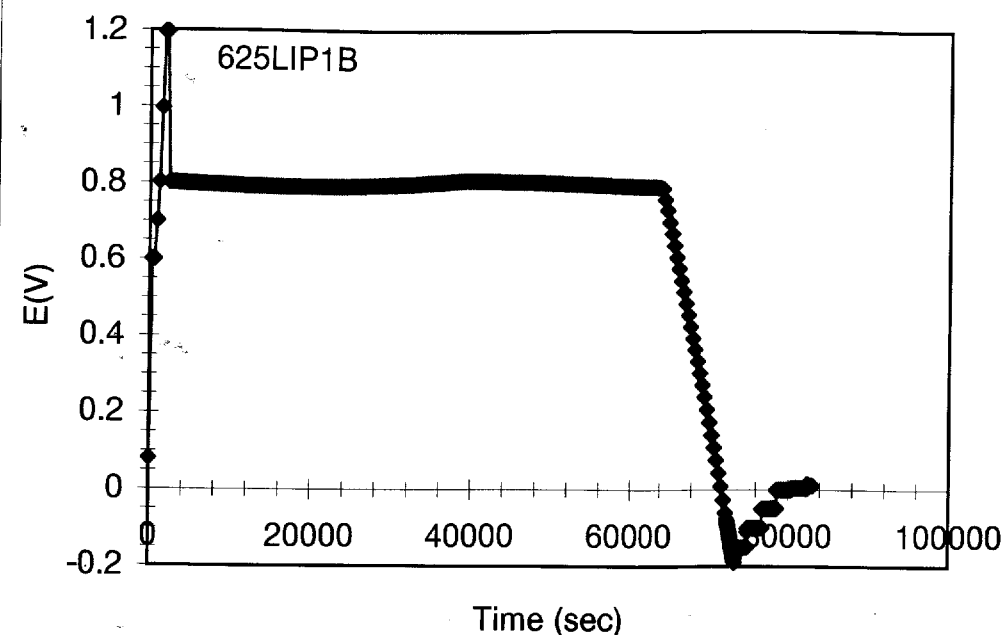
Counter Electrode: Pt. Flag

$$E_{\text{cor}} = -297 \text{ mV}$$
$$E_{pt} = -60 \text{ mV}$$

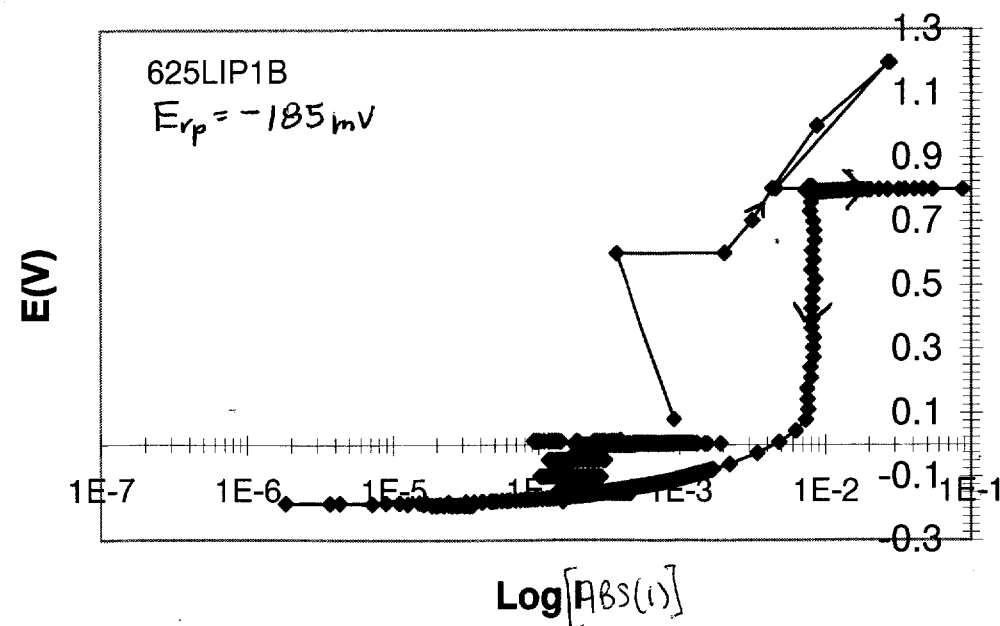
Specimen appears to be corroded around the sides + at the top of thinnest part.

Kindly the Encls
5/6/77

Potential vs. Time
Alloy 625, 4M Cl⁻, pH=8.5, T=95 C



Potential vs. Current Density
Alloy 625, 4M Cl⁻, pH=8.5, T=95 C



Kay 5/14/97

CPP of Alloy 625, 1M Cl⁻, pH=8.5, T=95°C

625cpp13.dat

Objective: to measure E_{pit} + E_{cp} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht# NX9936AG, $\rho = 8.44 \text{ g/cm}^3$

Specimen Dimensions - See p.24

600 grit finish, exposed area 20.0 cm^2

Start wt: 31.05119 gm

End wt: 30.93291 gm

Solution: 1 M Cl⁻ as NaCl lot# 960780 (116.87894 gm)

20ml SO_4^{2-} Stock Sol'n (20ppm)

20ml NO_3^- Stock Sol'n (10ppm)

4ml F^- Stock Sol'n (2ppm)

85ppm HCO_3^- as NaHCO_3 lot# (0.11765 gm)

+ DI Water to 2000ml, Deaerated w/ 99.999% N_2

T=95°C Hg thermometer# 183301

Start pH = 8.135

End pH = 8.784

Potentiostat: EG&G Versastat w/ Model 352C software

Ref. Electrode: Fisher SCE #13-601-51 S/N 3106339

Counter Electrode: Pt Flag

$E_{cor} = -359 \text{ mV}$

$E_{pt} = -345 \text{ mV}$

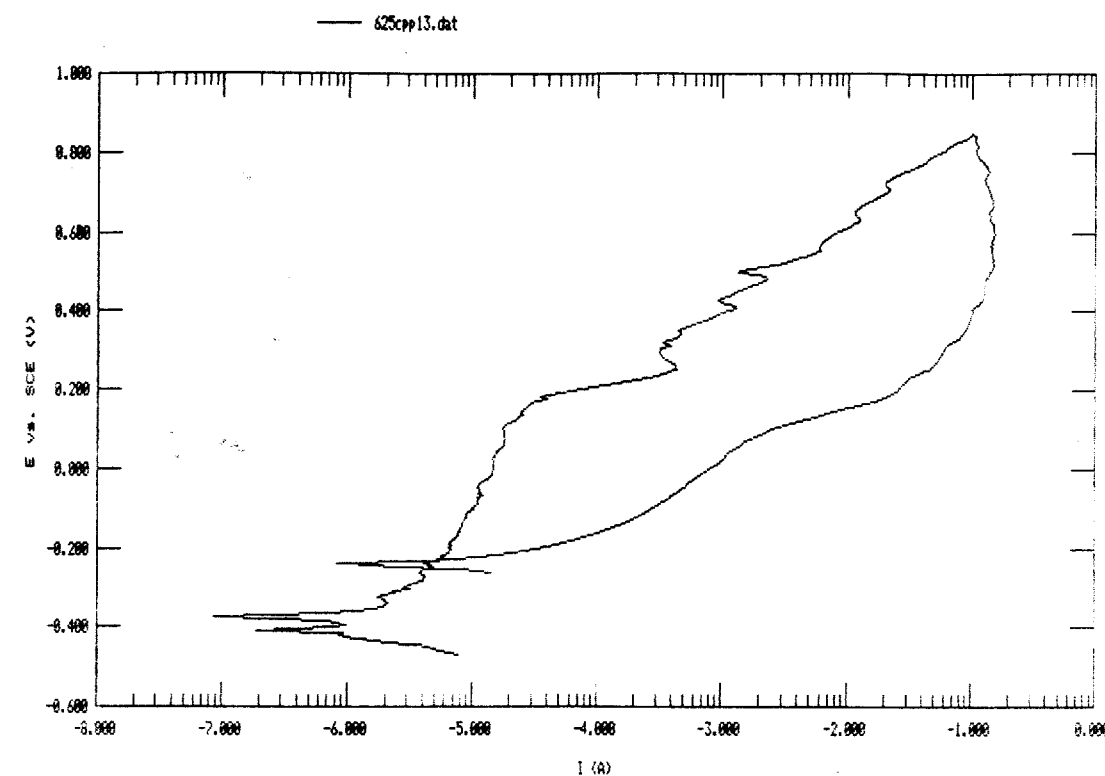
Test Date: 4/30/97

$E_{pit} = 303 \text{ mV}$

$E_{cp} = -232 \text{ mV}$

Kimberly Ann Dumas 5/14/97

Kimberly Ann Dumas 5/14/97



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp13.dat

Pstat: VStat[] Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-26-97

File Status: NORMAL

Time Run: 13:44:33

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	486					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	15.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.3670	V

CPP of Alloy 625, 1 MCl⁻, pH=8.5, T=95°C

625cpp14.dat

Objective: to measure E_{pit} + E_{rep} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht# NK9936AG, $P = 8.44 \text{ g/ml}$

Specimen Dimensions - see p. 24

600 grit finish, exposed area 20.0 cm²

Start wt: 31.15711 gm

End wt: 31.05026 gm

Solution: 1 MCl⁻, 85 ppm HClO₃⁻, 20 ppm SO₄⁻, 10 ppm NO₃⁻

2 ppm F⁻; 2000 ml solution from p. 49

T=95°C, Hg thermometer 183304

Start pH = 8.214

End pH = 9.091

Potentiostat: EG&G Versastat w/ Model 352C Software

Ref. Electrode: Fisher SCE #13-601-51 S/N 3106339

Counter Electrode: Pt. Flag

$E_{corr} = -377 \text{ mV}$

$E_{pe} = +330 \text{ mV}$

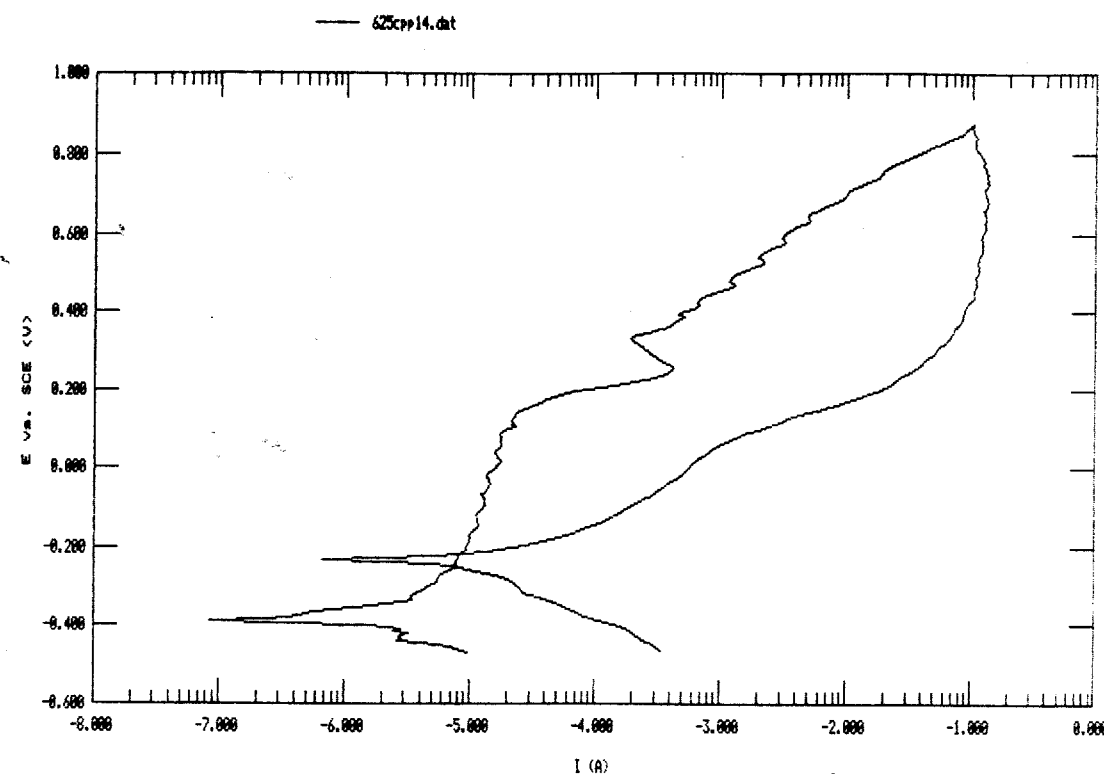
Test Date: 5/1/97

$E_{pit} = 331 \text{ mV}$

$E_{rep} = -219 \text{ mV}$

Kimberly Ann Gmos 5/2/97

Kimberly Ann Gmos 5/9/97



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp14.dat

Pstat: VStatII Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-27-97

File Status: NORMAL

Time Run: 07:31:49

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92 s
No. of Points	NP	538				

Line Sync.	LS	yes		GI Time Const.	TC	Off
Rise Time	RT	high stability		IR Mode	IR	none
Working Elec.	WE	Solid		Filter	FL	15.3Hz
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415 V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000 g
				Open Circuit	OC	-0.3698 V

Lead-in-Pencil of Alloy ^{C22} 625, 4MCl⁻, pH=8.5, T=95°C
Kag 5/6/97

~~625~~ Strip: C22 lip1a.dat
Kag 5/6/97

Objective: to measure E_{pp} of a single pit

Specimen: Alloy C22, Ht # ~~NX9936AG~~ 2278-8-3175, P = 8.69 gm/ml
Kag 5/6/97

Specimen Dimensions - see p. 48

Start wt: 6.32633 gm

End wt: 6.27108 gm

Solution: Same mixture of Solutions as on p. 43

Start pH = 7.683

End pH = 7.595

T=95°C, Hg Thermometer # 0323008

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: Pine Model AFRDES Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE # 13-620-51 S/N 5129169

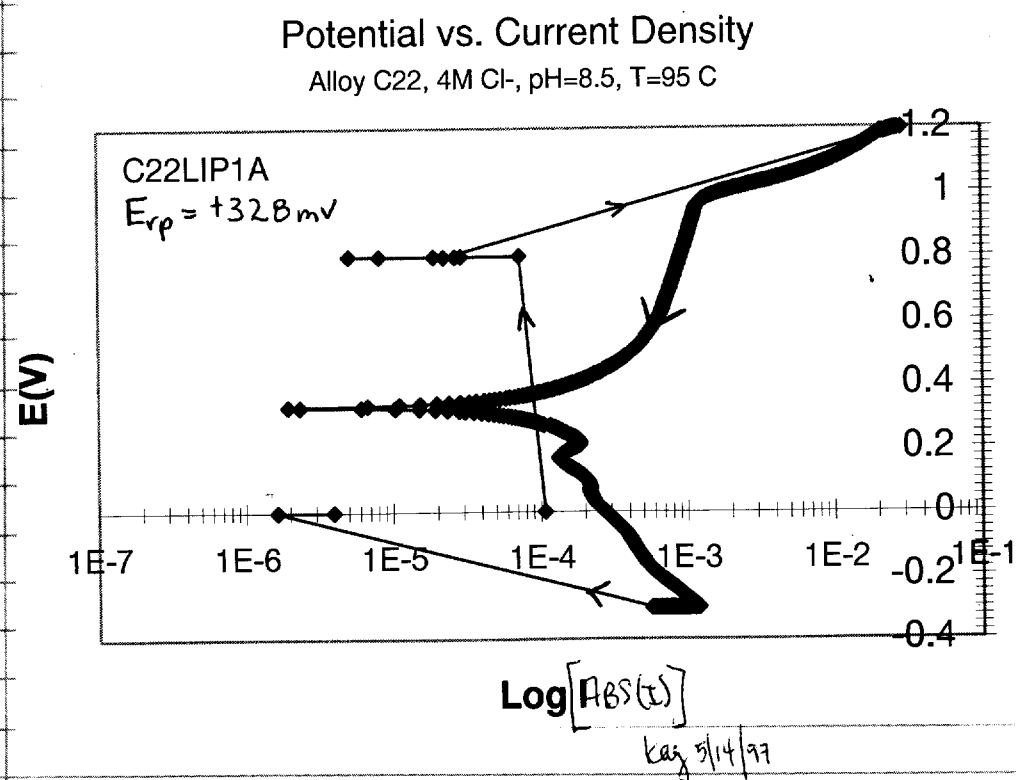
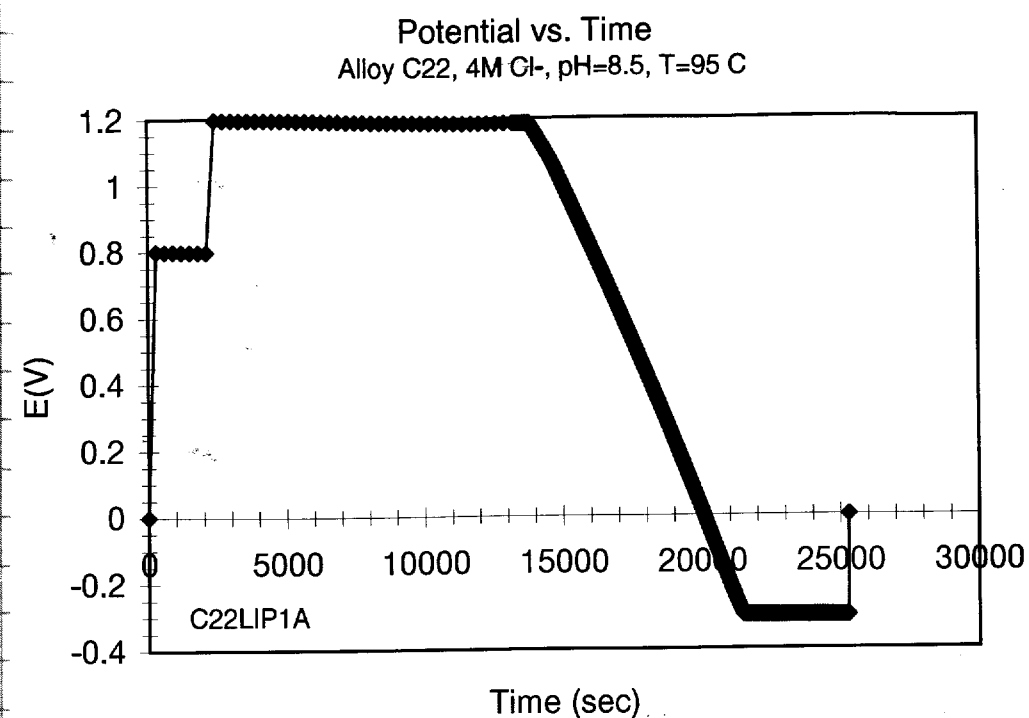
Counter Electrode: Pt. Flag

E_{corr} = -497 mV

E_{pt} = -125 mV

Kirkley Ann Duroo 5/9/97

Kirkley Ann Duroo 5/9/97



Lead-in-Pencil of Alloy C22, 4MCl⁻, pH=8.5, T=95°C

C22lip1b.dat

Objective: to measure E_p of a single pit + reproduce E_p from experiment on p. 53

Specimen: Alloy C22, Ht # 2278-8-3175, $\rho = 8.69 \text{ g/ml}$
Specimen Dimensions - see p. 53 (same specimen as used for experiment on p. 53)
Start/End wt: see p. 53.

Solution: Same mixture of Solutions as on p. 43

Start pH = 7.595

End pH =

T=95°C, Hg thermometer # 0323008

Deaerated Solution w/ 99.999% N₂

Potentiostat: Pine Model AFRDES Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE[®] 13-620-51 S/N ^{log 5/11/97} ~~6091~~ 3106339

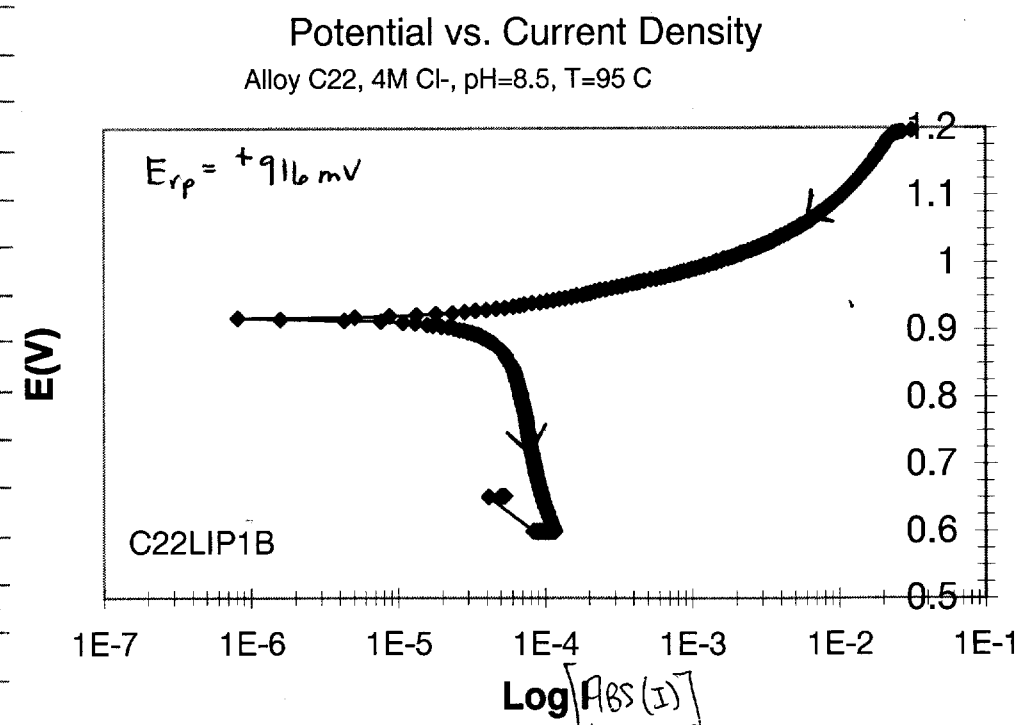
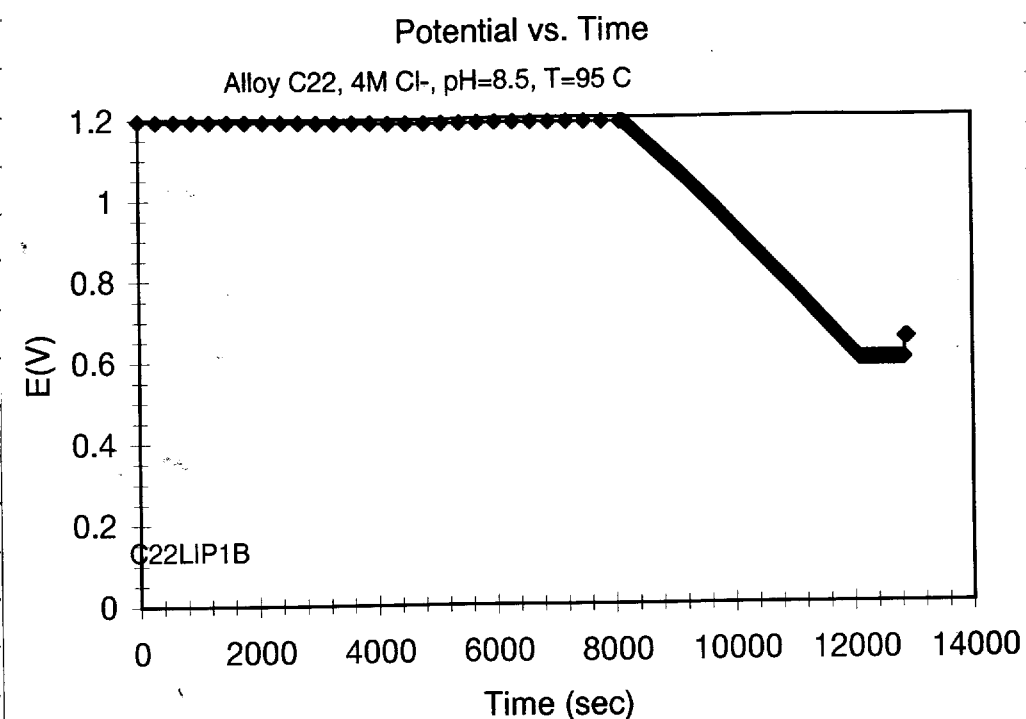
Counter Electrode: Pt. Flag

$E_{cor} = -292.50 \text{ mV}$

$E_{Pt} = -118 \text{ mV}$

Kimberly Ann Doss 5/9/97

Kimberly Ann Doss 5/15/97



Kag 5/14/97

Lead-in-Pencil of Alloy C22, 4M Cl⁻, pH=8.5, T=95°C

C22lip1c.dat

Objective: to measure E_{rp} of a single pit + reproduce E_{rp} from experiments on p. 53 + 55

Specimen: Alloy C22, Ht # 2278-8-3175, $\rho = 8.69 \text{ g/ml}$
 Specimen Dimensions - see p. 53 - same specimen as used for experiments on pg. 53 + 55
 Start/End wt: see p. 53

Solution: Same mixture of Solutions as on p. 43

Start pH = Did not record pH at start of test

End pH = 7.413

T=95°C, Hg thermometer # 0323008

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091
 w/ Workbench Software

Ref. Electrode: Fisher SCE # 13-620-51 S/N 6091 ^{Kag 5/14/97}

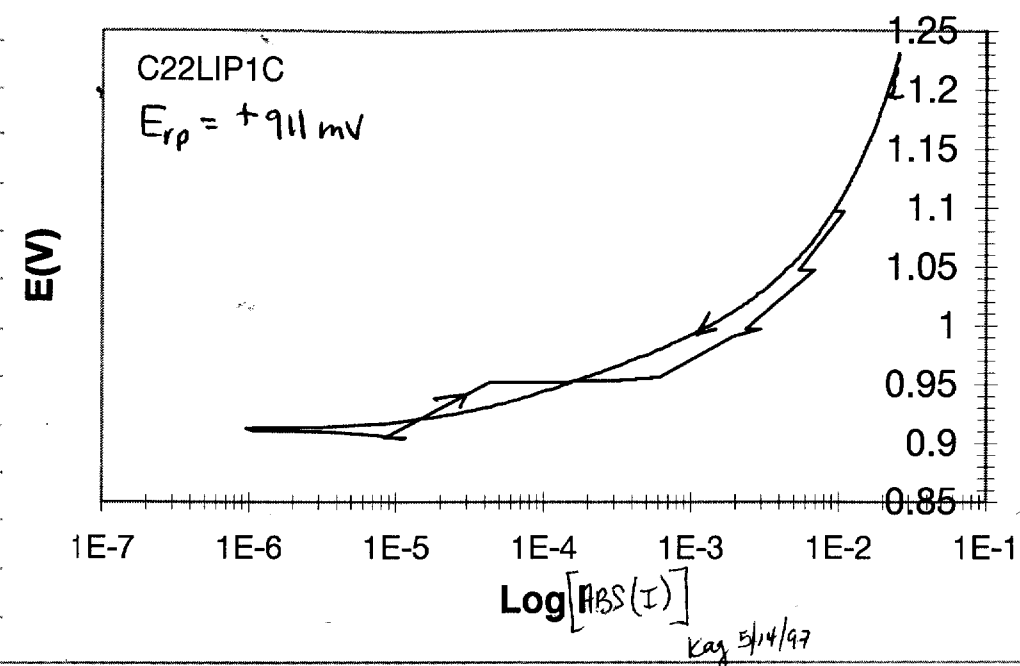
Counter Electrode: Pt. Flag

 $E_{corr} = +754.6 \text{ mV}$ $E_{pt} = -149.98 \text{ mV}$

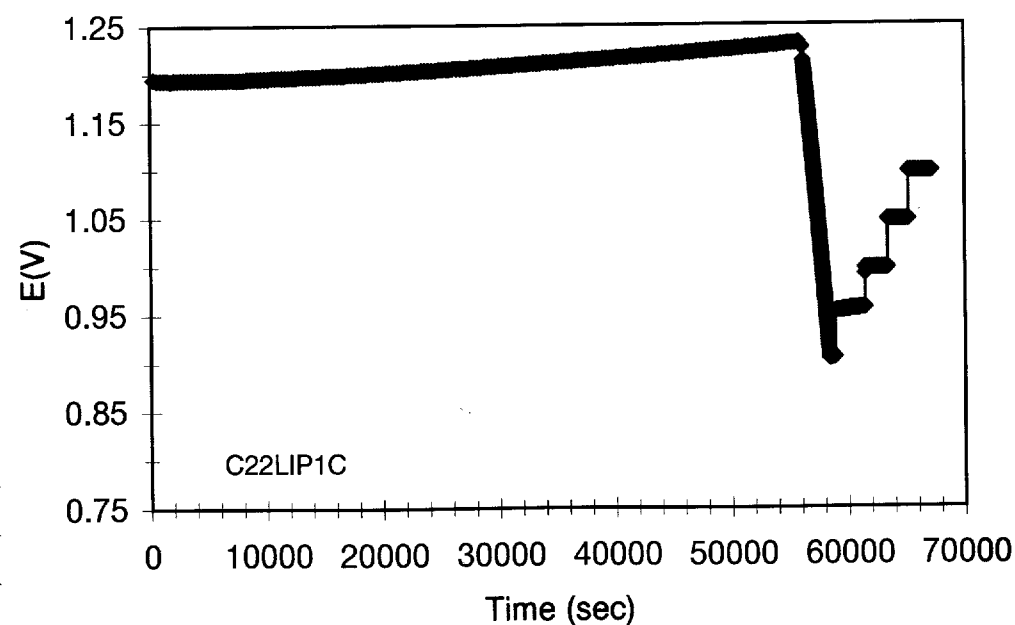
Kimberly Ann Jones 5/15/97

Kimberly Ann Jones 5/15/97

Potential vs. Current Density

Alloy C22, 4M Cl⁻, pH=8.5, T=95 C

Potential vs. Time

Alloy C22, 4M Cl⁻, pH=8.5, T=95 C

Kimberly Ann Jones 5/15/97

Lead-in-Pencil of Alloy 625, 1 MCl⁻, pH=8.5, T=95°C625-^{IP}2a-dat
May 5/11/97Objective: to measure E_{rp} of a single pitSpecimen: Alloy 625, H6#NX9936AG, $\rho = 8.44 \text{ g/cm}^3$

Specimen Dimensions - see P. 46

Start wt: ~~6.32422~~ ^{6.32422} gm

End wt: 6.30319 gm

Pit depth - Start: 9.0mm End:

Solution: 1 MCl⁻ as NaCl lot #960780 (116.88371 gm)40ml SO₄²⁻ Stock Sol'n20ml NO₃⁻ Stock Sol'n } NB 157, p. 1724ml F⁻ Stock Sol'n

+ DI water to 2000 ml

Start pH = 6.194

1 MCl⁻ as NaCl lot #960780 (58.44355 gm)20ml SO₄²⁻ Stock Sol'n10ml NO₃⁻ Stock Sol'n } NB 157, p. 1722ml F⁻ Stock Sol'n

+ DI water to 1000 ml

Start pH = 6.313

3 L of sol'n needed for experiment - mixed both solutions

Start pH = 6.167 for mixed solutions

End pH = 8.034

T=95°C, Hg thermometer # 0323008

Deaerated sol'n w/ 99.999% N₂

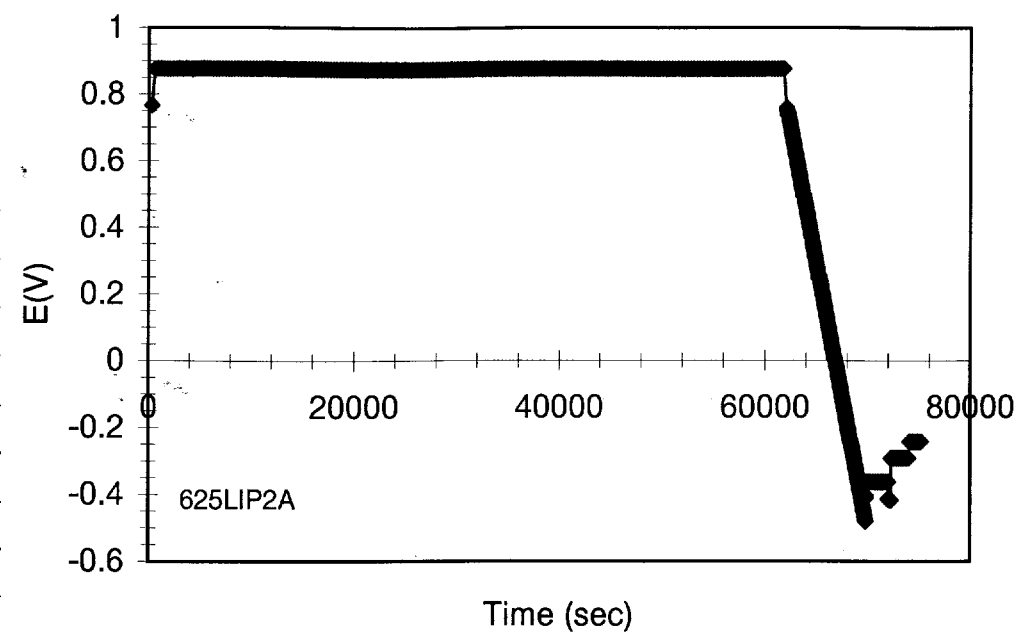
Potentiostat: EG&G Potentiostat Model 273 S/N 41108 w/ Wark bench Software

Ref. Electrode: Fisher SCE # 13-601-51 S/N 3106339

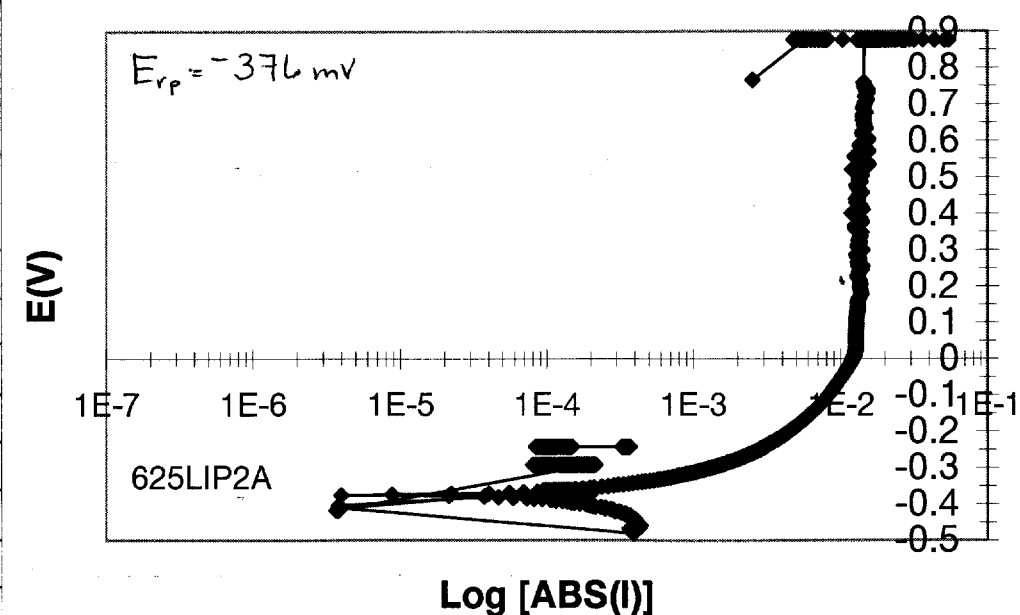
Counter Electrode: Pt Flag.

Kimberly Ann Jones 5/15/97

Potential vs. Time
Alloy 625, 1M Cl⁻, pH=8.5, T=95 C



Potential vs. Current Density
Alloy 625, 1M Cl⁻, pH=8.5, T=95 C



Kimberly Ann Gura 5/15/97

Lead-in-Pencil of Alloy C22, 4M Cl⁻, pH=8.5, T=60°C

~~022lip2b.dat~~ C22lip1d.dat
Kag 4/11/97

Objective: to measure E_{rp} of a single pit

Specimen: Alloy C22, Ht # 2278-B-3.75, $\rho = 8.69 \text{ gm/cc}$
Specimen Dimensions - see p. 53 (Same specimen as used for
Start wt/End wt: see p. 53 experiment on p. 53)

Solution: Same mixture of Solutions as on p. 43

Start pH = 7.413

End pH = 7.263 Kag 5/11/97

T=60°C, Hg thermometer # 0323008

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: Pot model APRDE5 Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE # 13-620-51 S/N ~~6041~~ 3106339
Kag 5/11/97

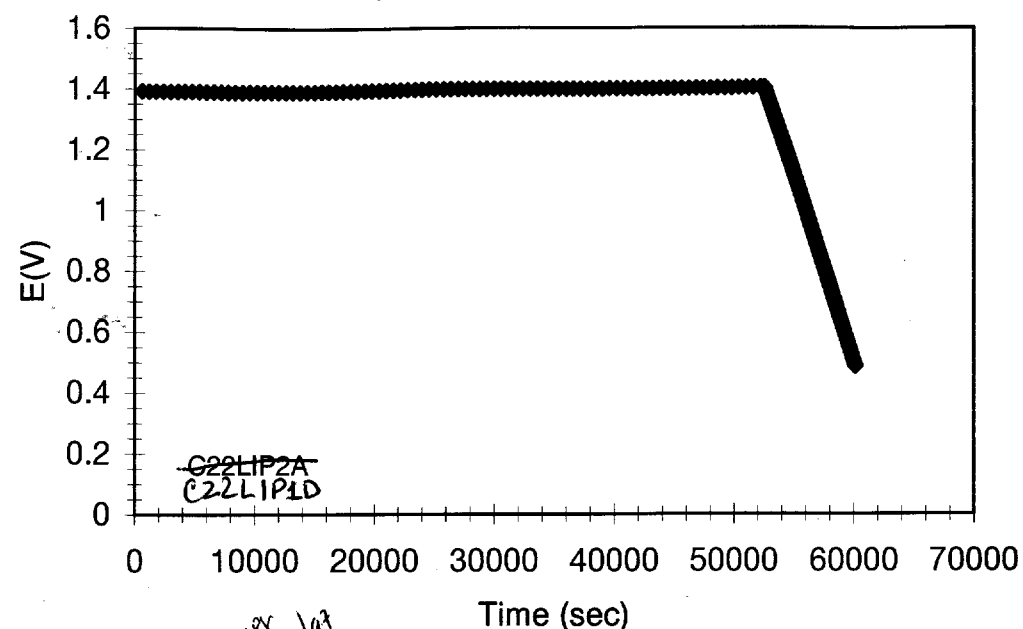
Counter Electrode: Pt. Flag

$E_{corr} = +650 \text{ mV}$

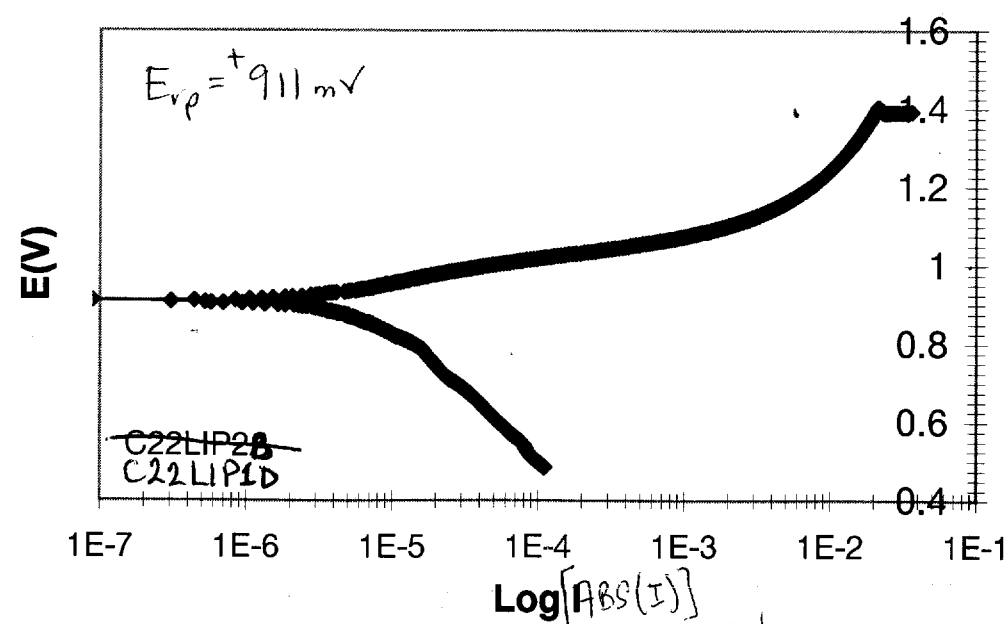
$E_{pt} = +31 \text{ mV}$

Kimberly Ann Gura 5/15/97

Potential vs. Time
Alloy C22, 4M Cl⁻, pH=8.5, T=60 C



Potential vs. Current Density
Alloy C22, 4M Cl⁻, pH=8.5, T=60 C



CPP of Alloy 625, 0.1 M Cl⁻, pH=8.5, T=95°C w/ Crevice geometry
625cpp15.dat

Objective: to measure E_{pit} + E_{rp} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht# NX9936AG, P=8.44 g/ml

Specimen Dimensions - see p. 24

600 grit finish - exposed area 20.0 cm²

Start wt: 31.10867 gm

End wt: 31.06550 gm

Solution: 0.1 M Cl⁻ as NaCl Lot # 960780 (5.84325 gm)
85 ppm HCO₃⁻ as NaHCO₃ Lot # 923337A (0.11803 gm)
20 ml SO₄²⁻ Stock Sol'n } NB157, p.172
10 ml NO₃⁻ Stock Sol'n }
2 ml F⁻ Stock Sol'n }
+ DI water to 1000 ml (key 5/14/97)
T=95°C, thermometer, 183301
Start pH = 8.207
End pH = 9.246

Potentiostat: EG&G Versastat w/ Model 352C Software

Ref. Electrode: Fisher SCE # 13-601-51 S/N 5144349
~~3104339~~ key 5/9/97

Counter Electrode: Pt Flag

E_{cor} = -247 mV

E_{pt} = +320 mV

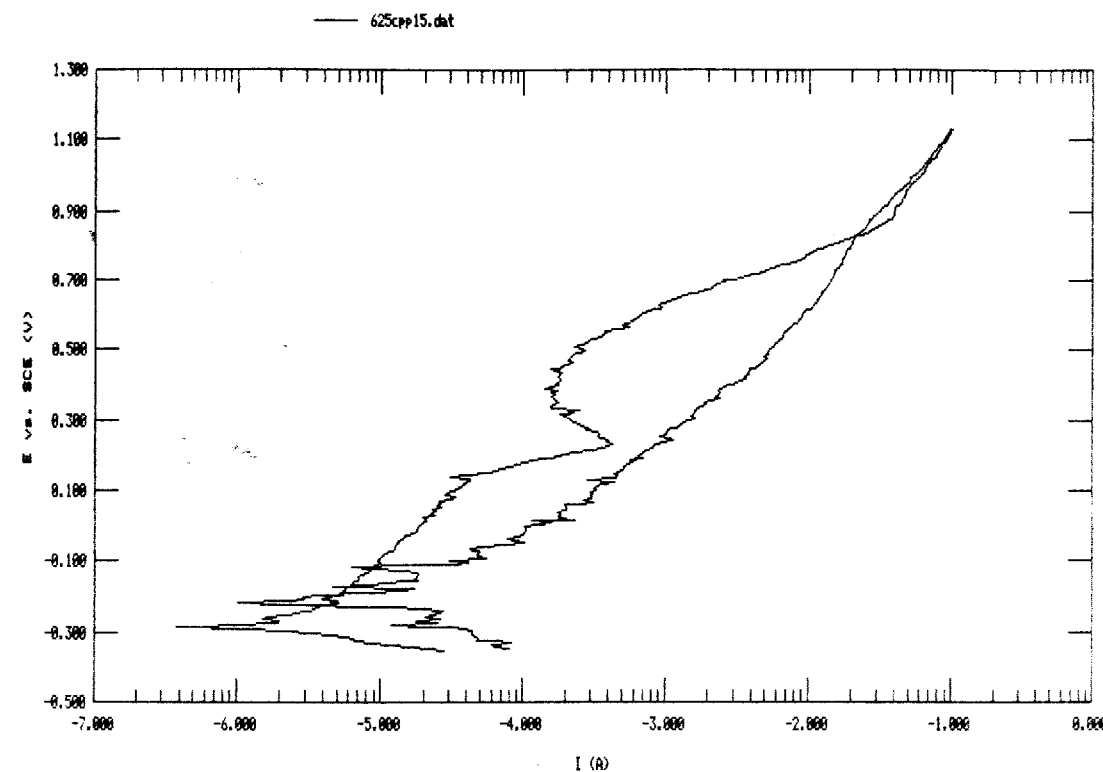
Test Date = 5/9/97

E_{pit} = 403

E_{rp} = -117

Kimberly Ann Dumas 5/15/97

Kimberly Ann Dumas 5/15/97



Model 352/252 Corrosion Analysis Software, v. 2.01

Filename: a:\625cpp15.dat

Pstat: UStat1 Ver 2

CP CYCLIC POLARIZATION

Date Run: 04-30-97

File Status: NORMAL

Time Run: 08:01:21

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	594					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	15.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.2520	V

CPP of Alloy 625 - 0.3 M Cl⁻, pH=8.5, T=95°C w/ crevice geometry

625cpp16.dat

Objective: to measure E_{cp} + E_{pt} w/ a crevice corrosion geometry

Specimen: Alloy 625, Ht. # N1X9936AG, $\rho = 8.44 \text{ g/ml}$

Specimen Dimensions - see p.24

600 grit finish - exposed area 20.0 cm²

Start wt: 31.11130 gm

End wt: 31.08924 gm

Solution: 0.3 M Cl⁻ as NaCl lot # 960780 (17.53439 gm)

85 ppm HCO₃⁻ as NaCO₃ lot # 923337A (0.11750 gm)

20 ml SO₄²⁻ Stock Sol'n

10 ml NO₃⁻ Stock Sol'n } NB157, p.172

2 ml F⁻ Stock Sol'n

+ DI water to 1000 ml (Kag 5/11/97)

T=95°C, Hg thermometer, 183304

Start pH = 8.187

End pH = 8.956

Potentiostat: EG&G Versastat w/ Model 352C Software

Ref. Electrode: Fisher SCE # 13-601-51 S/N ~~60~~ 3106337 5087374 Kag 5/1/97

Counter Electrode: Pt. Flag

$E_{corr} = -253 \text{ mV}$

$E_{pt} = -385 \text{ mV}$

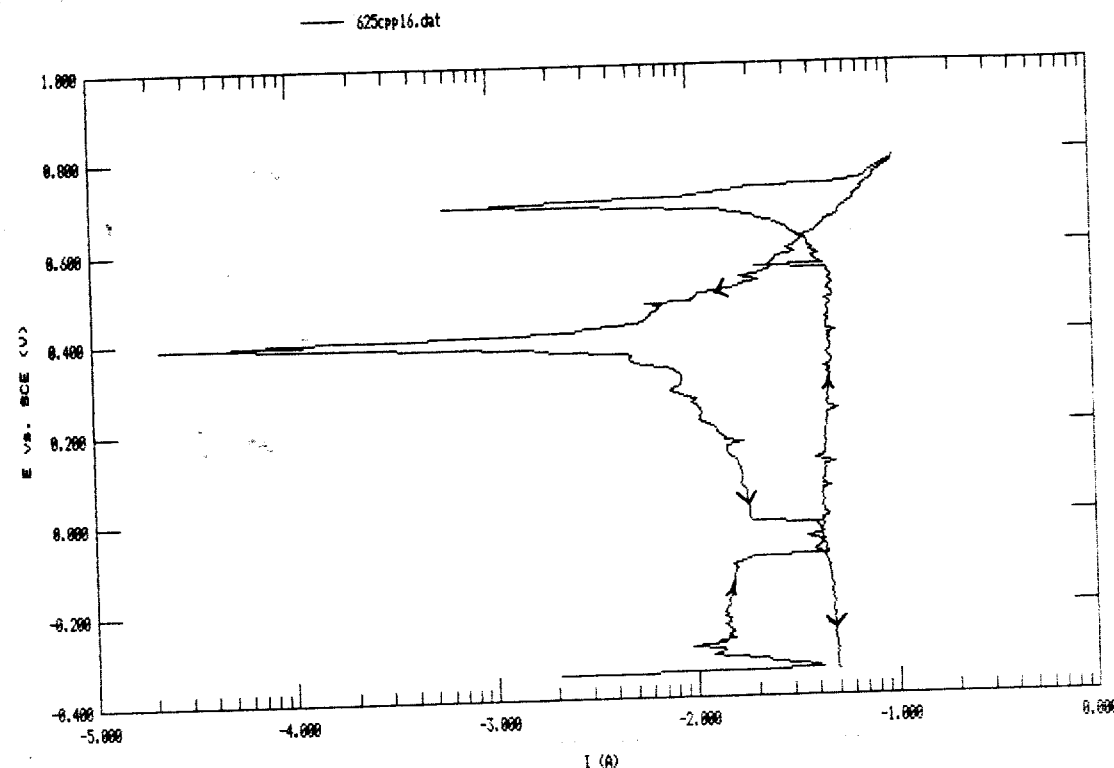
Test Date = 5/5/97

$E_{pt} = ?$

$E_{corr} = ?$

Kinshuk from Bina 5/15/97

Kinshuk from Bina 5/15/97



Model 352/252 Corrosion Analysis Software, v. 2.01
 Filename: a:\625cpp16.dat
 Pstat: VStat[] Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 04-30-97

File Status: NORMAL
 Time Run: 13:30:40

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.92	s
No. of Points	NP	454					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.2400	V

Lead-in - Pencil of Alloy C22, 4M Cl⁻, pH=8.5, T=60°

C22lip1e.dat

Objective: Measure Exp of a single p.t

Specimen: Alloy C22, HL# 2278-8-3175, $\rho = 8.69 \text{ g/mL}$

Specimen Dimensions - see p. 53 (same specimen as used for experiment on p. 53)

Start/End Wt: See p. 53

Solution: Same Mixture of Solutions as on p. 43

Start pH = 7.263

End pH = 6.697

T=60°C, Hg thermometer # 0323008

Deaerated Soln w/ 99.999% N₂

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091
 w/ WorkBench Software

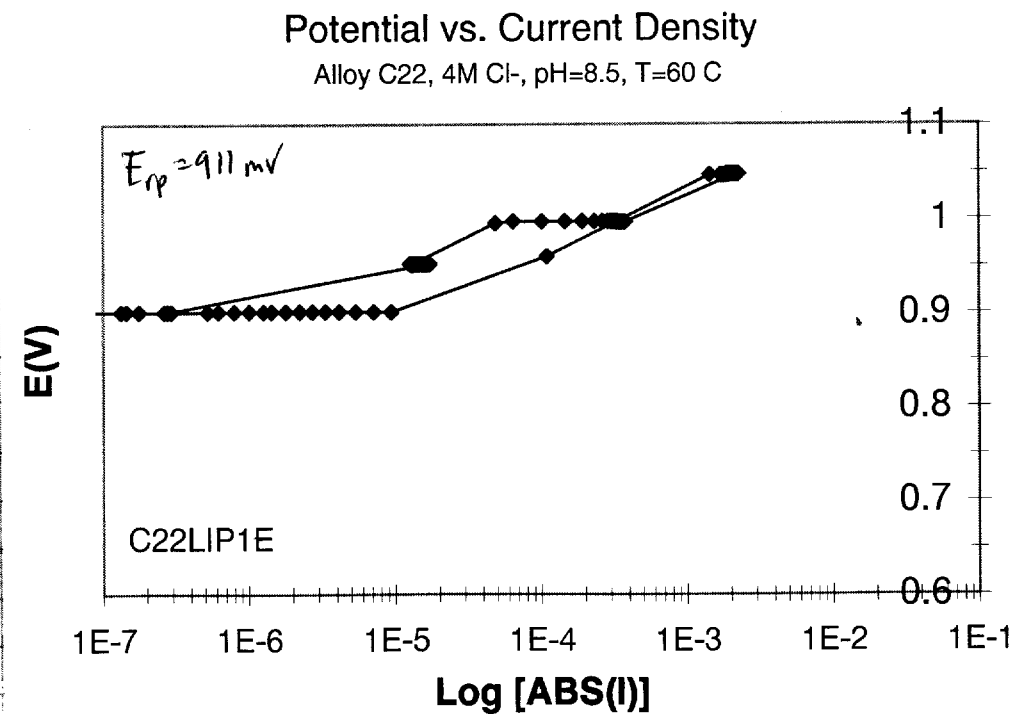
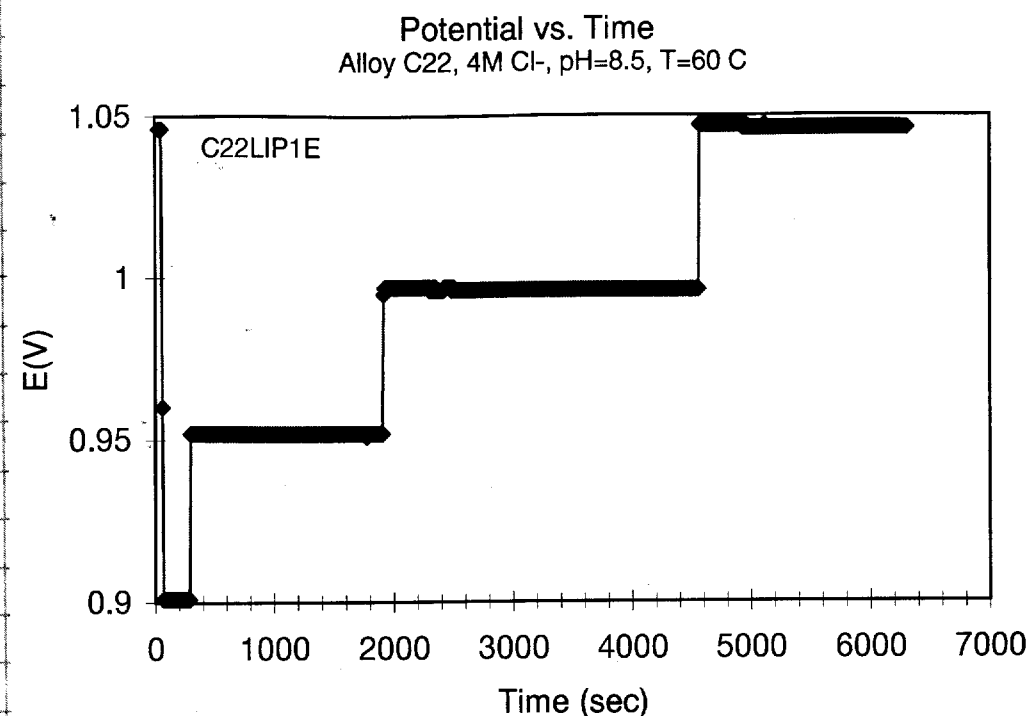
Ref. Electrode: Fisher SCE # 13-620-51 S/N 3106339

Counter Electrode: Pt Flag

$E_{cor} = +6.1 \text{ mV}$

$E_{pe} = +3.1 \text{ mV}$

Note: Data obtained from this experiment is a continuation of the experiment for specimen C22lip1d (on p. 61).



Lead-in-Pencil of Alloy 625, 4MCl⁻, pH=8.5, T=60°C

625 Lip 2a, dat

Objective: Measure E_{cp} of a single pit

Specimen: Alloy 625, HE# NX 9936AG, $\rho = 8.44 \text{ g/ml}$

Specimen Dimensions - See p. 46

Start wt: 6.39862 gm

End wt: 6.39642 gm

Solution: 4MCl⁻, 60ml SO₄²⁻ Stock Sol'n, 30ml NO₃⁻ Stock Sol'n,
6 ml F⁻ Stock Sol'n + DI water to 3000 ml as
described on p. 57. 43
Key 5/11/97

Start pH = 6.697

End pH = 7.214

T = 60°C, Hg Thermometer #183305

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: Pine Model AFRDES Bi-Potentiostat S/N 6091
w/ Work Bench Software

Ref. Electrode: Fisher SCE # 13-620-S1 S/N 3106345

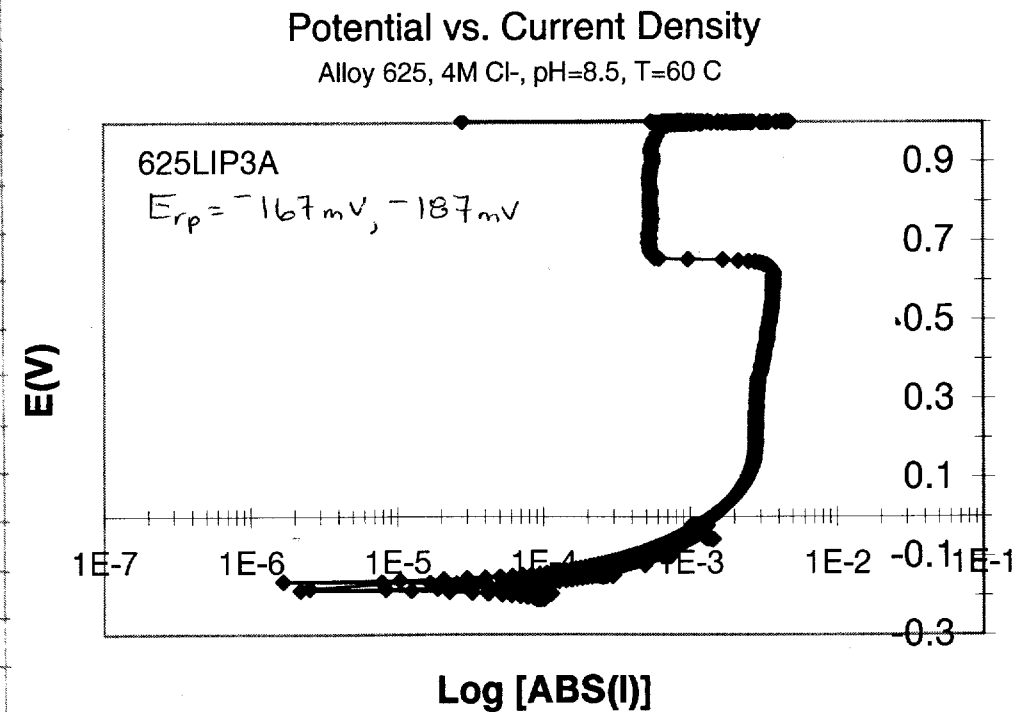
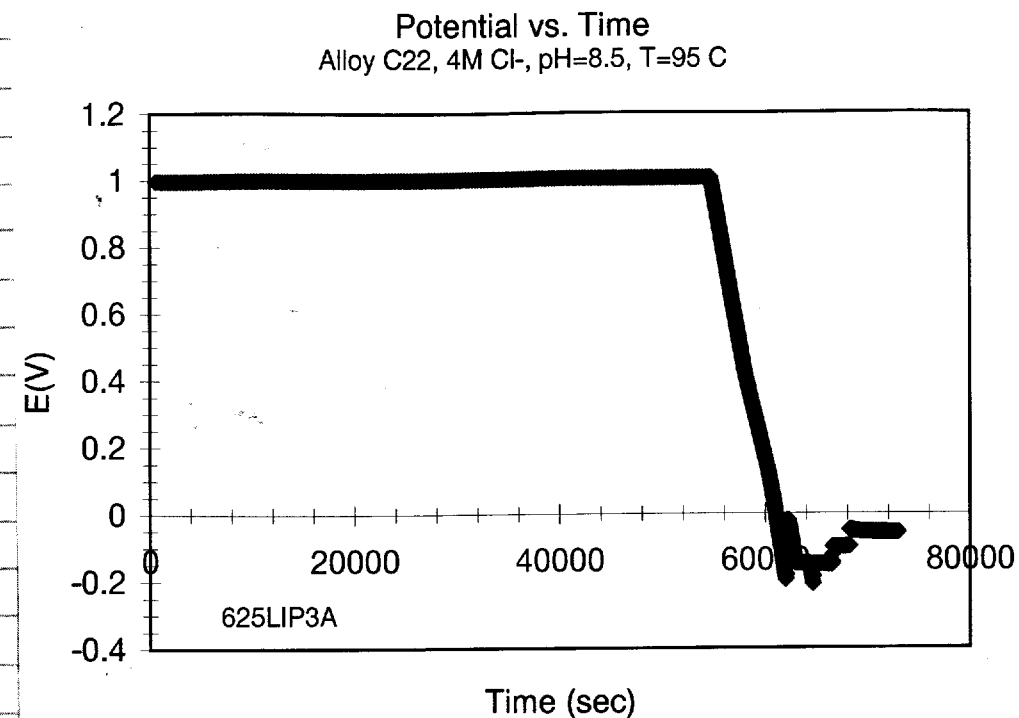
Counter Electrode: Pt. Flay

$E_{corr} = -195 \text{ mV}$

$E_{pt} = +137 \text{ mV} \rightarrow -35 \text{ mV}$

Kimberly Ann Jones 5/15/97

Kimberly Ann Jones 5/15/97



Kimberly Ann Dumas 5/15/97

Lead-in-Pencil of Alloy 625, 1MCl⁻, pH=8.5, T=60°C

625lip4.dat

Objective: Measure E_{rp} of a single pit

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44\text{ g/cm}^3$

Specimen Dimensions - See p. 46

Start wt: 6.36158 gm

End wt: 6.36005 gm

Solution: 4MCl⁻, 20ppmSe²⁻, 10ppmNO₃⁻, 2ppmF⁻, 3000ml
Solution from p. 59

Start pH=8.034

End pH=7.703

T=60°C, Hg thermometer #183305

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: EG&G Potentiostat Model 273 S/N 91108 w/
Workbench Software

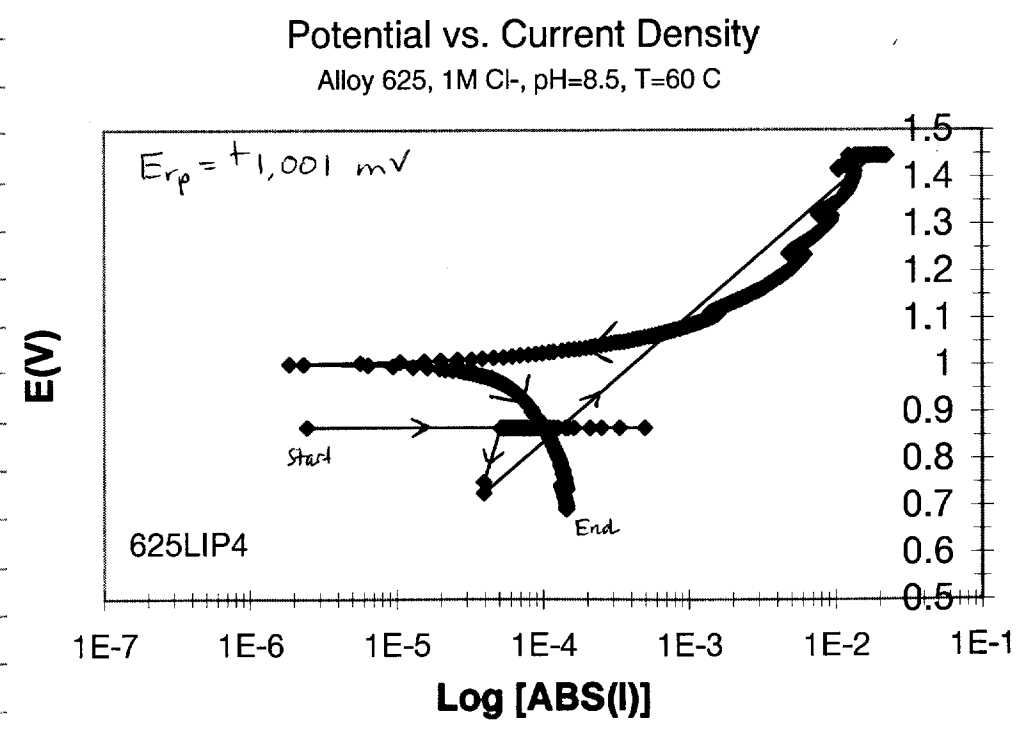
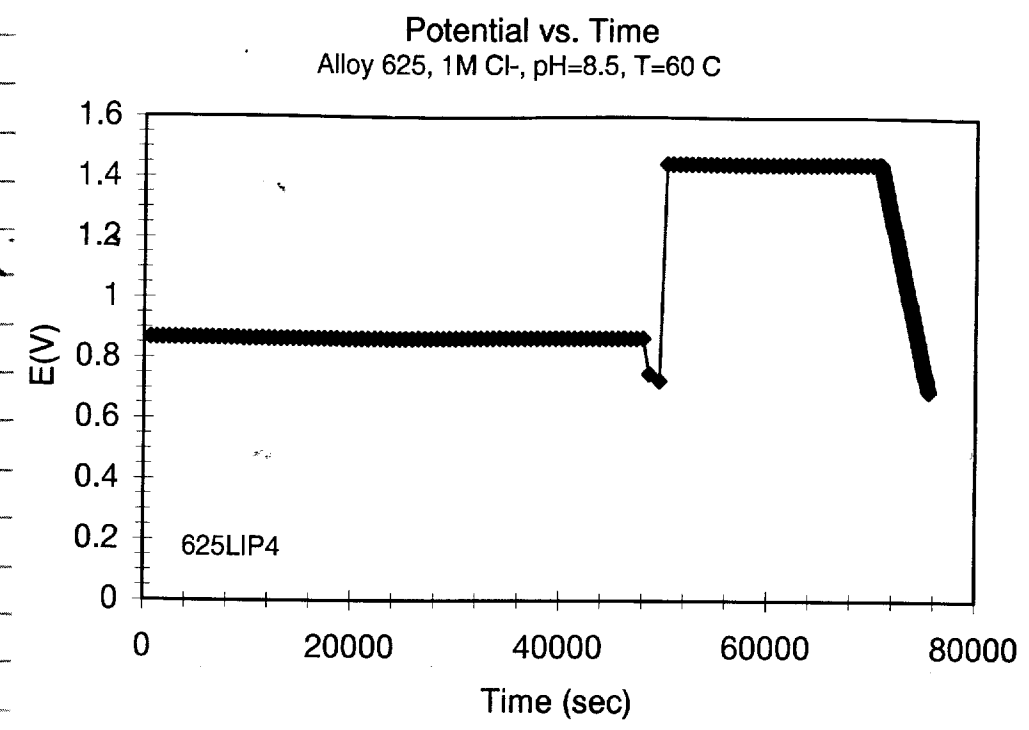
Ref. Electrode: Fisher SCE #13-620-51 S/N 3106345

Counter Electrode: Pt. Flag

$E_{cor} = -322\text{ mV}$

$E_{pt} = -280\text{ mV}$

Kimberly Ann Dumas 5/15/97



Kimberly Ann Jones 5/15/97

Lead-in-Pencil of Alloy 625, 1000ppm Cl⁻, pH=8.5, T=60°C

625 11p 5th dat

Objective: Measure E_p of a single pit

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44 \text{ g/cm}^3$

Specimen Dimensions - see p. 46

Start wt: 6.35634 gm

End wt: 6.34948 gm

Solution: 1000ppm Cl⁻ as NaCl - lot # 960780 (4.94719 gm)

60ml SO₄²⁻ Stock Sol'n (20ppm)

30ml NO₃⁻ Stock Sol'n (10ppm)

6ml F⁻ Stock Sol'n (2ppm)

+ DI water to 3000 mL, Deaerated w/ 99.999% N₂

T=60°C, Hg thermometer # 0323008

Start pH = 5.703

End pH = 6.540

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091
w/ Warkbench Software

Ref. Electrode: Fisher SCE # B-620-51 S/N 3106339

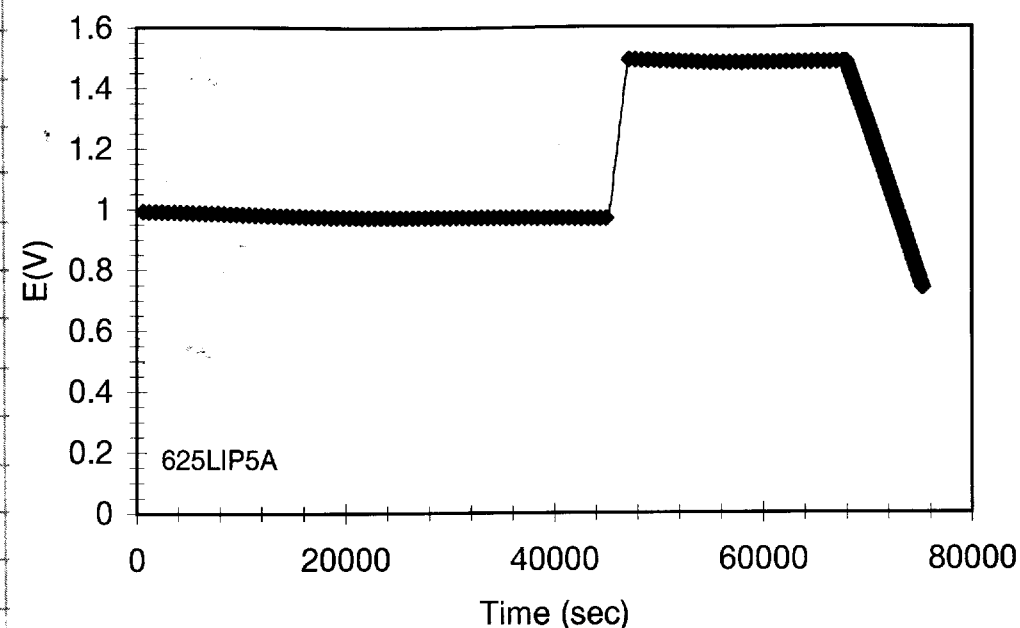
Counter Electrode: Pt. Flag

$E_{corr} = -220 \text{ mV}$

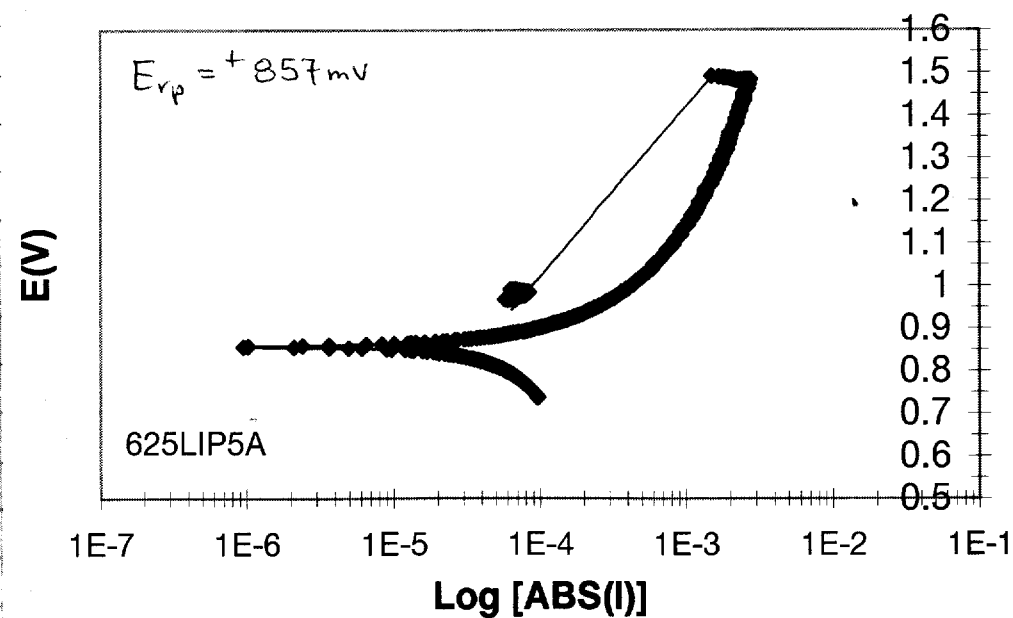
$E_{et} = -56 \text{ mV}$

Kimberly Ann Jones 5/15/97

Potential vs. Time
Alloy 625, 1,000 ppm Cl⁻, pH=5.7, T=95 C



Potential vs. Current Density
Alloy 625, 1,000 ppm Cl⁻, pH=5.7, T=95 C



Lead-in-Pencil of Alloy C22-4MCl⁻, pH=8.5, T=25°C

C221.p1f.dat

Objective: To measure E_{rp} of a single pit

Specimen: Alloy C22, HT# 2278-8-3175, $\rho = 8.69 \text{ g/ml}$

Specimen Dimensions - see p.53 (same specimen as used for experiment on p.53)

Start/End wt: see p.53

Solution: Same Mixture of Solutions as on p.43

Start pH = Did not record pH at start of test.

End pH = 6.697

T = 25°C, Hg thermometer #0323000

Deaerated Sol'n w/ 99.999% N₂

Potentiostat: Pine Model AFRDES Bi-Potentiostat S/N 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE# 13-620-51 S/N 3106339

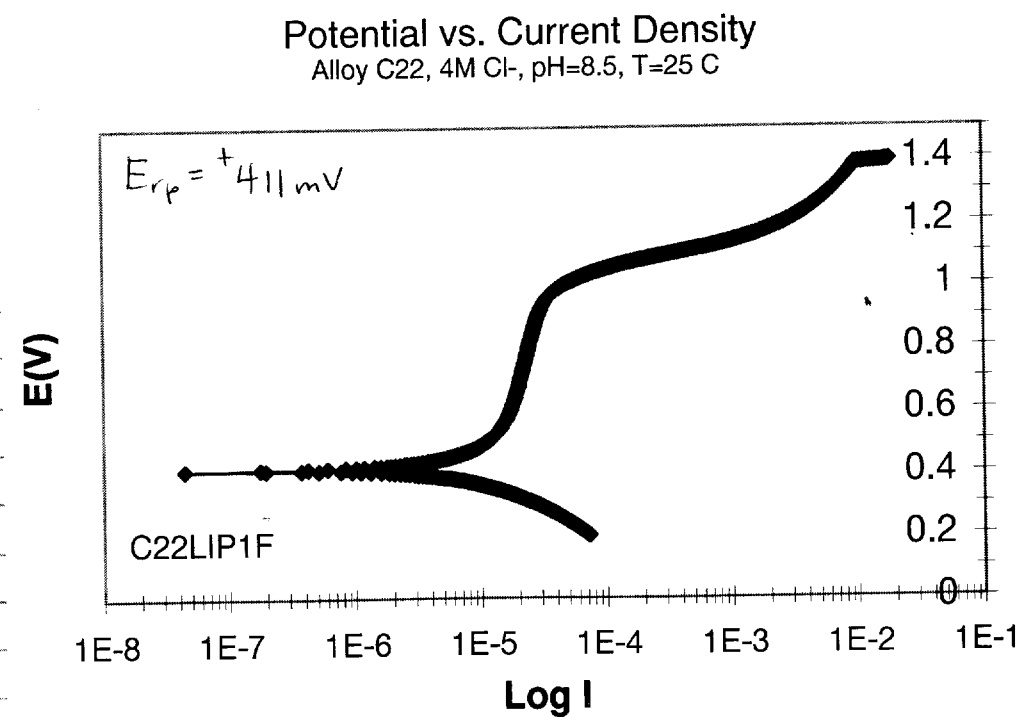
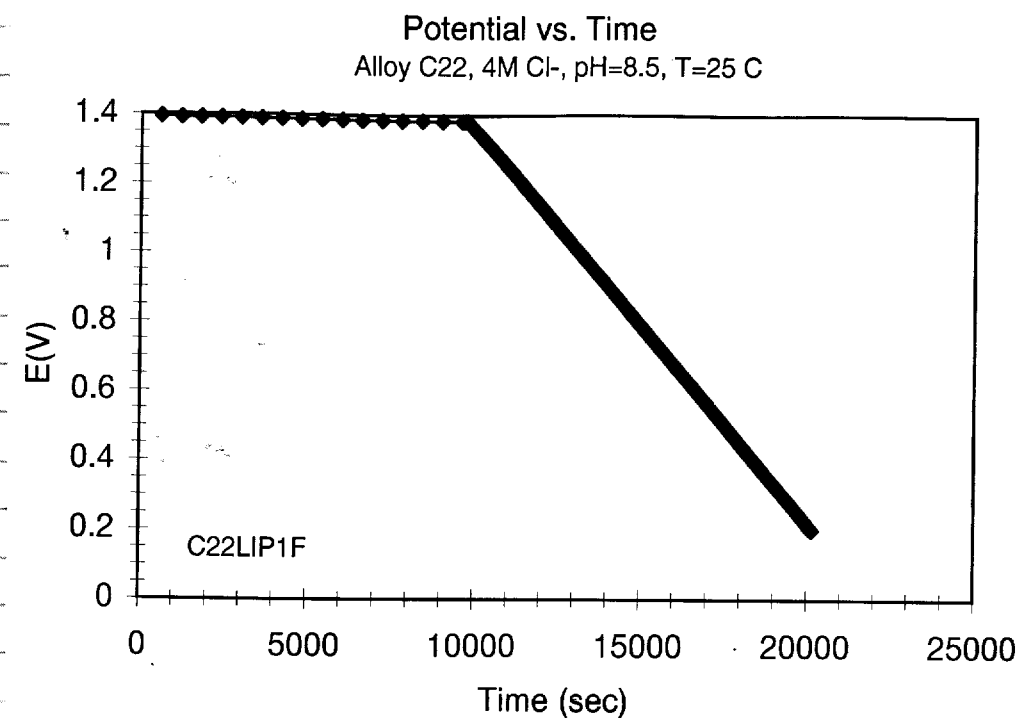
Counter Electrode: Pt. Flag

$E_{\text{cor}} = +250.4 \text{ mV}$

$E_{\text{pe}} = +10.3 \text{ mV}$

Kimberly Ann Guss 5/15/97

Kimberly Ann Guss 5/15/97



Lead-in-Pencil of Alloy C22 - 1M Cl⁻, pH=8.5, T=95°C

C22lip3.dat

Objective: to measure E_p of a single pit

Specimen: Alloy C22, HL #227B-B-3175, $\rho = 8.69 \text{ g/cm}^3$

Specimen Dimensions - see p. 46

Start wt: 6.31756 gm

End wt: 6.29555 gm

Solution: Same Mixture of Solutions as on p. 59

1M Cl⁻, 20 ppm SO₄²⁻, 10 ppm NO₃⁻, 2 ppm F⁻ + DI water

Start pH = 7.703

End pH = 7.953

T = 95°C, Hg thermometer #0323008

Deaerated Sol'n w/ 99.999% N₂

EG&G Potentiostat Model 273 S/N 41108

Potentiostat: Pine Model AFRDE5 Bi-Potentiostat S/N 6091

w/ Workbench Software

Kay 5/15/97

Ref. Electrode: Fisher SCE # 13-620-51, S/N 3106339

3106345

Kay 5/15/97

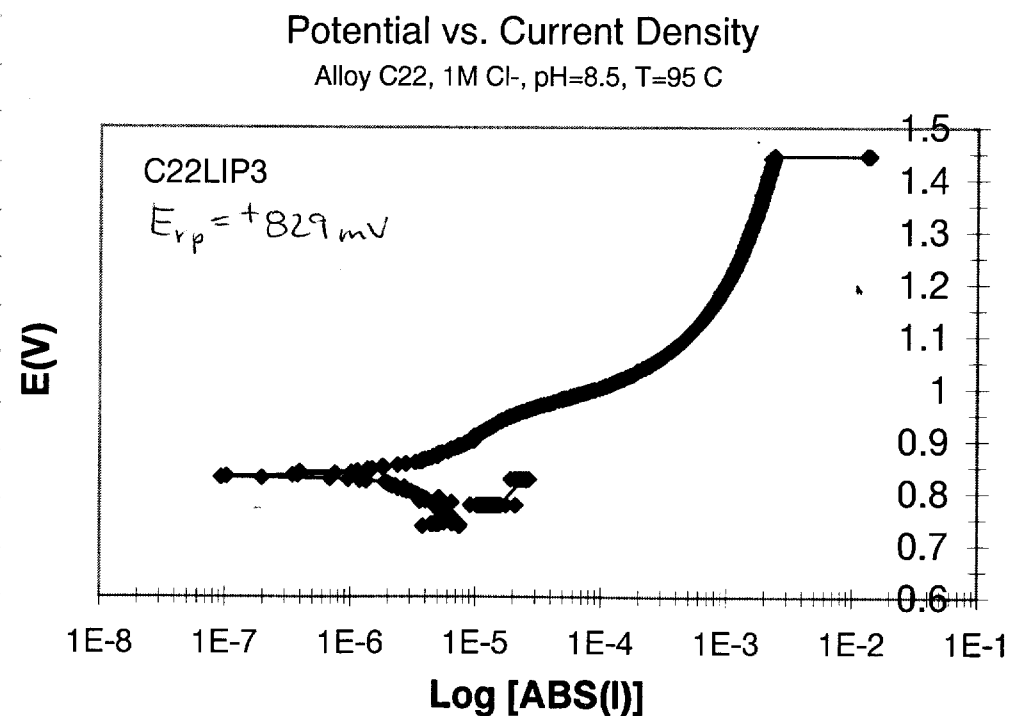
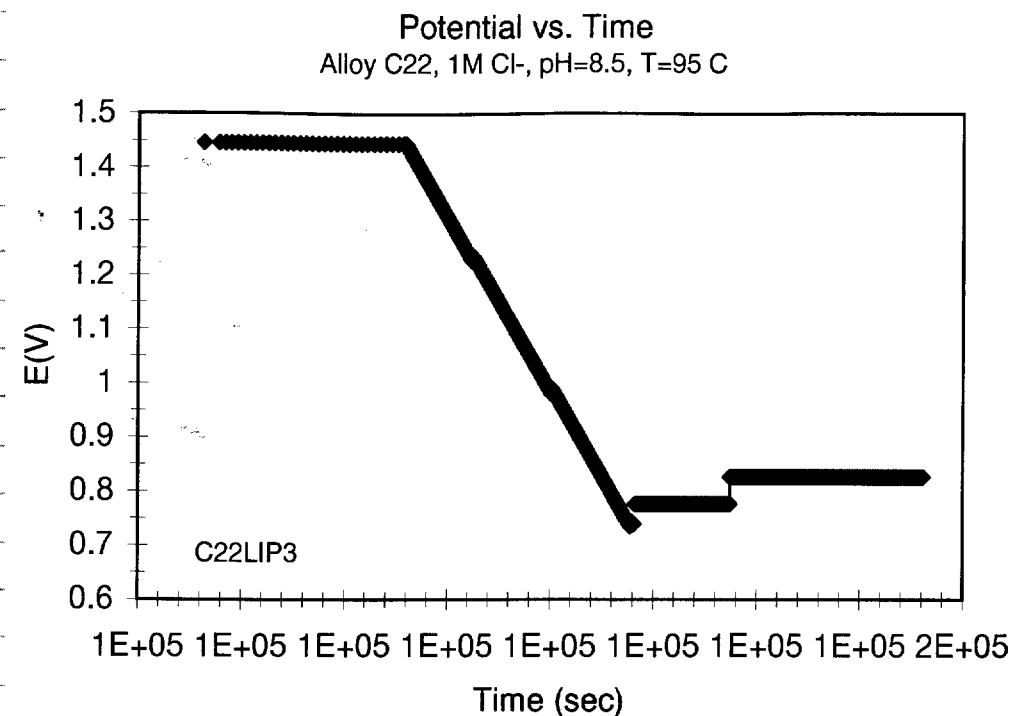
Counter Electrode: Pt. Flag

$E_{corr} = -498 \text{ mV}$

$E_{pe} = -547 \text{ mV}$

Kimberly Ann Gross 5/15/97

Kimberly Ann Gross 5/15/97



Lead-in-Pencil Alloy C22 - 1000 ppm Cl⁻, pH=8.5, T=95°C

C22lip5.dat

Objective: measure E_p of a single pit

Specimen: Alloy C22, Ht #2278-8-3175, $\rho = 8.69 \text{ g/cm}^3$

Specimen Dimensions - see p. 46

Start wt: 6.17638 gm

End wt: 6.17324 gm

Solution: Same Mixture of Solutions as on p. 73

1000 ppm Cl⁻, 20 ppm SO₄²⁻, 10 ppm NO₃⁻, 2 ppm F⁻ + DI water

Start pH = 6.540

End pH = 7.422

T=95°C, Hg thermometer #183305

Deaerated Solution w/ 99.999% N₂

Potentiostat: Pine Model AFRDES Bi-Potentiostat SN 6091
w/ Workbench Software

Ref. Electrode: Fisher SCE #13-620-51, SN 3106345

3106339

10/5/97

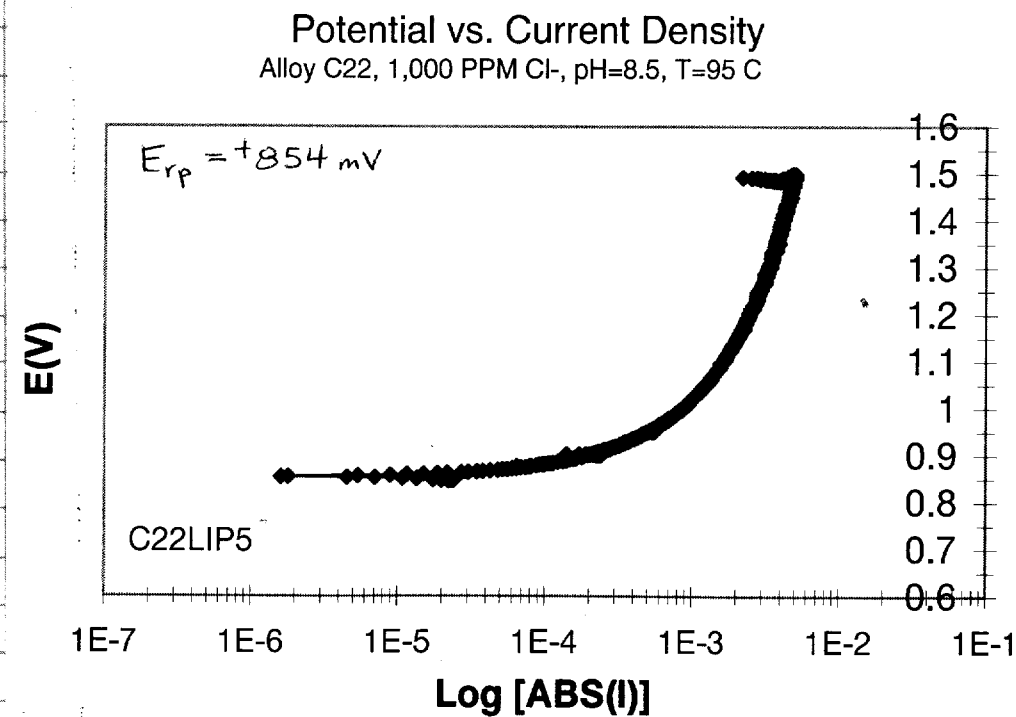
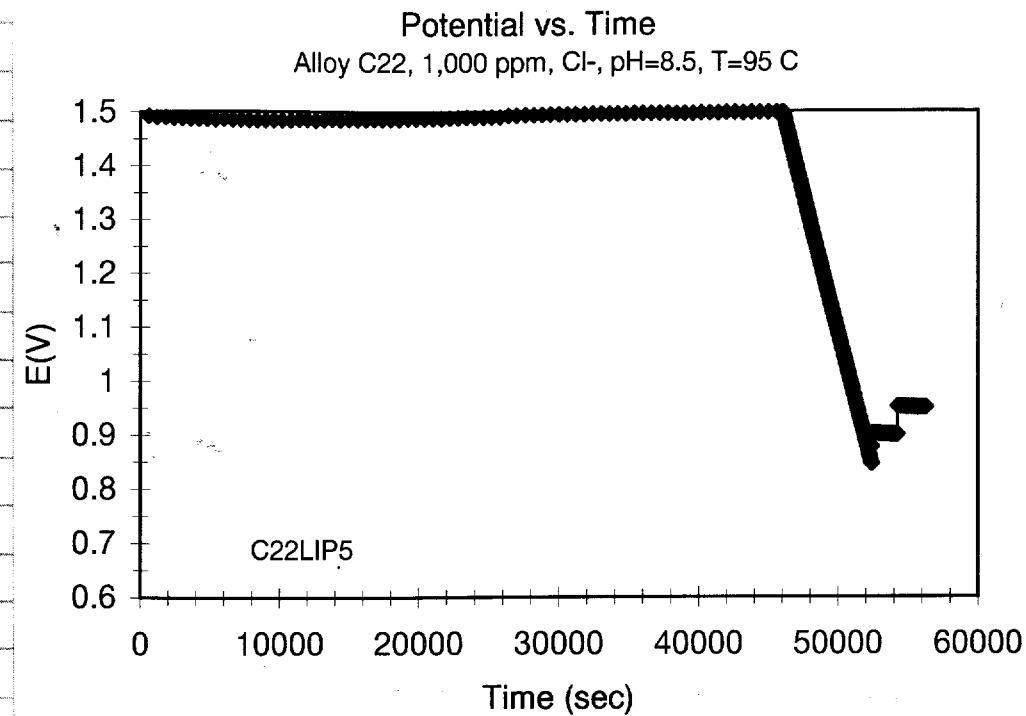
Counter Electrode: Pt. Flag

$E_{corr} = -518 \text{ mV}$

$E_{pe} = -498 \text{ mV}$

Kimberly Ann Dumas 5/15/97

Kimberly Ann Dumas 5/15/97



Lead-in- Pencil of Alloy 625 - 1MCl⁻, pH=8.5, T=95°C

625lip7.dat

Objective: Measure E_{mp} of a single pit

Specimen: Alloy 625, Ht #NX9936AG, $\rho = 8.449 \text{ g/ml}$

Specimen Dimensions - See p. 46

Start wt: 6.31756 gm

End wt: 6.29318 gm \Rightarrow Note: a few filings fell out while cleaning

Solution: Same Mixture of Solutions as on p. 59 ⁵⁹ kay 5/15/97
1 MCl⁻, 20 ppm SO_4^{2-} , 10 ppm NO_3^- , 2 ppm F^-

Start pH = 7.953

End pH = 7.904

T = 95°C, Hg Thermometer #183305 ⁰³²³⁰⁰⁸ kay 5/19/97

Deaerated Solution w/ 99.999% N_2

EG&G Potentiostat Model 273 S/N 41108

Potentiostat: Pine Model AFRDES Bi-Potentiostat ^{S/N 6094} kay 5/15/97
w/ Workbench Software

Ref. Electrode: Fisher SCE #13-620-51, S/N 3106345

Counter Electrode: Pt. Flag

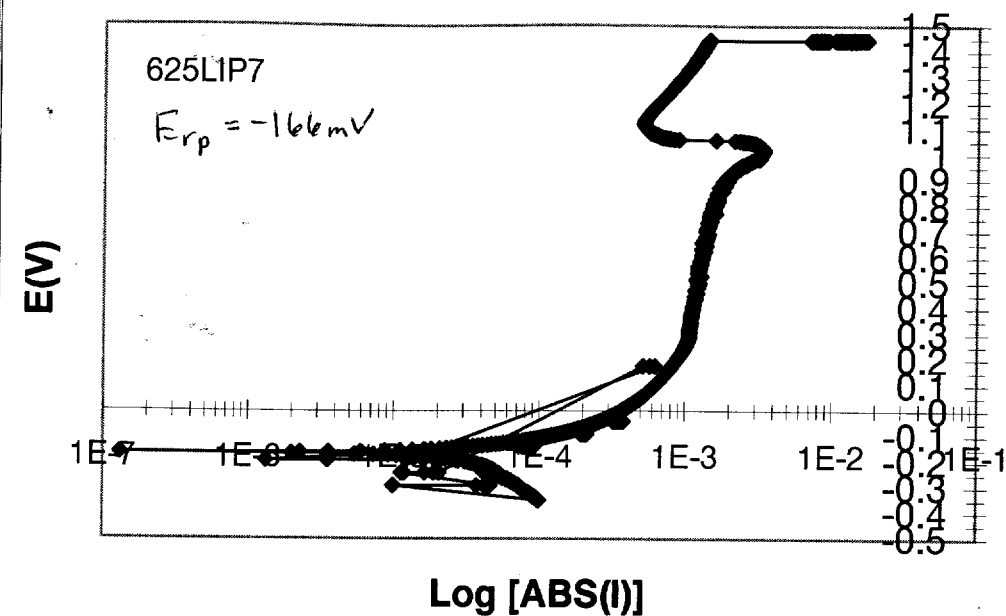
$E_{corr} = -670 \text{ mV}$

$E_{pt} = -675 \text{ mV}$

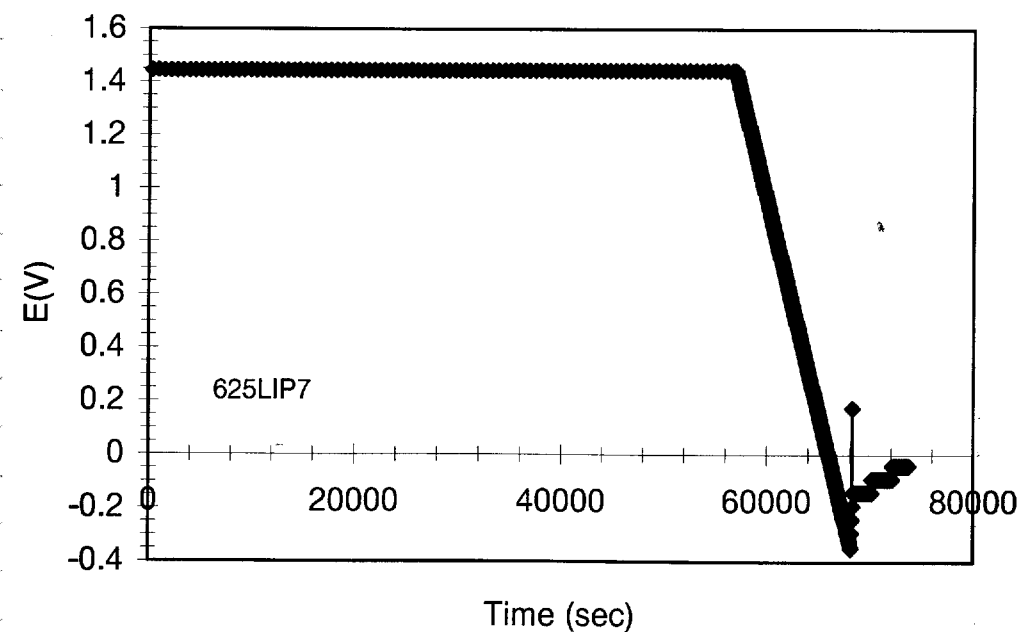
Kimberly Ann Duse 5/15/97

Kimberly Ann Duse 5/15/97

Potential vs. Current Density

Alloy 625, 1M Cl⁻, pH=8.5, T=95 C

Potential vs. Time

Alloy 625, 1M Cl⁻, pH=8.5, T=95 C

load-in- Penail of alloy 625 - 1000ppm, pH=8.5, 60°C

625lip6.dat

Objective: to measure E_{rp} of a single pitSpecimen: Alloy 625, Ht # NX9936AG, $p = 8.44 \text{ g/ml}$

Specimen Dimensions - see p. 46

Start wt: 6.31996 gm

End wt: 6.31484 gm \Rightarrow few filings came out of sample while cleaning in acetone.
 6.31531 gm w/ 2 small filings added to specimen

Solution: Same Mixture of Solutions as on p. 73

1000 ppm Cl⁻, 20 ppm SO₄²⁻, 10 ppm NO₃⁻, 2 ppm F⁻ + DI water

Start pH = 7.422

End pH = 6.739

T = 60°C, Hg thermometer # 183305

Deaerated Sol'n w/ 99.999% N₂Potentiostat: Pine Model AFRDE5 Bi-Potentiostat SN 6091
w/ Workbench SoftwareRef. Electrode: Fisher SCE #13-620-S1, S/N 3106339
3106345

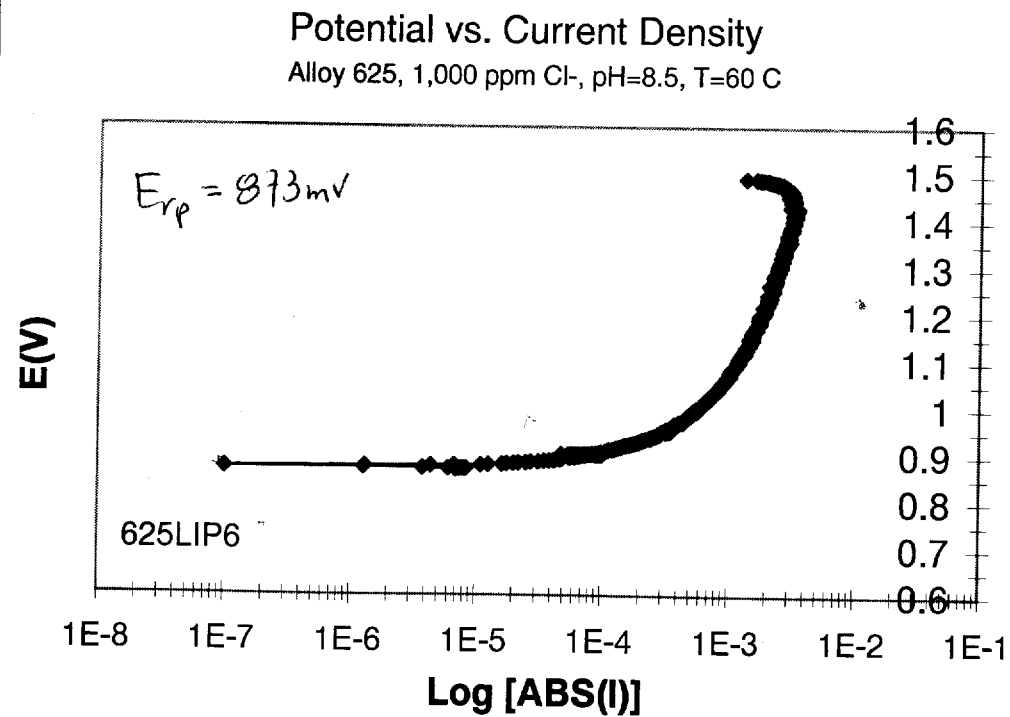
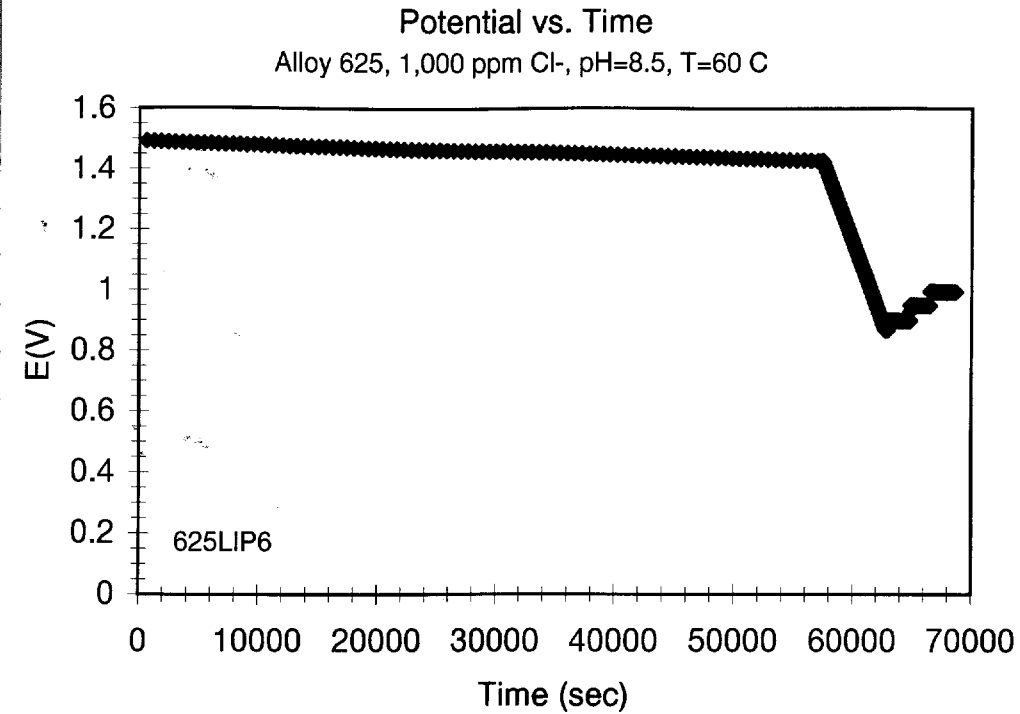
Tag 5/15/97

Counter Electrode: Pt. Flag

 $E_{corr} = -443 \text{ mV}$ $E_{pr} = -485 \text{ mV}$

Kimberly Ann Dumas 5/15/97

Kimberly Ann Dumas 5/15/97



Lead-in-Pencil of Alloy C22 - 1M Cl⁻, pH=8.5, T=60°C

C22lip4.dat

Objective: Measure E_p of a single pit

Specimen: Alloy C22, Ht # 2278-B-3175, $p = 8.69 \text{ g/ml}$

Specimen Dimensions - see p. 46

Start wt: 6.15265

End wt: 6.13319 gm

Solution: 1M Cl⁻, 20 ppm SO₄²⁻, 10 ppm NO₃⁻, 2 ppm F⁻
Same Solutions as on p. 59.

Start pH = 7.904

End pH = 7.662

0323008

T=60°C, Hg thermometer #103305 lag 5/17/97

Deaerated Solution, w/ 99.999% N₂

Potentiostat: EG&G Potentiostat Model 273 S/N 4408
w/ Workbench Software

Ref. Electrode: Fisher SCE # 13-620-51, S/N 3106345

Counter Electrode: Pt. Flag

$E_{\text{corr}} = -249 \text{ mV}$

$E_{\text{H}} = -83 \text{ mV}$

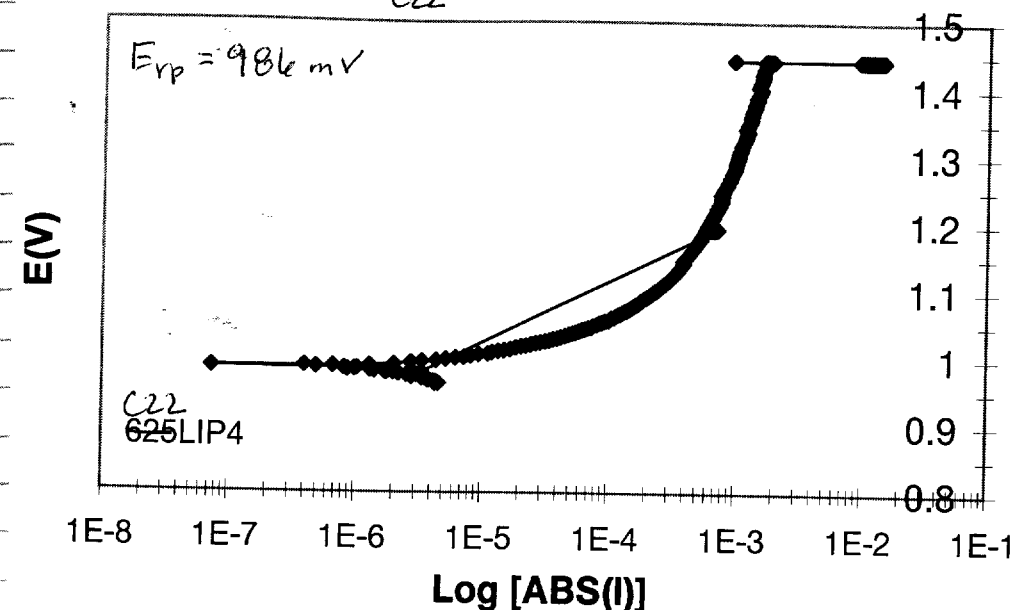
During the test, the solution in the pit was brownish-yellow in color.

After test, observed a bright yellow corrosion product.
After the Specimen was sitting out (the ^{solution} in the pit removed),
the corrosion product appeared to be a yellow-brown color.

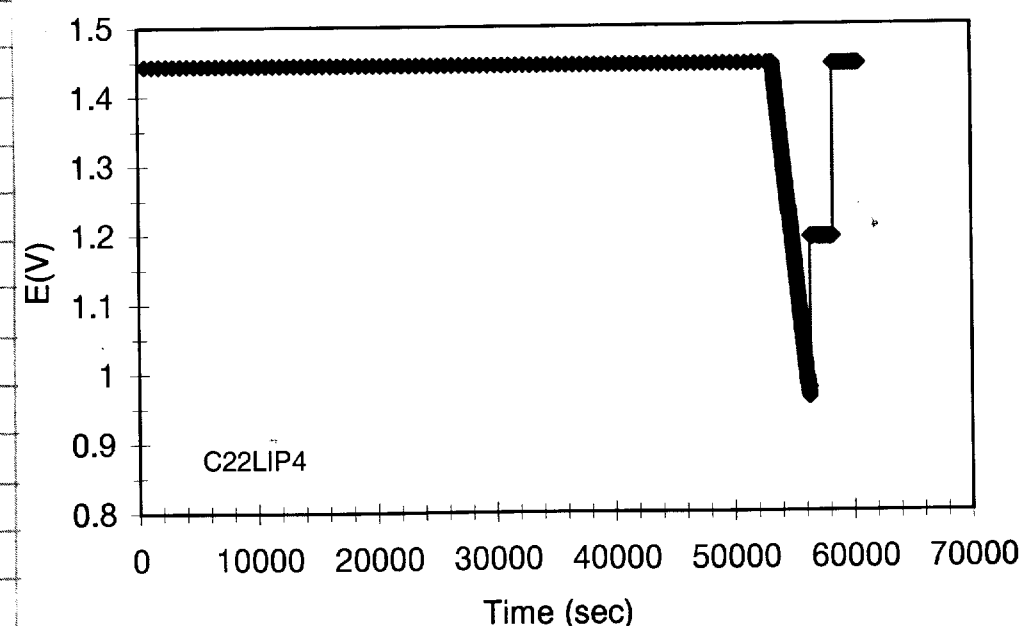
Kristy Ann Guntz 5/15/97

Kristy Ann Guntz
5/27/97

Potential vs. Current Density

Alloy C22, 1M Cl⁻, pH=8.5, T=60 C
C22

Potential vs. Time

Alloy C22, 1M Cl⁻, pH=8.5, T=60 CLead-in-Pencil of Alloy C22 - 4M Cl⁻, pH=8.5, T=95°C

C22lip8. dat

Objective: Measure E_{cp} of a single pitSpecimen: Alloy C22, Ht # 2278-8-3175, $\rho = 8.69 \text{ g/cm}^3$

Specimen Dimensions - see p. 46

Start wt: 6.19348 gm

End wt: 6.16849 gm

Solution: 4M Cl⁻ as NaCl lot # 960780 (701.024550 gm)20ppm SO_4^{2-} Stock Solution (60 mL)10ppm NO_3^- Stock Solution (30 mL)2ppm F^- Stock Solution (6 mL)+ DI water to 3,000 mL, Deaerated w/ 99.999% N_2

NB157, p.172

T=95°C, Hg thermometer #183305

Start pH=8.003

Deaerated Solution w/ kay 5/19/97

End pH=4.046

Potentiostat: EG&G Potentiostat Model 273 S/N kay 5/19/97

Pine Model A PRDE5 Bi-Potentiostat S/N 6091

w/ Workbench Software

Ref. Electrode: Fisher SCE #13-620-51, S/N 3106339

Counter Electrode: Pt. Flag

 $E_{corr} = -1 \text{ mV}$ $E_{pt} = -278 \text{ mV}$

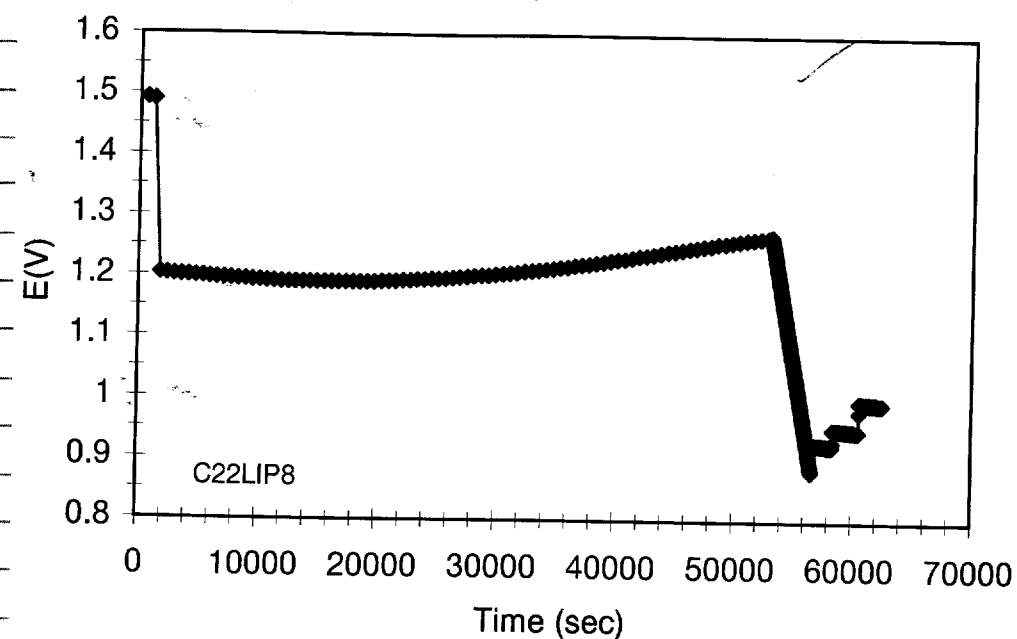
During the experiment, the solution in the pit was brownish-yellow in color.

After the test, the corrosion product appeared to be a bright yellow. The flat + sides (between specimen + glass) were covered w/ this material

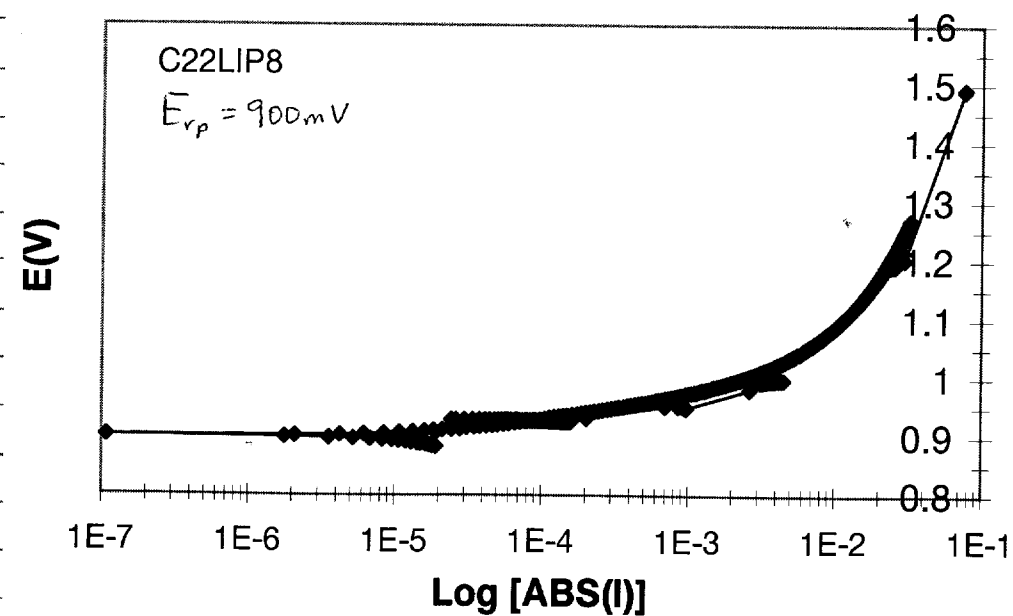
Kimberly Ann Guss 5/27/97

Kimberly Ann Guss 5/27/97

Potential vs. Time
Alloy C22, 4M Cl⁻, pH=8.5, T=95 C



Potential vs. Current Density
Alloy C22, 4M Cl⁻, pH=8.5, T=95 C



Lead-in-Pencil of Alloy 625 - 1M Cl⁻, pH=8.5, T=95°C

625lip9.dat

Objective: measure E_{rp} of a single pit

Specimen: Alloy 625, Ht # NX9936AG, $\rho = 8.44\text{ g/cm}^3$

Specimen Dimensions - see p. 46

Start wt: 6.24467 gm

End wt: 6.22262 gm

Solution: 1M Cl⁻, 20 ppm SO₄²⁻, 10 ppm NO₃⁻, 2 ppm F⁻ + DI water
Same solution as on p. 59

Start pH = 7.662

End pH = 7.868

T=95°C, Hg thermometer # 0323008

Deaerated Solution w/ 99.999 % N₂

Potentiostat: EG&G Potentiostat Model 273 S/N 41108
w/ Workbench Software

Ref. Electrode: Fisher SCE # B-620-51, S/N 3106345

Counter Electrode: Pt. Flag

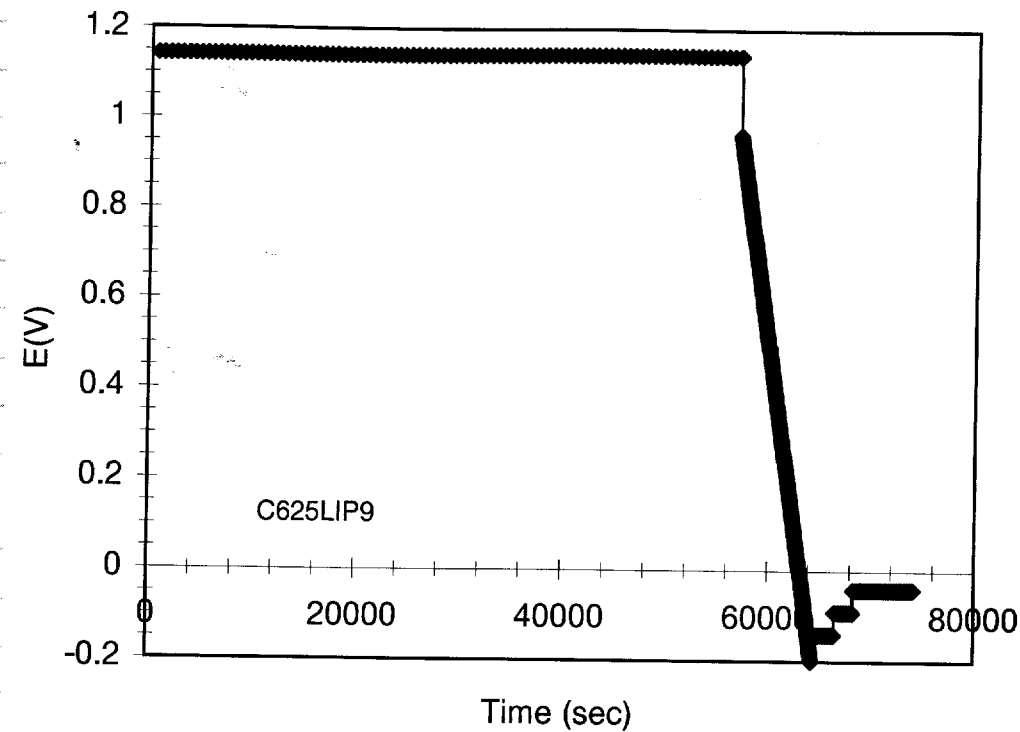
$E_{corr} = -501\text{ mV}$

$E_{pit} = -353\text{ mV}$

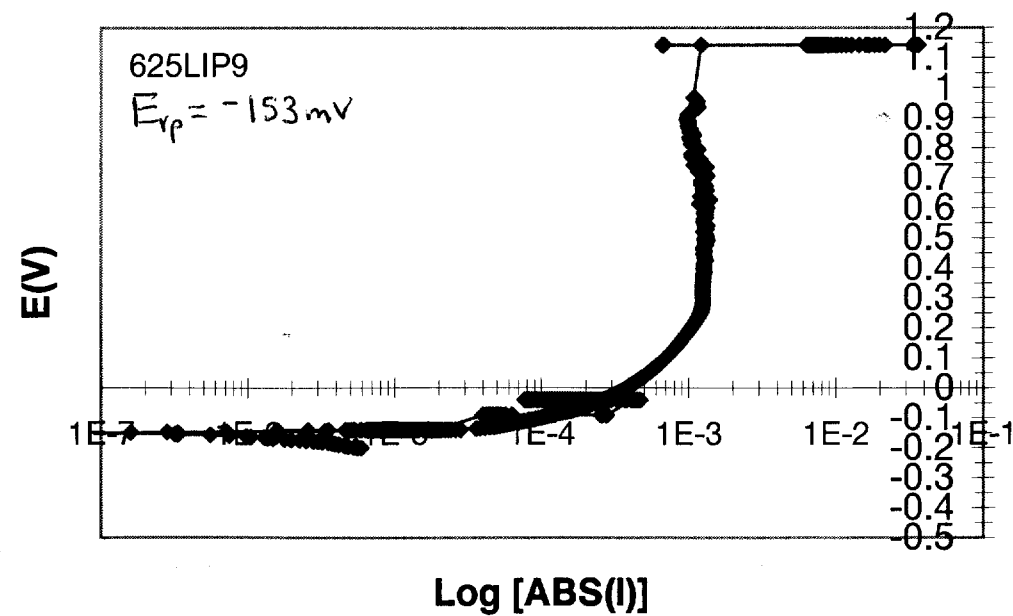
Kimberly Ann Gnae 5/27/97

Kimberly Ann Gnae 5/27/97

Potential vs. Time
Alloy 625, 1M Cl⁻, pH=8.5, T=95 C



Potential vs. Current Density
Alloy 625, 1M Cl⁻, pH=8.5, T=95 C



The Degredation of Summary of Lead-in-Pencil Specimens

(Measured w/ uncalibrated caliper)

Final length

1.79 cm

625 lip 1/b

Appearance



looks like some kind of dark gray oxide, located between top + bottom 1/3's of specimen, forming a band around the lead. The top 1/2 + flat appear to be a dull bright gray (not the same gray oxide). Sharp corners at top. Not a significant amt. of crevice corrosion.

adherent surface film

1.90 cm

625 lip 2a

top 2/3 of specimen + the flat (area covered w/ glass) appears to be dull light gray. the corner is ~~not~~ rounded, it is sharp. The top 1/3 ~~is~~ like there was more significant crevice corrosion than the middle 1/3. There does not appear to be any dark gray oxide. surface film. w/ microscope at 50x, there appears to be many (high density) of small pits from top + middle 2/3. Small pits ~ 10 μm deep.

1.78 cm

625 lip 3a

top 1/3 of specimen + flat are dull light gray. middle 1/3 appears to have a gray/green scale on it. Crevice corr. appears at crevice where glass + felt tube meet (~ 70 μm deep). Looks like general corrosion elsewhere - not a lot of large distinct pits. Corner is somewhat rounded.

1.90 cm

625 lip 4

Surface is covered w/ adherent scale that is rainbow colored. It does not appear to have been corroded (in that there appears to be no dull light gray metal exposed). The top flat has cylindrical depression in it (may be from machining process). At the tip, the scale is yellowish and there are depressions running longitudinally. Corner is sharp.

Stability Ann Gump 5/27/97

Stability Ann Gump 5/27/97

Summary of the Degradation of Lead-in-Pencil Specimens (Cont)

1.88 cm

6251p5a

Surface is covered w/ a very light yellow ^{adherent} scale. Except at the end where it is light gray (dull). The flat is also covered w/ a light yellow film. The corner is rounded slightly. And longitudinal depressed striations are visible. At the tip, a very high density of very small pits was observed.

1.67 cm

C221p1a-f

No discoloration in the surface - shiny metal. Except at tip where it appears to have pits. The corner is very well rounded, so the tip is almost spherical. There is crevice corr. where the glass + teflon tube met at about $\frac{2}{3}$ from the tip. The crevice is 45 μ m deep. Also, some g.b. appear to be etched, and there are ^{small} nearly spherical pits at the tip.

1.82 cm

C221p3

^{adherent} Brownish surface scale. Crevice corr. where glass + teflon met (30 μ m). Tip is slightly rounded + ~~has pits~~ is pitted. Pit density is much less than for 625. Also, spherically shaped + seem to coalesce.

1.82 cm

C221p4

No discoloration in the surface - shiny metal. Tip appears to be fairly flat, but w/ rounded corners. There appears to be no crevice corrosion. There are some pits at the tip of the specimen, though the density of pits is much less than for C221p8. These pits are also somewhat spherical.

1.82 cm

C221p8

No discoloration in the surface - shiny metal. Tip is rounded + almost spherical. There was no crevice corrosion. The tip is heavily pitted w/ nearly spherical pits. The pit density seems large, and the pits seemed to coalesce.

(Cont'd)

Note: Un corroded specimen length

C22 = 1.91 cm, 1.91 cm

625 = 1.90 cm, 1.90 cm

Final length

1.90 cm

C221p5

Brownish adherent surface scale. Tip is rounded. ~~At~~ No crevice corr.

1.81 cm

6251p7

^{adherent} yellow \rightarrow gray surface scale. Significant crevice (10 μ m) corrosion at glass/teflon joint + crevice-like longitudinal corrosion that originates at the tip + goes down to glass/teflon joint. The corners are gone; i.e. the tip is rounded and not flat any more. Looks like a type of general corrosion, in that there doesn't seem to be noticeable pits, OR there are so many pits they coalesced?

1.90 cm

6251p6

Rainbow colored surface film. At tip, there are ~~very~~ longitudinal ridges. The corners are sharp, but pits are found on the tip + sides. The tip looks heavily pitted with small pits - almost like Swiss cheese.

Kimberly Ann Jones 5/27/97

Kimberly Ann Jones 5/27/97

Results from XRD Scans of Specimens 625cpp9 + 625cpp11

FORM FOR REQUESTING WORK FROM OTHER DIVISIONS**A. TO BE COMPLETED BY DIVISION 20 PERSONNEL**

Requester: D. Dunn Request Date: 4/29/97
 Project No.: 20-5708-561 Phone No.: 6090
 Description of Work Requested: XRD OF SELECTED SPECIMENS
625CPP9 (GOLD FILM) 625CPP11 (CORROSION PRODUCTS)
OPTICAL PHOTO OF SPECIMENS 1 PHOTO OF ENTIRE SPECIMEN
2 CLOSEUP OF CORRODED AREAS.
EDS OF 625CPP9 & 625CPP11
☐ Optical Microscopy ☐ SEM ☐ Hardness ☐ Profilometer ☐ Auger ☐ Other

QUALITY REQUIREMENTS: The work requested is governed by the CNWRA Quality Assurance Program which addresses requirements of 10CFR50, Appendix B. Personnel performing this work shall be qualified under the CNWRA QA program or equivalently under the SwRI Nuclear QA program. Test and analysis methods shall be documented by approved procedures or recognized, standard methods. Measuring and test equipment shall be calibrated and controlled according to CNWRA and SwRI Nuclear QA program requirements.

Sample Identification	Description
825CPP1	ALLOY 825 CYL SPECIMEN w/ PITS
C22CPP1	C22 w/ CREVICE CORROSION
625CPP5	ALLOY 625 w/ CREVICE CORROSION
625CPP10	ALLOY 625 w/ CREVICE CORROSION
625CPP9	ALLOY 625 w/ CREVICE CORROSION
625CPP11	ALLOY 625 w/ CREVICE CORROSION

B. TO BE COMPLETED BY DIVISION PERFORMING WORK¹

☐ Optical Microscopy ☐ SEM ☐ Hardness ☐ Profilometer ☐ Auger ☐ Other

Person Assigned: JIM SPENCER Signature: J. Spencer
 Division: 06 Date: 5/12/97
 EMPLOYEE # 3889
 Make, Model & Serial No. of Equipment Used (attach list if necessary): _____

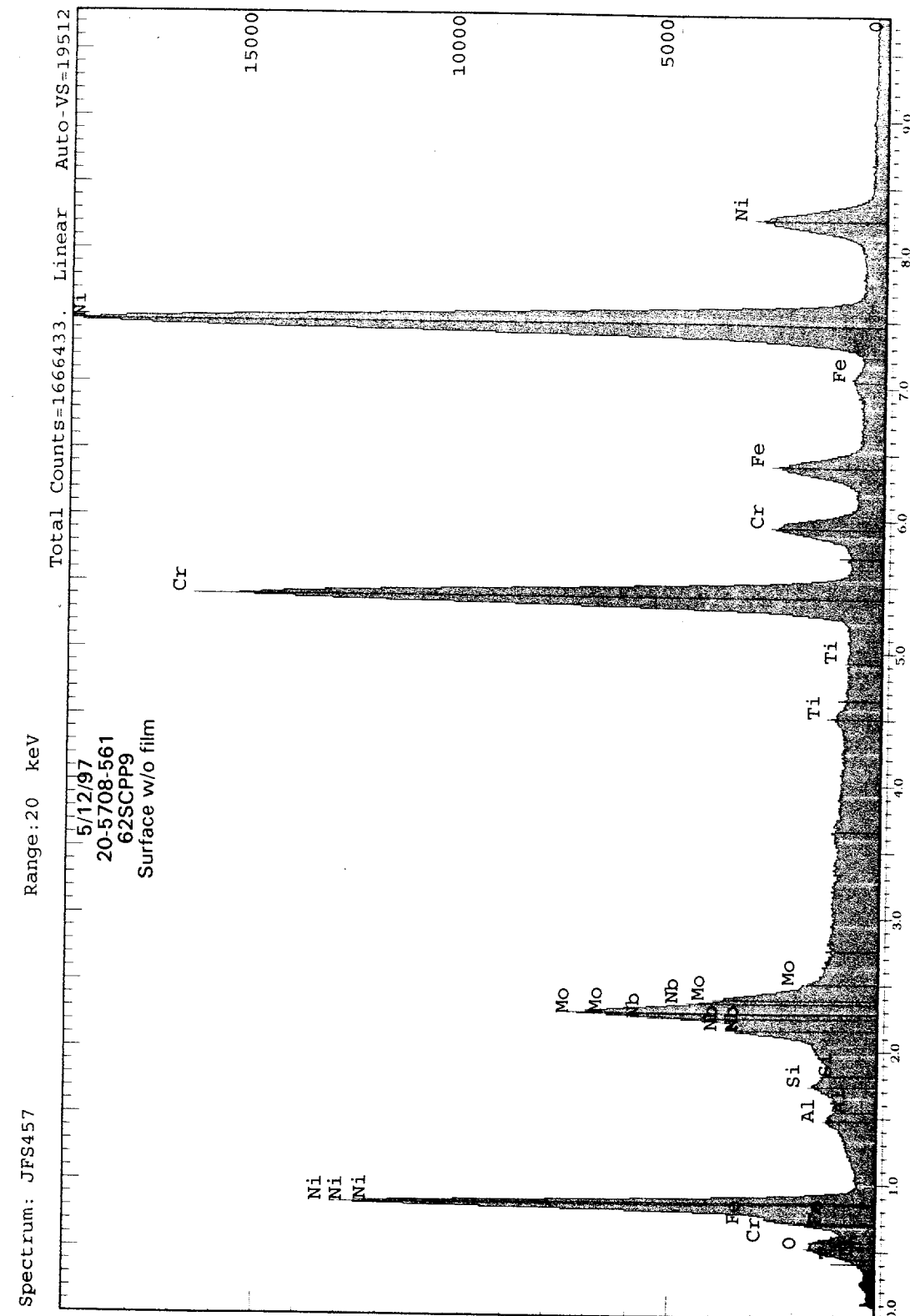
Software Used (If any): _____

Standards Used (If any): _____

Photographic Negative Numbers (If Applicable): _____

¹ Please sign and date any hardcopy of analysis or list of photographs (The photographs themselves need not be signed). If error occurred during entry, do not erase or overwrite, but strikeout with single line, initial and date, and then reenter correct information.

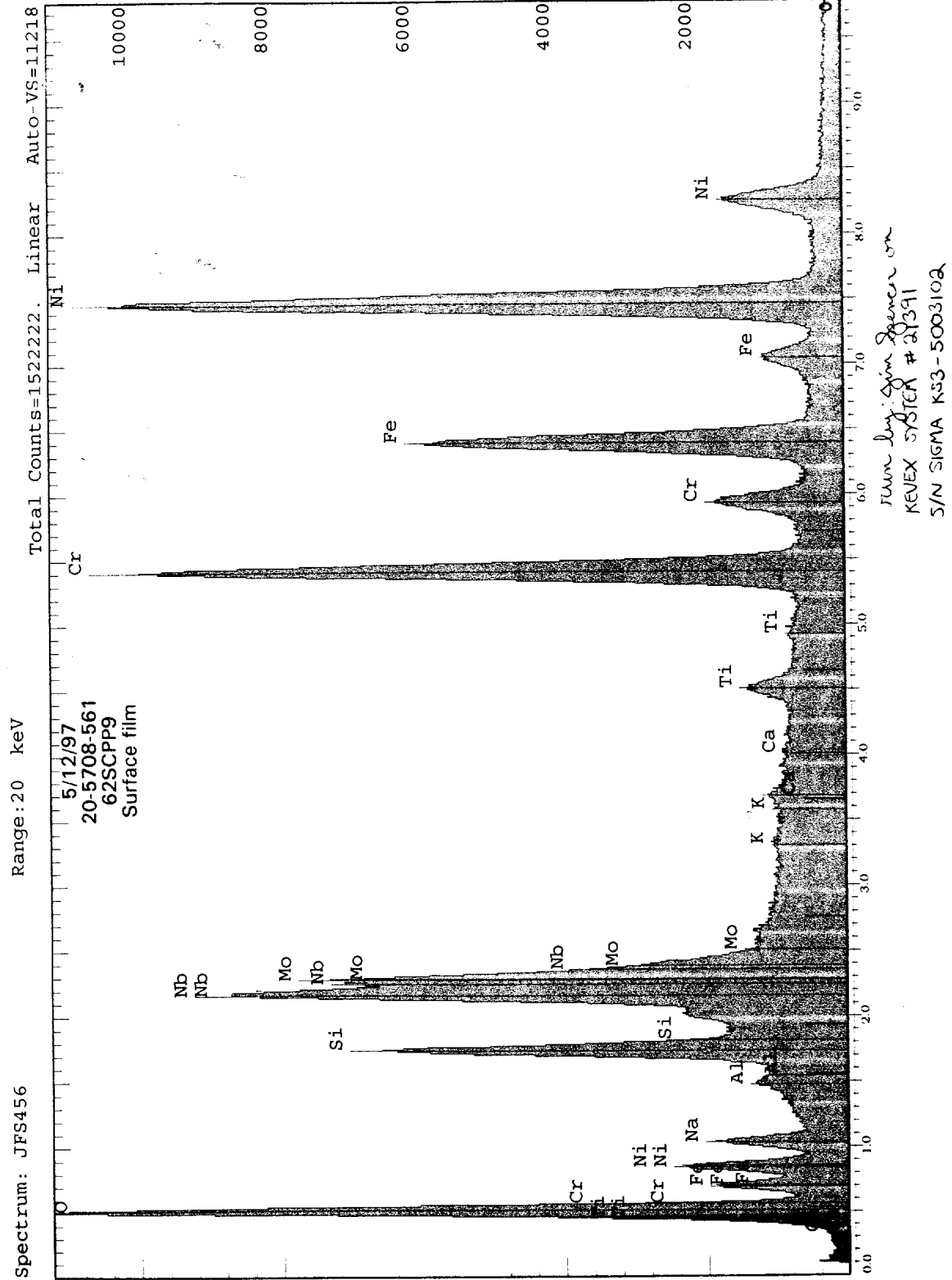
EDS spectrum of untarnish area on 625cpp9



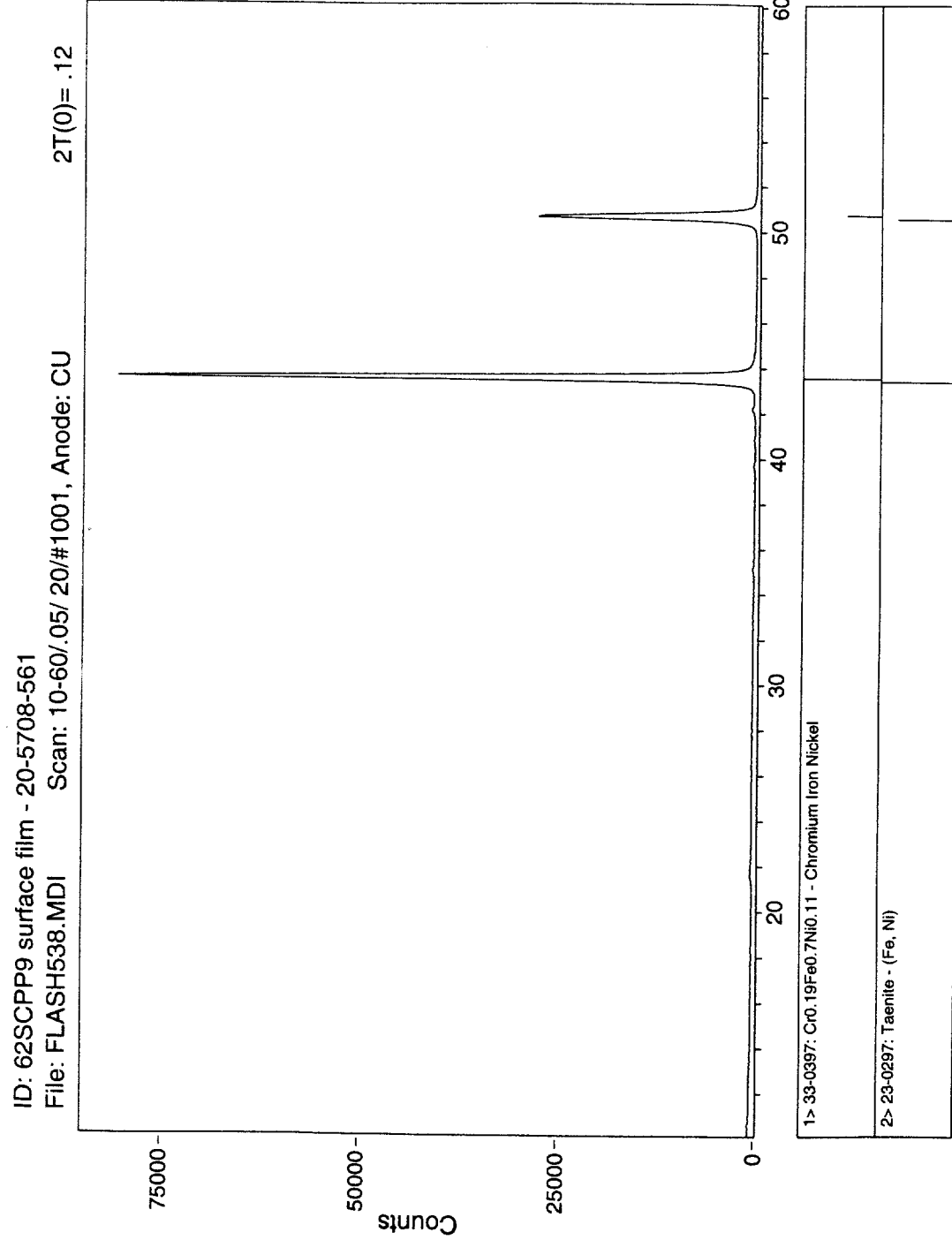
Kimberly Ann Dunn 5/27/97

Kimberly Ann Dunn 5/27/97

EDS Spectrum of Tarnished Surface on 625cpp9



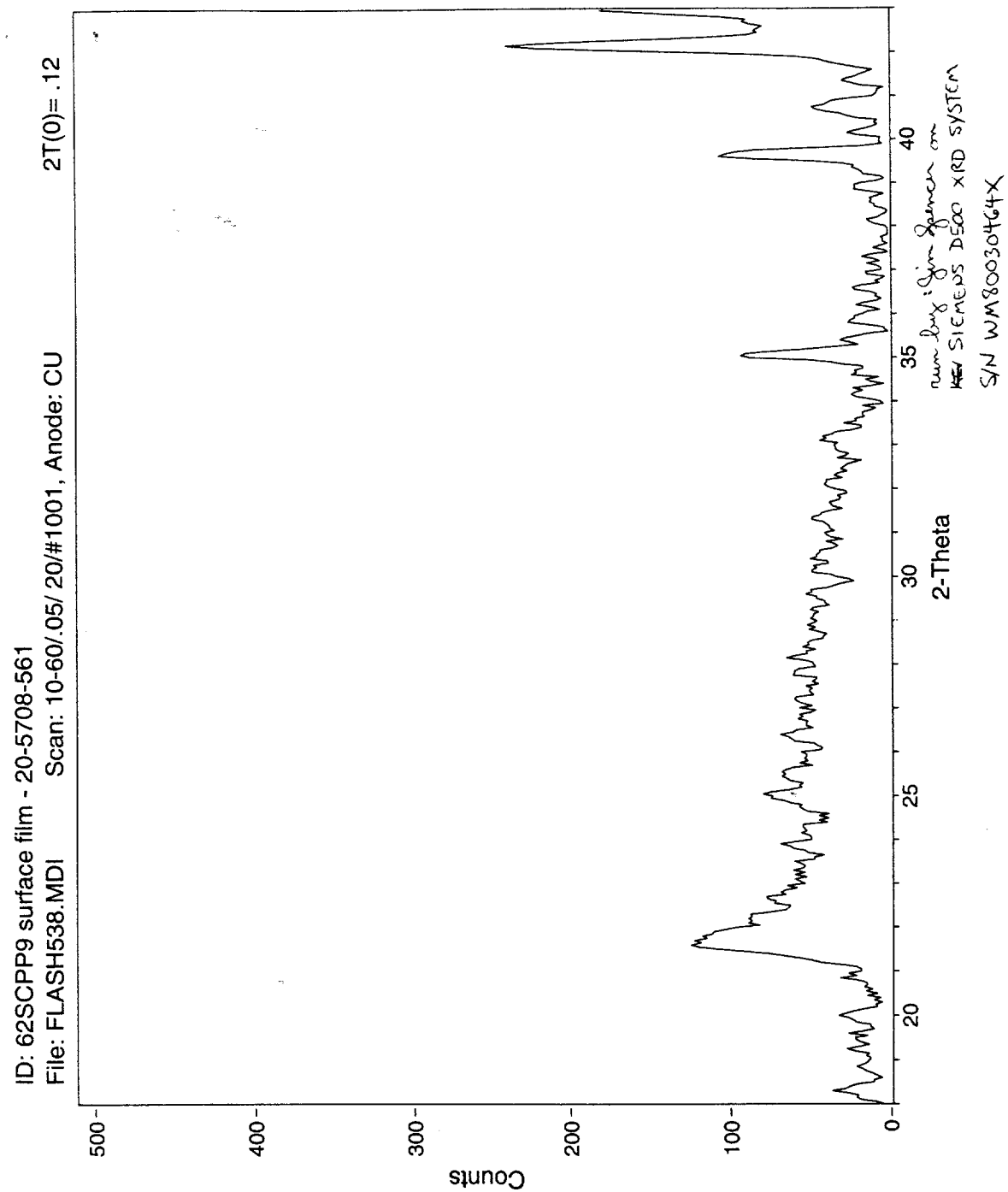
XRD Spectrum of Specimen 625cpp9 - High intensity peaks are those of the 625 specimen.



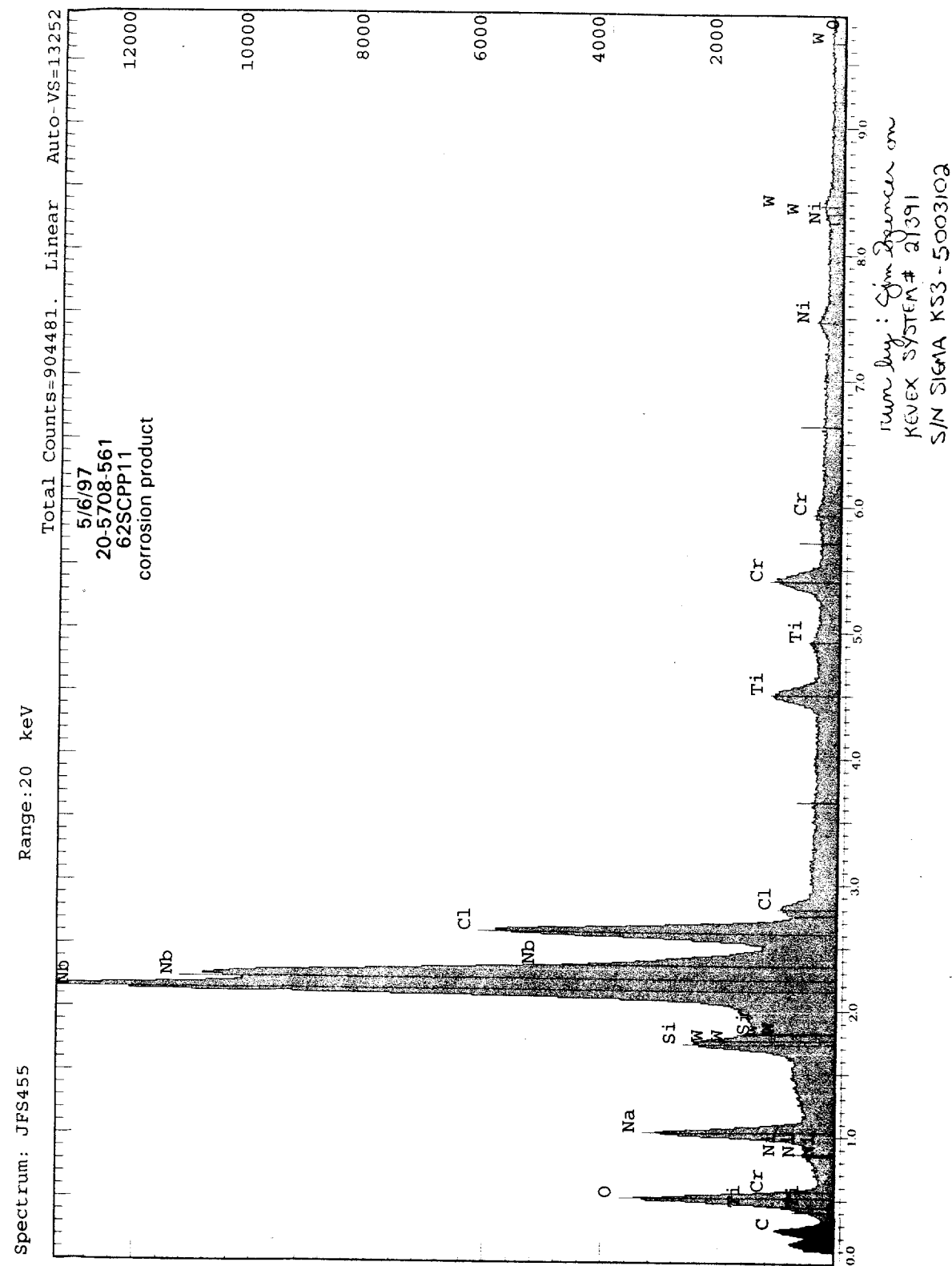
2-Theta
Run by: Jim Jones 5/12/97
on SIEMENS D5000 XRD SYSTEM
S/N WM80030464X

Run by: Jim Jones 5/27/97

XRD Spectrum of Specimen 625CPP9 - low intensity peaks are those of the scan on P. 97



EDS spectrum of the Corrosion product on 625CPP11



XRD of the Corrosion Product on 625cpp11
Note: Color of this product was a dark black/brown.

EDS results of the Corrosion Product on 625cpp11

JFS455.RPT

[ANALYSIS REPORT]

GENERAL CONDITIONS

Result File : JFS455
 File Version : 1
 Background Method : Auto
 Decon Method : Gaussian
 Decon ChiSquared : 32.11
 Analysis Date : 6-MAY-97
 Microscope : SEM
 Comments : 62SCPP11 corr. product
 20-5708-561

ANALYSIS CONDITIONS

Quant. Method : XPP/ASAP
 Acquire Time : 200 secs
 Normalization Factor: 100.00

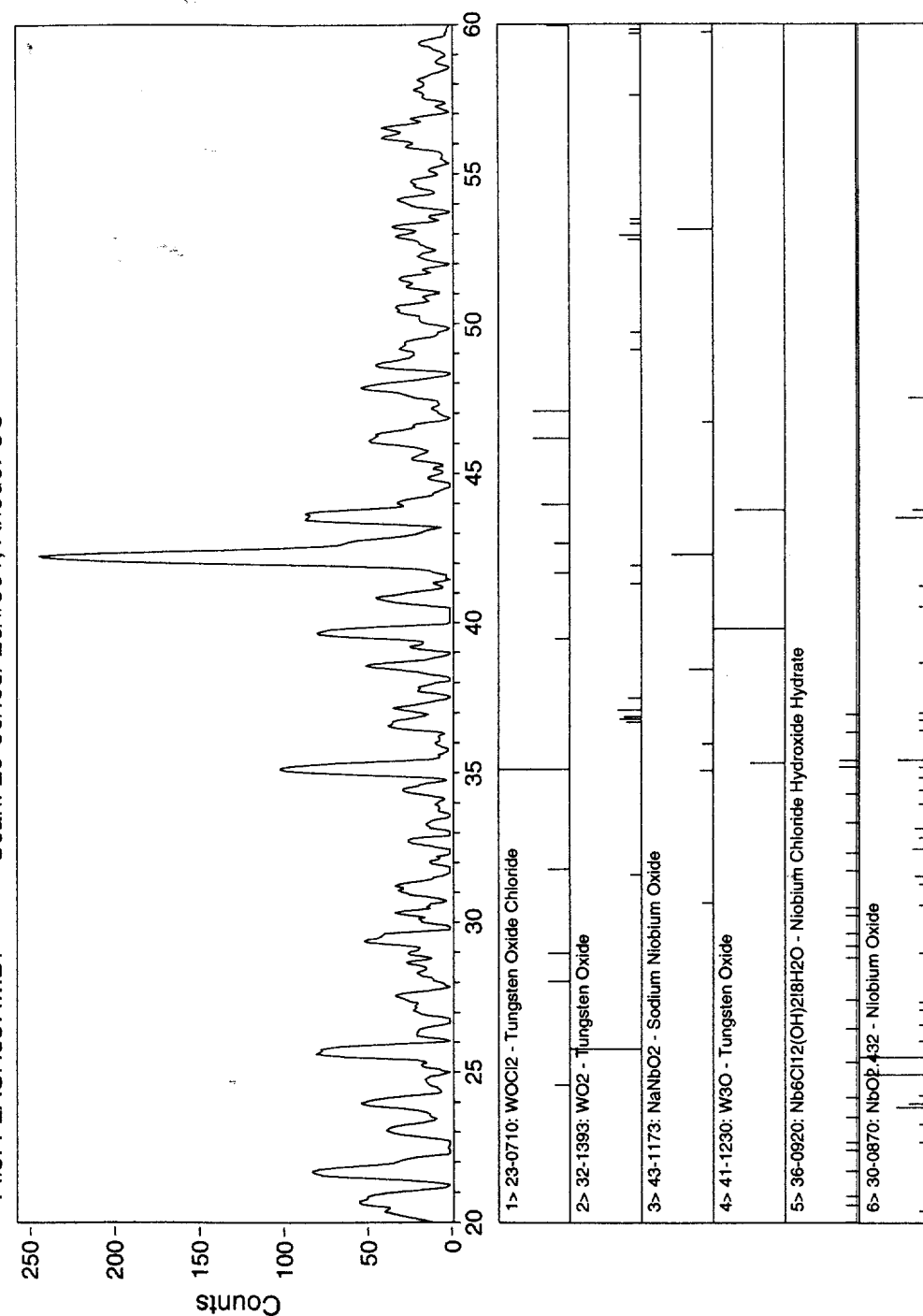
SAMPLE CONDITIONS

kV : 20.0
 Beam Current : 100.0 picoAmps
 Working Distance : 29.5 mm
 Tilt Angle : 0.0 Degrees
 TakeOff Angle : 31.1 Degrees
 Solid Angle*BeamCurrent: 0.5

Element	Line	Weight%	K-Ratio	Cnts/s	Atomic%
Na	Ka	6.54	0.0245	97.01	17.37
Si	Ka	2.24	0.0176	76.39	4.87
Cl	Ka	15.67	0.0868	309.72	26.98
Ti	Ka	2.84	0.0235	53.30	3.63
Cr	Ka	3.52	0.0319	57.33	4.14
Ni	Ka	1.88	0.0193	19.14	1.95
Nb	La	57.55	0.4836	734.64	37.82
W	La	9.75	0.0789	18.62	3.24

run by: Jim Spencer on
 KEVEX SYSTEM # 21391
 S/N SIGMA KS3-5003102

ID: 62SCPP11 corr.prod. - 20-5708-561
 File: FLASH537.MDI Scan: 20-60/05/ 20/#801, Anode: CU



2-Theta

run by: Jim Spencer 5/9/97
 on SIEMENS D5000 XRD SYSTEM
 S/N WM80030464X

Kimberly Ann Gans 5/27/97

Kimberly Ann Gans 5/27/97

C.P.P. of Alloy 625 0.3M Cl^- , pH 8.5, 95°C
w/ crevice geometry

625 CPP 17. dat

Objective: To measure $E_{\text{ap}} + E_{\text{pit}}$ w/a crevice corrosion geometry

Specimen: Alloy 625 lot # NX 9936 AB

Spec. dimension see p. 24

600 grit polished 20 cm^2 exposed area

Start wt. 30.78316 g

End wt.

Solution: 0.3M Cl^- (as NaCl) 85 ppm HCO_3^-
20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

17.55860 g NaCl lot 960780

0.23729 g NaHCO_3 lot 923337A

20 ml SO_4 6/97

10 ml NO_3 6/97

2 ml F^- 6/97

+ DI water to 1000 mL
start pH 7.197 end pH

$T = 95^\circ\text{C}$ thermometer

Potentiostat: EG&G Versastat w/ 352C Software

Ref. electrode: Fisher SCE #13-601-51 S/N 5087374

Counter Electrode: Pt flag

$E_{\text{can}} = -499 \text{ mV}$

$E_{\text{pit}} = +201 \text{ mV}$

Power outage - test interrupted + data lost

Walter J. MacKowski
6/30/97

C.P.P. of Alloy 625 0.3M Cl^- , pH 8.5, 95°C
w/ crevice geometry

625 CPP 18. dat

Objective: To measure $E_{\text{ap}} + E_{\text{pit}}$ w/a crevice geometry

Specimen: Alloy 625 lot # NX 9936 AB

Spec. dimension see p. 24

600 grit polished 20 cm^2 exposed area

Start wt. 30.73314 g

end wt. 30.71425 g

Solution: 0.3M Cl^- (NaCl) 85 ppm HCO_3^-
20 ppm SO_4 10 ppm NO_3 2 ppm F^-

17.55193 17.55855 g NaCl lot # 960780

0.11756 0.23729 g NaHCO_3 lot # 923337A

6/30/97 20 ml SO_4 6/97

WJ MacKowski 10 ml NO_3 6/97

2 ml F^- 6/97

+ DI water to 1000 mL

start pH 8.046 end pH 9.425
7.888

WJ MacKowski
6/30/97 $T = 95^\circ\text{C}$ thermometer # 183304

Ref. electrode: Fisher SCE #13-601-51 S/N 5144349

Counter electrode: Pt flag

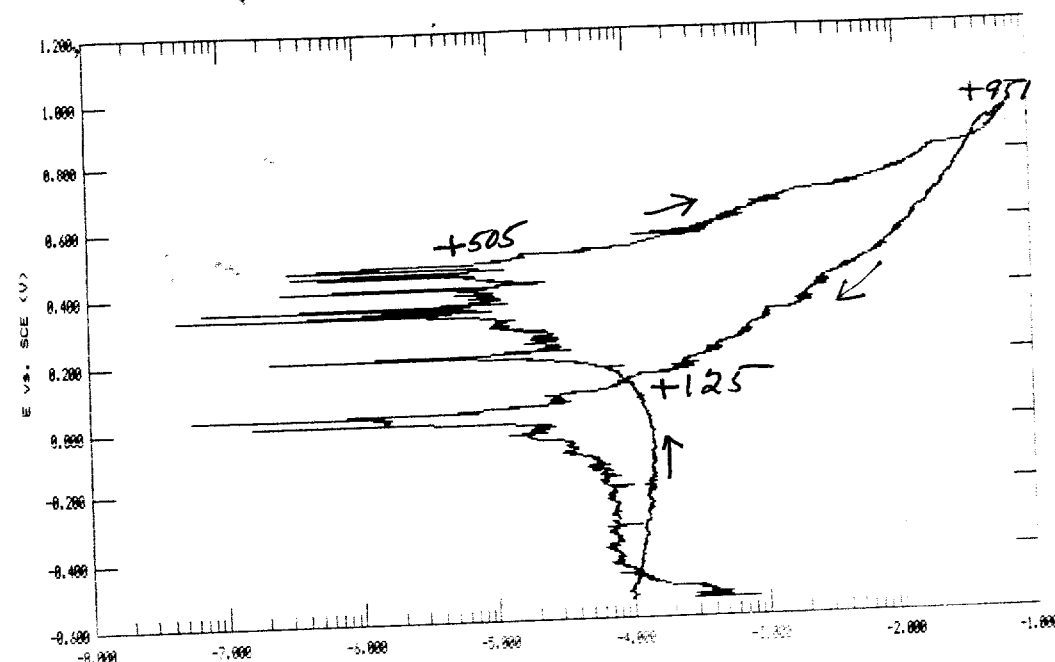
$E_{\text{can}} = -471 \text{ mV}$

$E_{\text{pit}} = +57 \text{ mV}$

Crevice corrosion in 7 or 8 areas
gold color on all areas away from crevice washers

Walter J. MacKowski
7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 SI 1.000E-03 SR 1.671E-04 ST 5.983E+00
 FL 1 5.3Hz RT HIGH STABILITY REF 0.2415V SCE
 IT 1.000E-01 ITR 1.000E+00 EN 0.000E+00
 Comment: Alloy 625 0.3M Cl⁻ 95°C pH 8.046 7.888 7/14/97
 b:625cpp18.d



Walter J Machumli 7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b:625cpp18.d
 Date Run: 07-01-97 Time Run: 07:32:36
 File Status: NORMAL
 CP CYCLIC POLARIZATION
 Date Run: 07-01-97
 Cond. Time CT PASS
 Cond. Pot. CP PASS
 Initial Delay ID 20
 Scan Rate SR 0.1671 mV/s
 Scan Incr. SI 1.000 mV
 No. of Points NP 2999
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Density DE 8.440 g/cm³
 Comment: Alloy 625 0.3M Cl⁻ 95°C pH 8.046 7/14/97

Walter J Machumli 7/14/97

Walter J Machumli
 7/14/97

CPP of Alloy 625 0.3M Cl⁻, pH 8.5, 95°C
 w/ crevice geometry

625cpp19.dat

Objective: To measure E_{ap} & E_{pit}

Specimen: Alloy 625 Rt # DX 9936 AG
 spec. dimensions see p.29
 600 grit polished 20cm² exposed area
 start wt. 31.06852 g
 final wt. 31.05259 g

Solution: 0.3M Cl⁻ (NaCl) 85 ppm HCO₃⁻
 20 ppm SO₄²⁻ 10 ppm NO₃⁻ 2 ppm F⁻
 17.55225 g NaCl lot 960780
 0.11681 g NaHCO₃ lot 923337A
 20 ml SO₄ 6/97
 10 ml NO₃ 6/97
 2 ml F⁻ 6/97
 plus DI water to 1000 ml
 start pH 7.895 final pH 9.425

T = 95°C thermometer # 183304

Ref electrode: Fisher SCE #13-620-51 S/N 5144349
 Counter electrode Pt flag

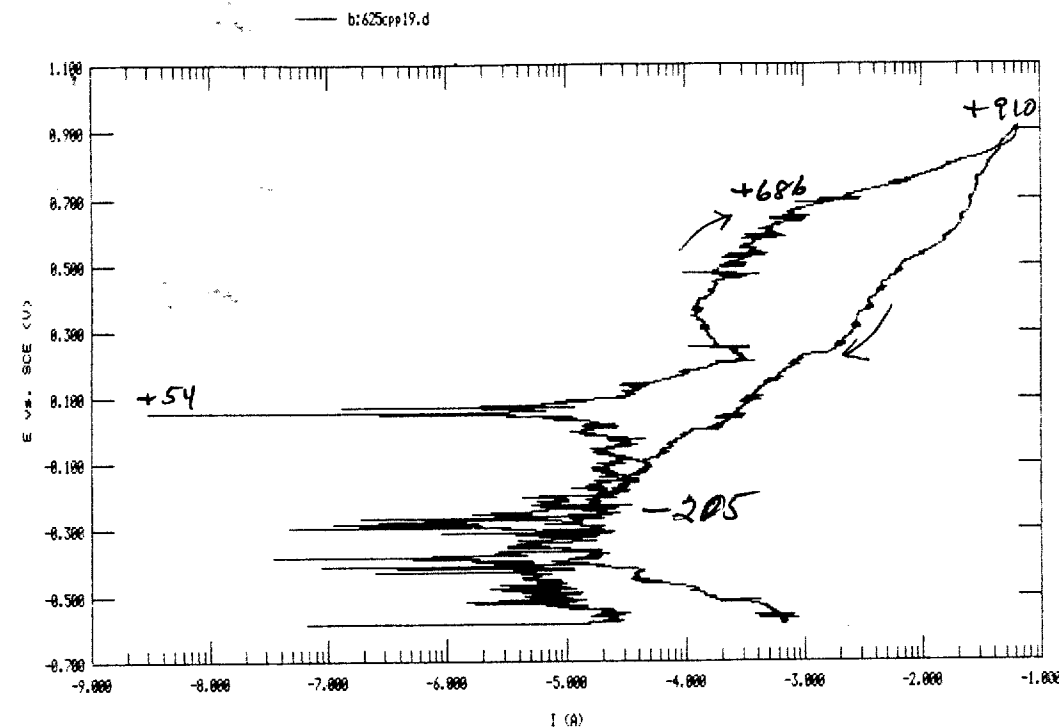
$E_{can} = -487$ mV

$E_{pe} = +114$ mV

Crevice corrosion in 6 or 7 areas
 gold color on all areas away from
 crevice washer

Walter J Machumli
 7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 File Status: NORMAL
 Date Run: 07-02-97
 Time Run: 07:40:03
 Pstat: UStat[] Ver 2
 CP PASS vs. R CT PASS
 SI 1.000E-03 SR 1.671E-04 ST 5.983E+00 CR AUTO
 FL 1.5.3Hz RT HIGH STABILITY REF 0.24150 SCE WKS SOLID
 IT 1.000E-01 ITA 1.000E+00 EN 0.000E+00 DEN 8.440E+00 OC -0.488
 Comment: Alloy 625 0.3M Cl⁻ 95°C pH 7.895



Walter J. Machowski
 7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL
 Date Run: 07-02-97
 Time Run: 07:40:03
 Pstat: UStat[] Ver 2
 CP CYCLIC POLARIZATION
 Cond. Time CT PASS S Initial Pot. IP -0.1000 V OC
 Cond. Delay CD PASS S I Threshold IT 0.1000 A
 Initial Delay ID 20 S Final Pot. FP -0.1000 V OC
 Scan Rate SR 0.1671 mV/s Curr. Range CR Auto
 Scan Incr. SI 1.000 mV Step Time ST 5.983 s
 No. of Points NP 2999
 GI Time Const. TC OFF
 IR Mode IR none
 Filter FL 1.5.3Hz
 Ref. Elec. RE SCE 0.2415 V
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Density DE 8.440 g/ml Open Circuit OC -0.488 V

Comment: Alloy 625 0.3M Cl⁻ 95°C pH 7.895

Walter J. Machowski 7/14/97

Walter J. Machowski
 7/14/97

CPP of Alloy 625 0.1M Cl⁻, pH 8.5, 95°C
 surface geometry

625cpp20.dat

Objectives: To measure E_{an} & E_{pit}

Specimen: Alloy 625 Rt# NX 9936 AG
 spec. dimension see p 29
 600 grit polished 20 cm² exposed area
 start wt. 31.13156 g
 end wt. 31.12533 g

Solution: 0.1M Cl⁻ (NaCl) 85 ppm HCO₃⁻
 20 ppm SO₄²⁻ 10 ppm NO₃⁻ 2 ppm F⁻
 5.84809 g NaCl lot 960780
 0.11872 g NaHCO₃ lot 923337A
 20 ml SO₄²⁻ 6/97
 10 ml NO₃⁻ 6/97
 2 ml F⁻ 6/97 } stock solution NB 157 p. 173
 plus DI water to 1000 mL
 start pH 7.643 end pH 9.931
 T = 95°C thermometer # 183304

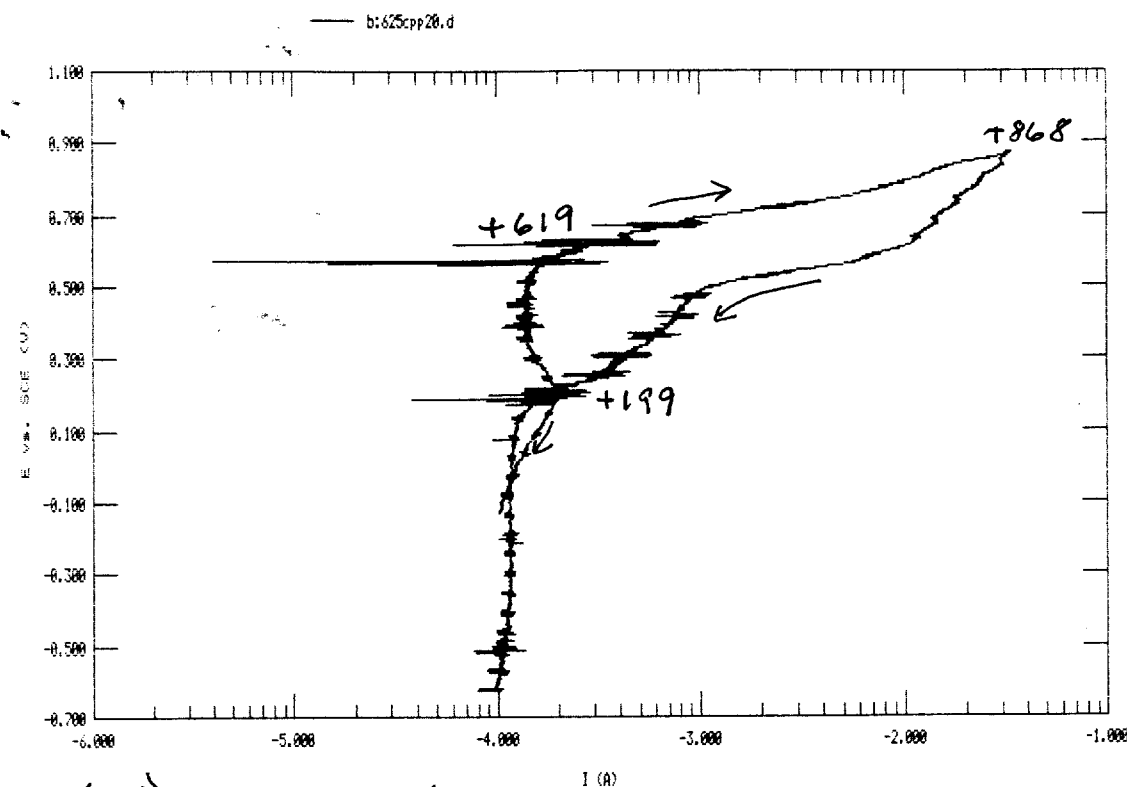
Reference electrode: Fisher SCE #13-62051 S/N 5144349
 Counter electrode: Pt flag

$E_{corr} = -531 \text{ mV}$
 $E_{pit} = +186 \text{ mV}$

since corrosion in three areas
 light gold color on all areas away from crevice washers

Walter J. Machowski
 7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL
 Date Run: 07-03-97
 Time Run: 07:26:43
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 IP -0.100 vs. OC
 ID 20 S
 V1 0.100 vs. OC
 FP -0.100 vs. OC
 SI 1.000E-03 SR 1.671E-04 ST 5.983E+00 CR AUTO NP 2501 IR NONE
 FL 1 5.3Hz RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 1.000E+00 LS YES
 IT 1.000E-01 ITA 1.000E+00 EM 0.000E+00 DEN 8.440E+00 OC -0.526
 Comment: Alloy 625 0.1M Cl⁻ 95 C pH 7.643



Walter J. Markunski 7/14/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b625cpp20.dat
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-03-97

Cond. Time	CT	PASS	S	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	PASS	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	S	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc
Scan Rate	SR	0.1671	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	1.000	mV	Step Time	ST	5.983	s
No. of Points	NP	2501					
Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/ml	Equiv. Wt.	EN	0.0000	g
				Open Circuit	OC	-0.5260	V

Comment: Alloy 625 0.1M Cl⁻ 95 C pH 7.643
 7/14/97 Walter J. Markunski

Walter J. Markunski
 7/14/97

CPP of Alloy 625 9M Cl⁻ as LiCl, 95°C
 of a wire geometry

625cpp21.dat

Objective: To measure E_{cp} + E_{pit}

Specimen: Alloy 625 lot # NX 9936 AG
 specimen dimensions see p. 29
 600 grit polished
 start wt. 31.28153 g
 end wt. 31.22893 g

Solution: 9M LiCl

296.9 g LiCl lot # 954236
 + DI water to 725 mL
 start pH 5.827 end pH 6.123

T = 95°C H₂ thermometer # 183304

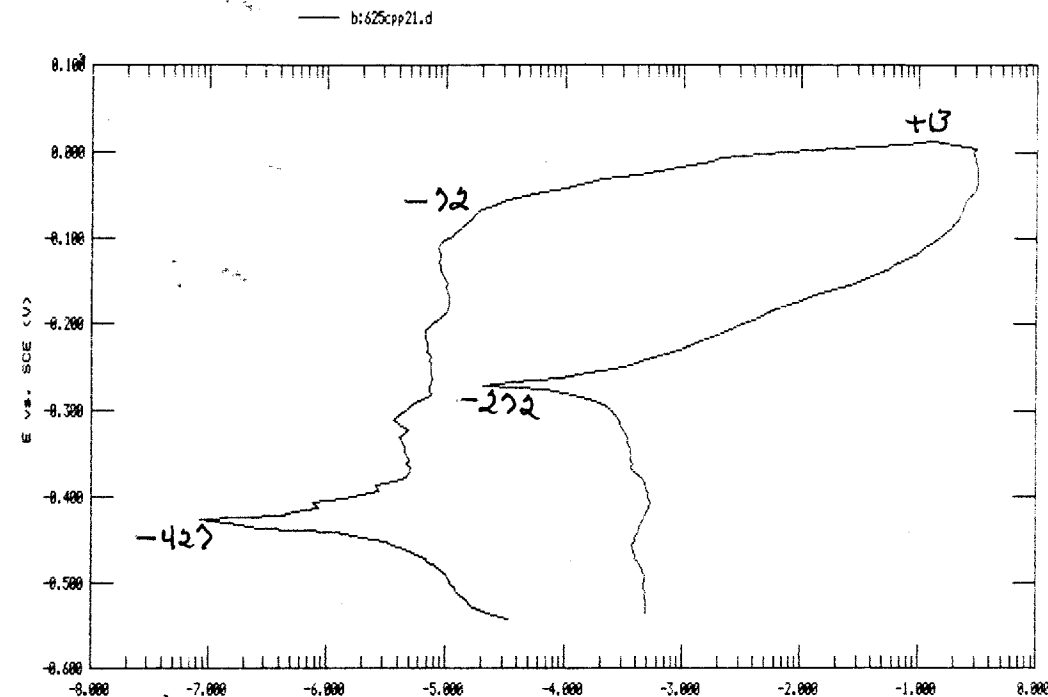
Ref. electrode: Fisher SCE # 13-620-51 S/N 3106339
 Counter electrode: Pt flag

$E_{com} = -448$ mV
 $E_{pe} = +349$ mV

no crevice or pitting corrosion
 some general attack

Walter J. Markunski
 7/21/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL
 Date Run: 07-14-97
 Time Run: 11:41:42
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 ST PASS
 RT HIGH STABILITY
 IT 1.000E+01
 REF 0.24150 SCE
 EW 0.000E+00
 DEN 8.440E+00
 OC -0.442
 Comment: Alloy 625, 9M LiCl, 95 C



Walter J Machurak 7/15/97 1 (A)

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL
 Date Run: 07-14-97
 Time Run: 11:41:42

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	V1	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc
Scan Rate	SR	0.1670	V/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	222					
Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/cm³	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4420	V

Comment: Alloy 625, 9M LiCl, 95 C

Walter J Machurak 7/15/97

Walter J Machurak
7/15/97

CPP of Alloy 625 4M Cl⁻ as LiCl, 95°C
w/ crevice geometry

625 cpp22.dat

Objective: to measure E_{ap} + E_{pit}

Specimen: Alloy 625 lot # NX 9936A0
 dimension see p. 29
 600 grit polished
 start wt. 31.40611 g
 end wt. 31.30578 g

Solution: 4M LiCl
 84.7 g LiCl lot # 954236
 + DI water to 500 mL
 start pH 7.410 end pH 8.251

$T = 95^{\circ}\text{C}$ Hg thermometer # 183304

Reference: Fisher SCE # 13-62051 S/N 3106339
 Counter electrode: Pt flag

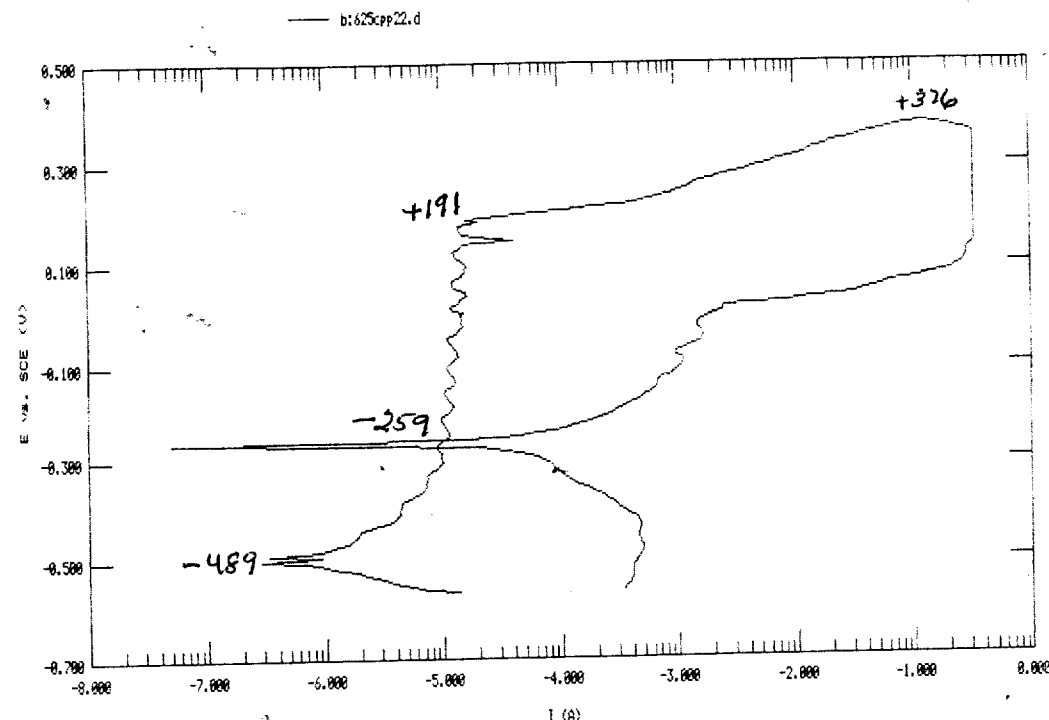
$E_{cor} = -460 \text{ mV}$

$E_{pc} = +146 \text{ mV}$

some pitting attack on corners + edges away from
 crevice washers
 some crevice attack at circumference of hole in
 specimen

Walter J Machurak
7/21/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 File Status: NORMAL
 Date Run: 07-15-97
 Time Run: 07:32:54
 Pstat: VStat11 Ver 2
 Cond. Time CT pass s Initial Pot. IP -0.1000 V oc
 Cond. Pot. CP pass V Vertex 1 Pot. V1 0.1000 V oc
 Initial Delay ID 20 s I Threshold IT 0.1000 A
 Final Pot. FP -0.1000 V oc
 Scan Rate SR 0.1670 mV/s Curr. Range CR Auto
 Scan Incr. SI 5.000 mV Step Time ST 29.93 s
 No. of Points NP 378
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Density DE 8.448 g/ml
 Comment: Alloy 625, 4M LiCl, 95°C



Walter J. MacKinnon

7/15/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b1625cpp22.dat
 Pstat: VStat11 Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-15-97
 File Status: NORMAL
 Time Run: 07:32:54

Cond. Time CT pass s Initial Pot. IP -0.1000 V oc
 Cond. Pot. CP pass V Vertex 1 Pot. V1 0.1000 V oc
 Initial Delay ID 20 s I Threshold IT 0.1000 A
 Final Pot. FP -0.1000 V oc
 Scan Rate SR 0.1670 mV/s Curr. Range CR Auto
 Scan Incr. SI 5.000 mV Step Time ST 29.93 s
 No. of Points NP 378
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Density DE 8.448 g/ml
 Comment: Alloy 625, 4M LiCl, 95°C

Walter J. MacKinnon

7/15/97

Walter J. MacKinnon
 7/15/97

CPP of Alloy 625 11.5M Cl⁻ in LiCl, 95°C
 w/crvice geometry

625cpp23.dat

Objective: To measure E_{ap} + E_{pit}
 625 symmetrical 7/17/97

Specimen: Alloy 625 Rt # NX9936AG
 dimension see p.29
 600 grit polished
 Start wt. 30.81041 g
 end wt. 30.78505 g

Solution: 11.5M LiCl
 243.7 g LiCl lot # 954236
 + DI water to 500 mL
 Start pH 5.580 end pH 6.879

T = 95°C Hg thermometer # 183304

Ref. electrode: Fisher SCE # 13-620-51 S/N 3106339
 Counter electrode: Pt flag

$E_{oc} = -459$ mV

$E_{ap} = +375$ mV

no crevice or pitting corrosion
 some general attack

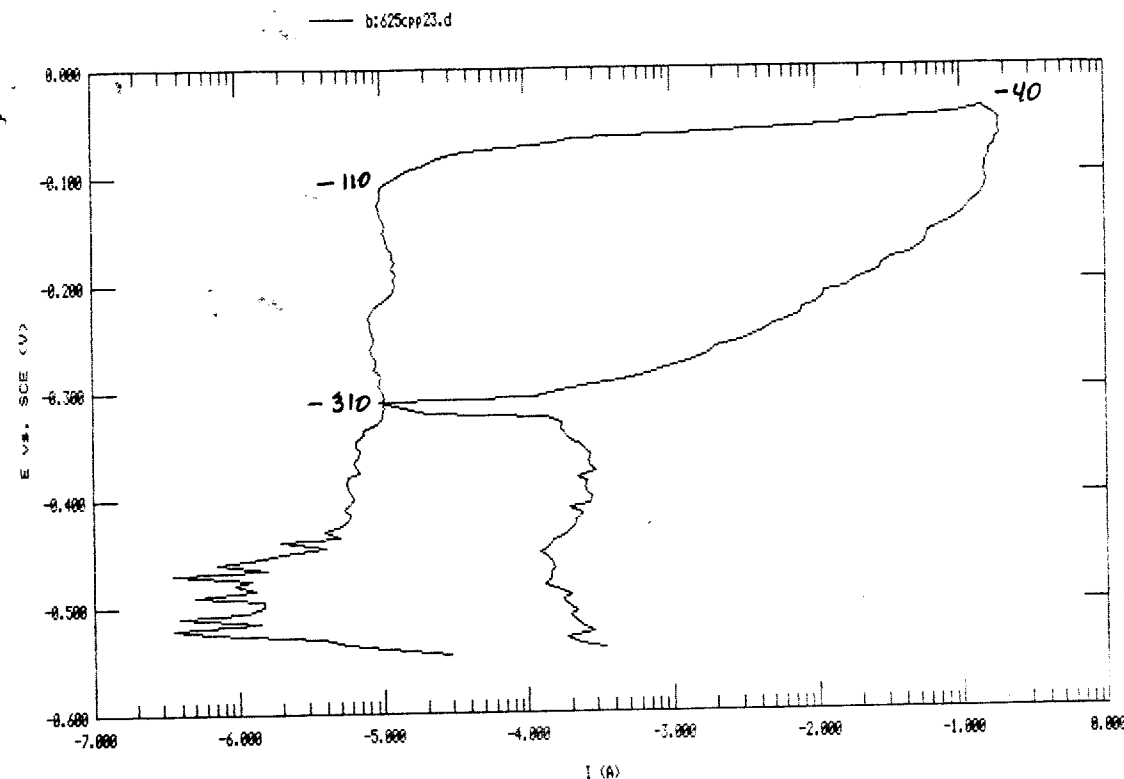
Walter J. MacKinnon
 7/21/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 ST 5.000E-03
 FL 1 5.3Hz
 IT 1.000E-01
 Comment: Alloy 625, 11.5M LiCl, 95 C

File Status: NORMAL
 Date Run: 07-16-97
 Time Run: 07:33:27
 UI 0.100 vs. OC
 VI 20.5
 CR 20.0
 AR 1.000E+00
 OC -0.445

File Name: b:625cpp23.dat
 Date Run: 07-16-97
 Time Run: 07:33:27
 UI 0.100 vs. OC
 VI 20.5
 CR 20.0
 AR 1.000E+00
 OC -0.445

Stat: VStat() Ver 2
 EP -0.100 vs. OC
 IR NONE
 LS YES



Walter J. MacKowski 7/17/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b:625cpp23.dat
 Stat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-16-97
 Time Run: 07:35:27

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Stop Time	ST	29.93	s
No. of Points	NP	202					

Line Sync.	LS	yes		GI Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	I 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415	V
Density	DE	8.440	g/cm ³	Equiv. Wt.	EW	0.0000	g
				Open Circuit	OC	-0.4450	V

Comment: Alloy 625, 11.5M LiCl, 95 C

Walter J. MacKowski 7/17/97

Walter J. MacKowski 7/17/97

CPP of Alloy 625 4M NaCl, 60°C, w/crevice geometry

625cpp24.dat

Objective: To measure E_{ap} and E_{pit}

Specimen: Alloy 625 Lot # NX9936 AC
 dimensions see p. 29
 600 grit polished
 Start wt 31.23661 g.
 end wt. 31.23290 g

Solution: 4M NaCl
 233.73416 g NaCl Lot # 960780
 + DI water to 1000 mL
 start pH 2.248 end pH 2.625

T=60°C Hg Thermometer # 183304

Ref electrode: Fisher SCE # 13620-51 S/N 3106345
 Counter electrode: Pt flag

$E_{com} = -420 \text{ mV}$

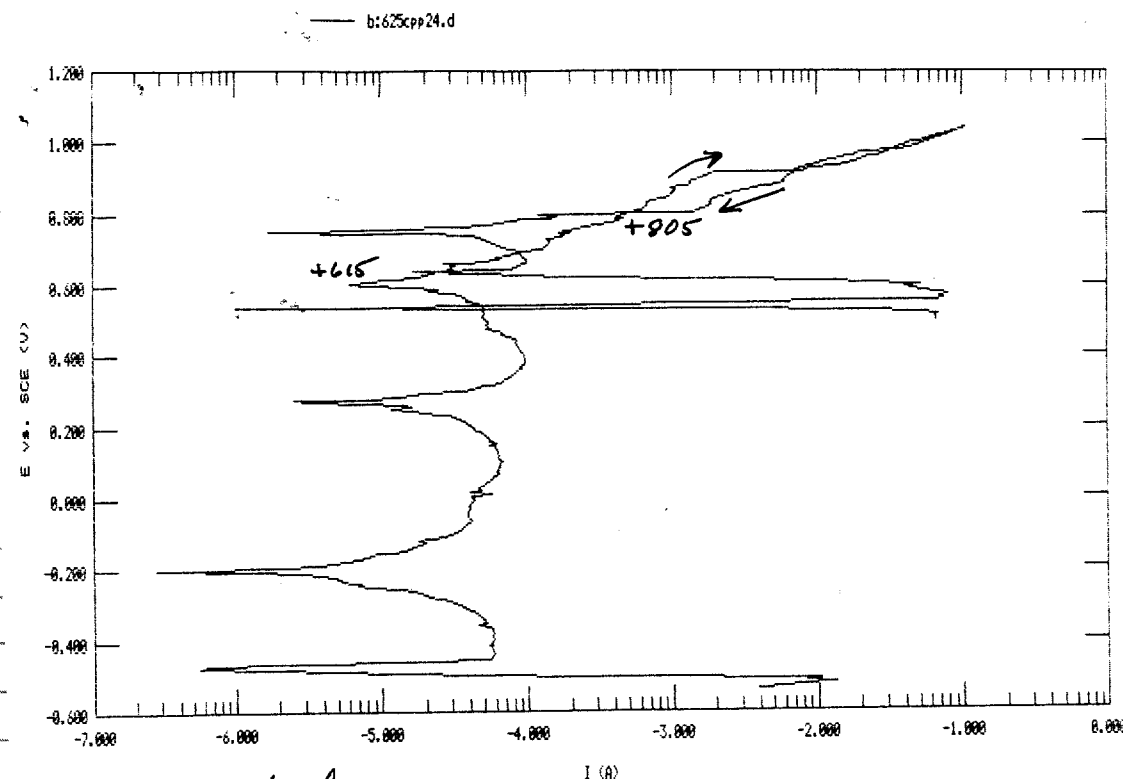
$E_{pc} = +125 \text{ mV}$

NOTE: one crevice washer was put on backwards
 i.e. flat side to specimen.

Some crevice corrosion visible in 4 or 5 areas.

Walter J. MacKowski
 7/18/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION File Status: NORMAL Date Run: 07-17-97 Time Run: 06:53:34
 CP PASS vs. R CT PASS ID 20 S VI 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO HP 424 IR NONE
 FL 1 5.3Hz RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AP 1.000E+00 LS YES
 IT 1.000E-01 ITA 1.000E+00 EW 0.000E+00 DEN 0.440E+00 OC -0.435
 Comment: Alloy 625, 4M NaCl, 60 C



Walter J. Mochowski 7/18/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 Filename: bt:625cpp24.d
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-17-97
 File Status: NORMAL
 Time Run: 06:53:34
 Cond. Time CT pass s Initial Pot. IP -0.1000 V oc
 Cond. Pot. CP pass V Vertex 1 Pot. VI 0.1000 V oc
 Initial Delay ID 20 s I Threshold IT 0.1000 A
 Final Pot. FP -0.1000 V oc
 Scan Rate SR 0.1670 mV/s Curr. Range CR Auto s
 Scan Incr. SI 5.000 mV Step Time ST 29.93 s
 No. of Points HP 424
 GI Time Const. TC Off
 IR Mode IR none
 Filter FL 1 5.3Hz
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm² Ref. Elec. RE SCE 0.2415 V
 Density DE 0.440 g/ml Open Circuit OC -0.4350 V

Comment: Alloy 625, 4M NaCl, 60 C

Walter J. Mochowski 7/18/97

Walter J. Mochowski
7/18/97

WJ Mochowski 7/18/97
 exp of Alloy 625 11.5M LiCl, 75-60°C
 w/ crevice geometry

625 cpp 25. dat

Objective: To measure E_{cp} and E_{pt}

Specimen: Alloy 625 Lot # NX 9936 AC
 dimensions see p. 29
 600 grit polished
 start wt. 31.16610 g
 end wt. 31.19349 g

Solution: 11.5M LiCl
 243.81 g LiCl Lot # 954236
 + DI water to 500 mL
 start pH 5.672 end pH 6.723

$T = 60^\circ\text{C}$ Hg thermometer # 183304

Ref. electrode: Fisher SCE #13-620-51 S/N 5129169

Counter electrode: Pt flag

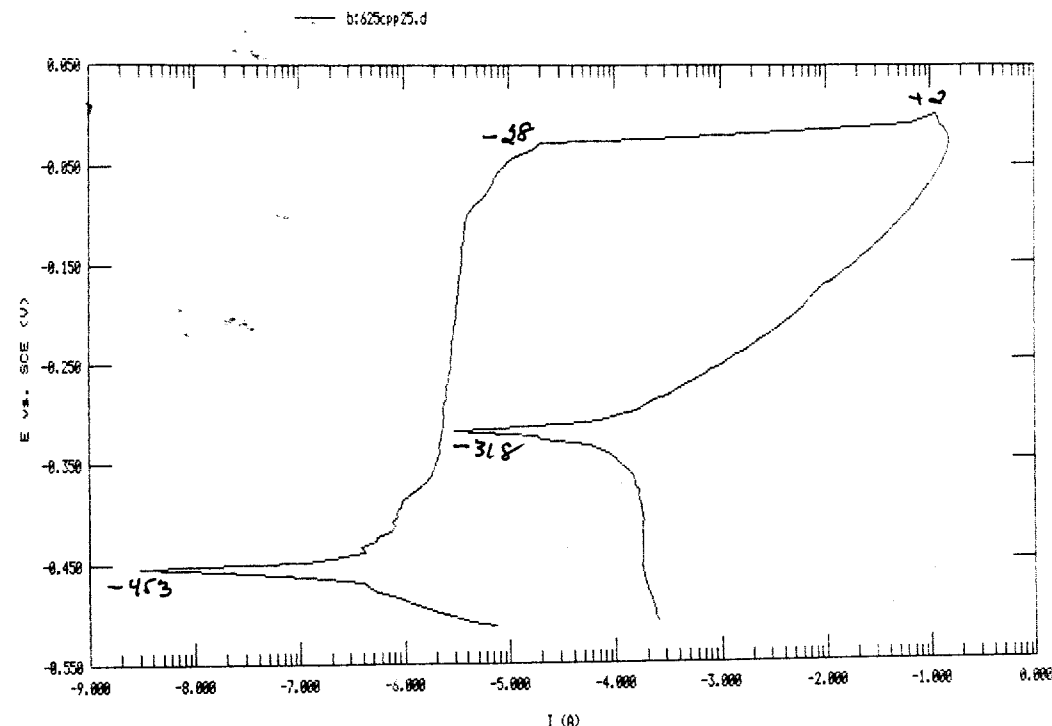
$E_{com} = -409\text{ mV}$

$E_{pt} = +392\text{ mV}$

no crevice or pitting corrosion

Walter J. Mochowski
7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 SI 5.000E-03 SR 1.670E-04 IP -0.100 vs. OC ID 20 S VI 0.100 vs. OC FP -0.100 vs. OC
 FL 1 5.3Hz RT HIGH STABILITY REF 0.24150 SCE CR AUTO NP 206 IR NONE
 IT 1.000E-01 ITA 1.000E+00 EW 0.000E+00 DEM 8.440E+00 AR 1.000E+00 LS YES
 Comment: Alloy 625, 11.5M LiCl, 60 C



Walter J. MacKinnon 7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 Filename: bi625cpp25.dat
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-18-97
 File Status: NORMAL
 Time Run: 07:13:59
 Cond. Time CT pass s Initial Pot. IP -0.1000 V oc
 Cond. Pot. CP pass V Vertex 1 Pot. VI 0.1000 V oc
 Initial Delay ID 20 s I Threshold IT 0.1000 V oc
 Final Pot. FP -0.1000 V oc
 Scan Rate SR 0.1670 mV/s Curr. Range CR Auto
 Scan Incr. SI 5.000 mV Step Time ST 29.93 s
 No. of Points NP 206
 GI Time Const. TC Off
 Line Sunc. LS yes IR Mode IR none
 Rise Time RT high stability Filter FL 1 5.3Hz
 Working Elec. WE Solid Ref. Elec. RE SCE 0.2415 V
 Sample Area AR 1.000 cm² Equiv. Wt. EW 0.0000 g
 Density DE 8.440 g/ml Open Circuit OC -0.4130 V
 Comment: Alloy 625, 11.5M LiCl, 60 C

Walter J. MacKinnon 7/22/97

Walter J. MacKinnon
 7/22/97

CPP of Alloy 625 9M LiCl, 60°C, ^{crevice} geometry

625cpp26.dat

Purpose: To measure E_{ap} and E_{pr}

Specimen: Alloy 625 lot # NX 9936 AC
 dimension see p. 29
 600 grit polished
 start wt. 31.34307 g
 end wt. 31.34055 g

Solution: 9M LiCl
 190.79 g LiCl lot # 954236
 + DI water to 500 mL
 start pH 5.987 end pH 3.926

$T = 60^\circ\text{C}$ Hg thermometer # 183304

Ref. electrode: Fisher SCE #13-620-51 S/N 5129169

Counter electrode: Pt flag

$E_{com} = -414\text{ mV}$
 $E_{Pr} = +237\text{ mV}$

some crevice corrosion which was widespread
 but very shallow, almost like general attack

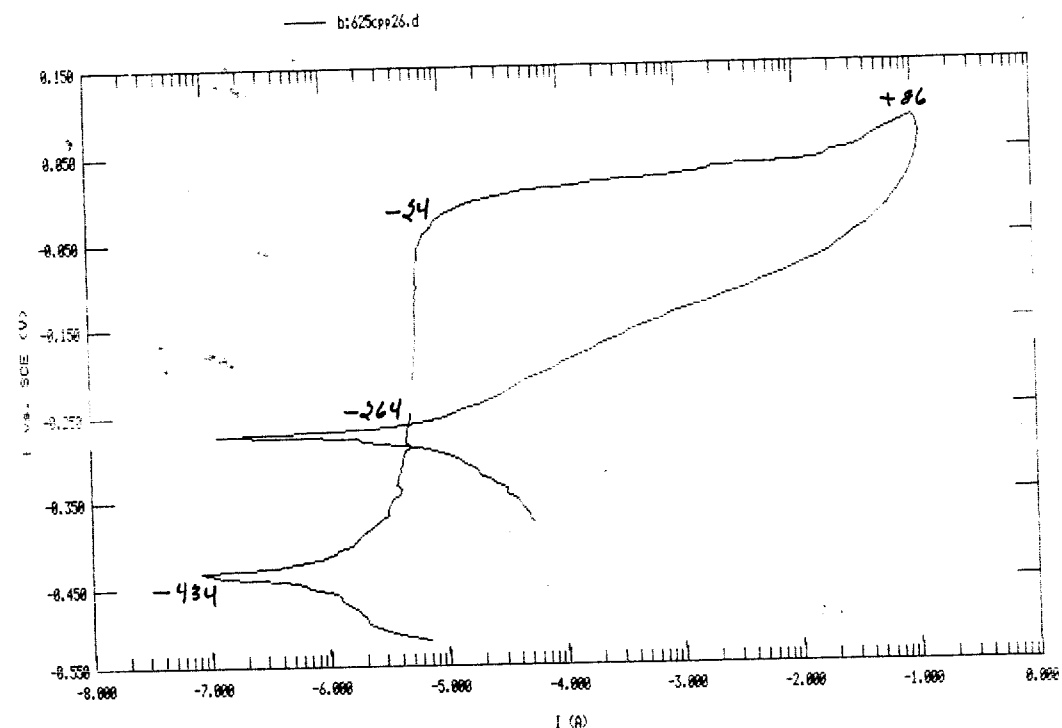
Walter J. MacKinnon
 7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 SI 5.000E-03 SR 1.670E-04
 FL 1.5.3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy 625, 9M LiCl, 60 C

File Status: NORMAL
 Date Run: 07-18-97
 ID 20 S
 ST 2.993E+01
 REF 0.24150 SCE
 EN 0.000E+00
 DEN 8.440E+00
 OC -0.414

Time Run: 11:28:21
 VI 0.100 vs. OC
 NP 214
 AR 1.000E+00
 OC -0.414

Estat: VStat() Ver 2
 EP -0.100 vs. OC
 IR NONE
 LS YES



Walter J. Macdonald

7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b1625cp26.dat
 Estat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-18-97

File Status: NORMAL
 Time Run: 11:28:21

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto
Scan Incr.	SI	5.000	mV <td>Step Time</td> <td>ST</td> <td>29.93</td>	Step Time	ST	29.93
No. of Points	NP	214				

Line Sync.	LS	yes	GI Time Const.	TC	Off
Rise Time	RT	high stability	IR Mode	IR	none
Working Elec.	WE	Solid	Filter	FL	1.5.3Hz
Sample Area	AR	1.000	Ref. Elec.	RE	SCE 0.2415
Density	DE	8.440	Equiv. Wt.	EW	8.0000
			Open Circuit	OC	-0.4140

Comment: Alloy 625, 9M LiCl, 60 C

Walter J. Macdonald 7/22/97

Walter J. Macdonald
 7/27/97

CPE of Alloy 625 4M LiCl, 60°C, crevice geometry

625 cpe27.dat

Objective: To measure E_{ap} and E_{pit}

Specimen: Alloy 625 lot # NX 9936 AB

dimension see p.29

600 grit polished

WJ Macdonald 7/22/97

start wt. 31.28684g 31.28684g

end wt. 31.28705g

Solution: 4M LiCl

84.85g LiCl lot # 954236

+ DI water to 500mL

start pH 6.347

end pH 6.382

$T = 60^\circ\text{C}$

Hg thermometer # 183301

Ref electrode: Fisher SCE #13-620-51

S/N 5129169

Counter electrode: Pt flag

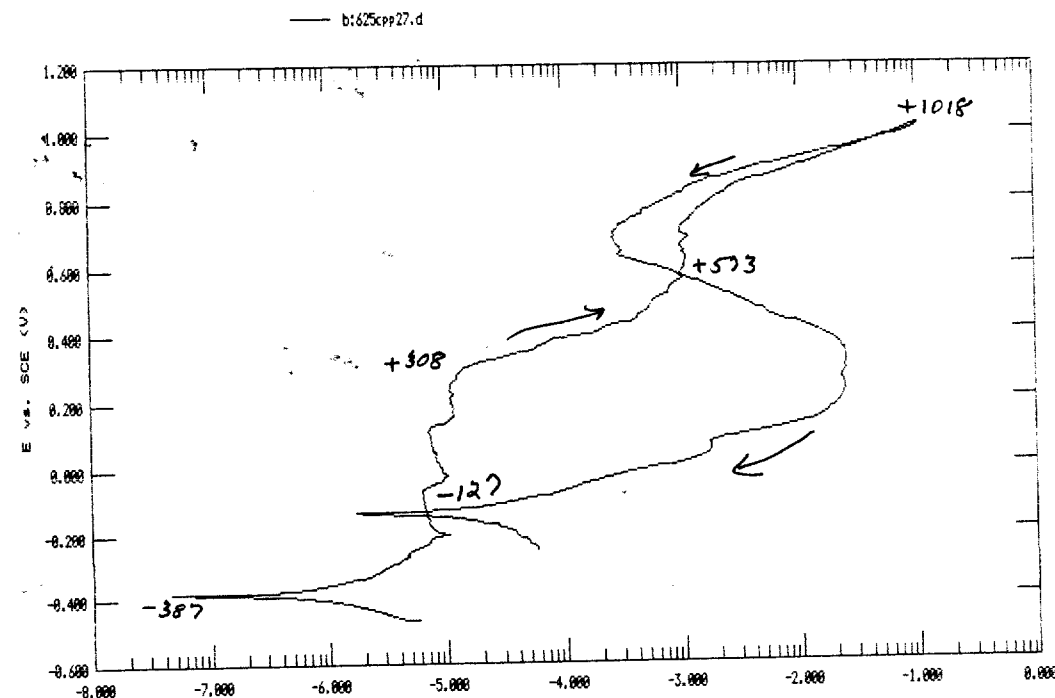
$E_{com} = -371\text{mV}$

$E_{pe} = +66\text{mV}$

Crevice corrosion in many areas.

Walter J. Macdonald
 7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b:625cpp27.dat
 Date Run: 07-19-97
 Time Run: 07:31:16
 Pstat: VStatII Ver 2
 CP CYCLIC POLARIZATION
 CT PASS
 ST 2.993E+01
 SR 1.670E-04
 RT HIGH STABILITY
 REF 0.24158 SCE
 EN 0.000E+00
 DEN 0.440E+00
 OC -0.372
 FP -0.100 vs. OC
 IR NONE
 LS YES
 Comment: Alloy 625, 4M LiCl, 60 C



Walter Machurski
 7/22/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b:625cpp27.dat
 Date Run: 07-19-97
 Time Run: 07:51:16
 Pstat: VStatII Ver 2
 CP CYCLIC POLARIZATION
 CT PASS
 ST 2.993E+01
 SR 1.670E-04
 RT HIGH STABILITY
 REF 0.24158 SCE
 EN 0.000E+00
 DEN 0.440E+00
 OC -0.372
 FP -0.100 vs. OC
 IR NONE
 LS YES
 Comment: Alloy 625, 4M LiCl, 60 C

Walter Machurski
 7/22/97

Walter J Machurski
 7/22/97

CPP of Alloy 625 1M NaCl, 60°C, crevice geometry
 625 cpp 28. dat

Objective: To measure E_{cp} and E_{pit}

Specimen: Alloy 625 lot # NX 9936 AB
 dimension see p. 29
 600 grit polished
 start wt. 31.37086 g
 end wt. 31.35458 g

Solution: 1M NaCl
 58.42992 g NaCl lot # 960780
 + DI water to 1000 mL
 start pH 6.239 end pH 5.477

$T = 60^\circ\text{C}$ Hg thermometer #183304

Ref. electrode: Fisher SCE #13-650-51 S/N 3106345

Counter electrode: Pt flag

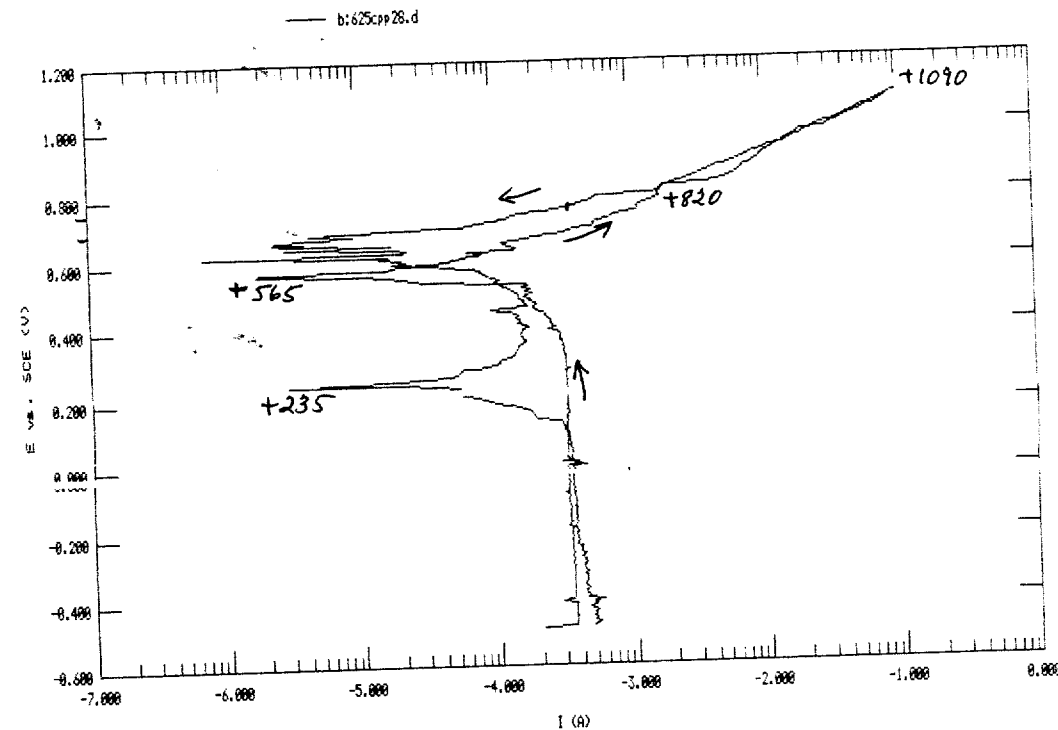
$E_{com} = -386 \text{ mV}$

$E_{pe} = +339 \text{ mV}$

some crevice corrosion in
 2 or 3 areas

Walter J Machurski
 7/25/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL Date Run: 07-26-97 Time Run: 13:11:22
 OP CYCLIC POLARIZATION File: b1625cpp28.dat
 CT PASS vs. R CT PASS IP -0.100 vs. OC VI 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO HP 638 IR NONE LS YES
 PL 1.5 Hz RT HIGH STABILITY REF 0.24150 SCE WKS SOLID AR 1.000E+00
 IT 1.000E-01 ITR 1.000E+00 EN 0.000E+00 DEN 0.440E+00 OC -0.325
 Comment: Alloy 625, 1M NaCl, 60 C



Walter J. MacKowski 7/25/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b1625cpp28.dat
 Potat: VStat11 Ver 2
 OP CYCLIC POLARIZATION
 Date Run: 07-26-97 File Status: NORMAL Time Run: 13:11:22

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	OP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc

Scan Rate	SR	0.1670	mV/s	Curr. Range	CR	Auto
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93 s
No. of Points	HP	638				

Line Sync.	LS	yes	GI Time Const.	TC	Off
Rise Time	RT	high stability	IR Mode	IR	none
Working Elec.	WE	Solid	Filter	FL	1.5 Hz
Sample Area	AR	1.000 cm ²	Ref. Elec.	RE	SCE 0.2415 V
Density	DE	8.440 g/ml	Equiv. Wt.	EW	8.0000 g
			Open Circuit	OC	-0.325 V

Comment: Alloy 625, 1M NaCl, 60 C

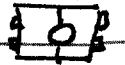
Walter J. MacKowski 7/25/97

Walter J. MacKowski 7/25/97

CP of Alloy 625 0.3M NaCl, 60°C crevice geometry

625cpp29.dat

Objective: To measure E_{ap} & E_{pt}



Specimen: Alloy 625 RT # NX 9936AB

cylindrical specimen w/ "clamped" crevice

600 grit polished

start wt. 12.25203 g

end wt. 12.25816 g



Solution: 0.3M NaCl

12.54990 g NaCl RT # 960780

+ DI water to 1000 mL

start pH 5.514

7.707 mV/mV w/ 7/28/97

end pH 2.325

T = 60°C

Hg thermometer # 183304

Ref electrode: Fisher SCE #13-620-51 S/N 5129169

Counter electrode: Pt flag

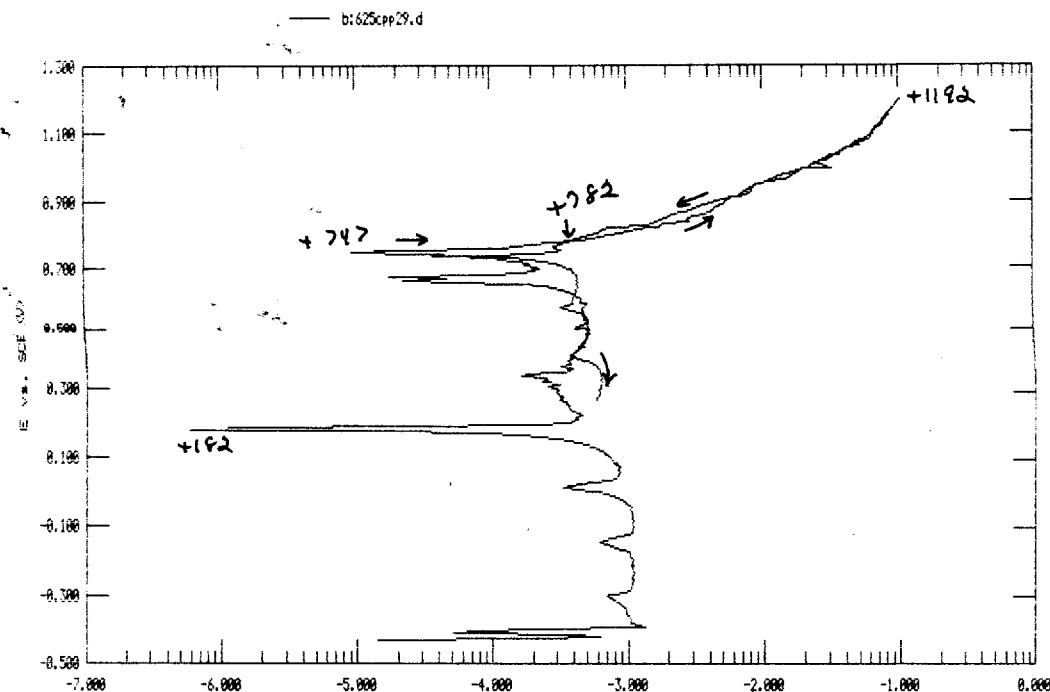
$E_{can} = -332 mV$

$E_{pt} = +553 mV$

no crevice corrosion apparent

Walter J. MacKowski 7/28/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b1625cyp29.dat
 Date Run: 87-22-97
 Time Run: 08:09:57
 Pstat: VStat1 Ver 2
 OP CYCLIC POLARIZATION
 Cond. Time CT PASS
 Cond. Pot. CP PASS
 Initial Delay ID 20
 Scan Rate SR 0.1670 mV/s
 Scan Incr. SI 5.000 mV
 No. of Points HP 512
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Comment: Alloy 625, 0.3M NaCl, 60 C



Walter J. Machowski 7/28/97

Walter J. Machowski 7/28/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b1625cyp29.dat
 Date Run: 87-22-97
 Time Run: 08:09:57
 Pstat: VStat1 Ver 2
 OP CYCLIC POLARIZATION
 File Status: NORMAL
 Cond. Time CT PASS
 Cond. Pot. CP PASS
 Initial Delay ID 20
 Scan Rate SR 0.1670 mV/s
 Scan Incr. SI 5.000 mV
 No. of Points HP 512
 Line Sync. LS yes
 Rise Time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000 cm²
 Comment: Alloy 625, 0.3M NaCl, 60 C

Walter J. Machowski
 7/28/97

CP of Alloy 625 0.1M NaCl, 60°C, crevice geometry

625cyp30.dat

Objective: To measure E_{ap} and E_{pit}

Specimen: Alloy 625 Lt # DX 9936AG
 crevice geometry see p. 125
 600 grit polished
 start wt 12.23460 g
 end wt. 12.24143 g

Solution: 0.1M NaCl
 5.83000g NaCl Lt # 960780
 + DI water to 1000 mL
 start pH 7.451 end pH 7.273

$T = 60^\circ\text{C}$ Hg thermometer # 183304

Ref. electrode: Fisher SCE #13-620-51 S/N 5129169
 Counter electrode: Pt flag

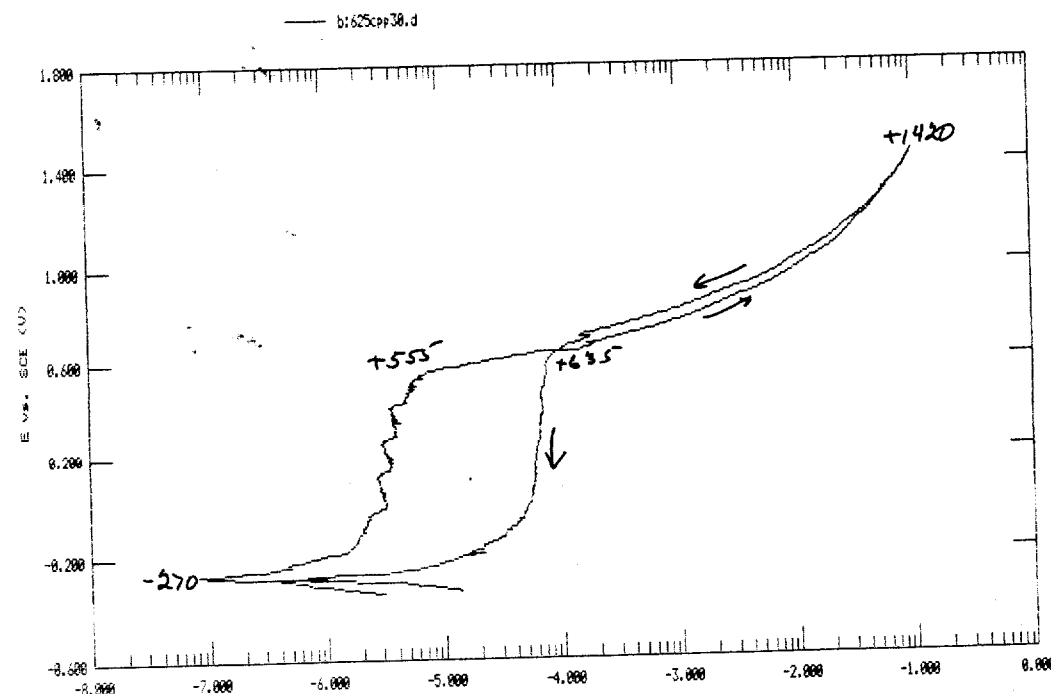
$E_{cor} = -233 \text{ mV}$

$E_{pe} = +463 \text{ mV}$

no crevice corrosion

Walter J. Machowski
 7/30/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b1625cpp30.dat
 File Status: NORMAL
 Date Run: 07-23-97
 Time Run: 07:11:28
 Potat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP Pass vs. R CT Pass
 SI 5.000E-03 SR 1.670E-04
 FL 1.5, 3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy 625, 0.1M NaCl, 50 C
 File Name: b1625cpp30.dat
 File Status: NORMAL
 Date Run: 07-23-97
 Time Run: 07:11:28
 Potat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP Pass vs. R CT Pass
 SI 5.000E-03 SR 1.670E-04
 FL 1.5, 3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy 625, 0.1M NaCl, 50 C



Walter J. Macchuk
 7/29/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b1625cpp30.dat
 File Status: NORMAL
 Date Run: 07-23-97
 Time Run: 07:11:28
 Potat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP Pass vs. R CT Pass
 SI 5.000E-03 SR 1.670E-04
 FL 1.5, 3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy 625, 0.1M NaCl, 50 C
 File Name: b1625cpp30.dat
 File Status: NORMAL
 Date Run: 07-23-97
 Time Run: 07:11:28
 Potat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP Pass vs. R CT Pass
 SI 5.000E-03 SR 1.670E-04
 FL 1.5, 3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy 625, 0.1M NaCl, 50 C

Walter J. Macchuk
 7/29/97

Walter J. Macchuk
 7/29/97

CPP of C-22 4M NaCl a/criss 95°C

C.22cpp 31. dat

Objective: To measure E_{ap} and E_{cp}

Specimen: Alloy C-22 lot # 2277-8-3125

Spec. dimensions p.24

600 grit finish

Start wt. 31.22254 g

end wt. 31.20502 g

Solution: 4M Cl⁻ as NaCl 20ppm SO₄²⁻ 10ppm NO₃⁻ 2ppm F⁻

232.99172g NaCl lot # 960780

20ml SO₄²⁻ 7/97

10ml NO₃⁻ 7/97

2ml F⁻ 7/97

+ DI water to 1000ml

start pH 7.438

and pH 6.005

T = 95°C

H₂ thermometer # 183304

Ref. electrode: Fricke SCE #13-60-51 S/N 5129169

Counter electrode: Pt flag

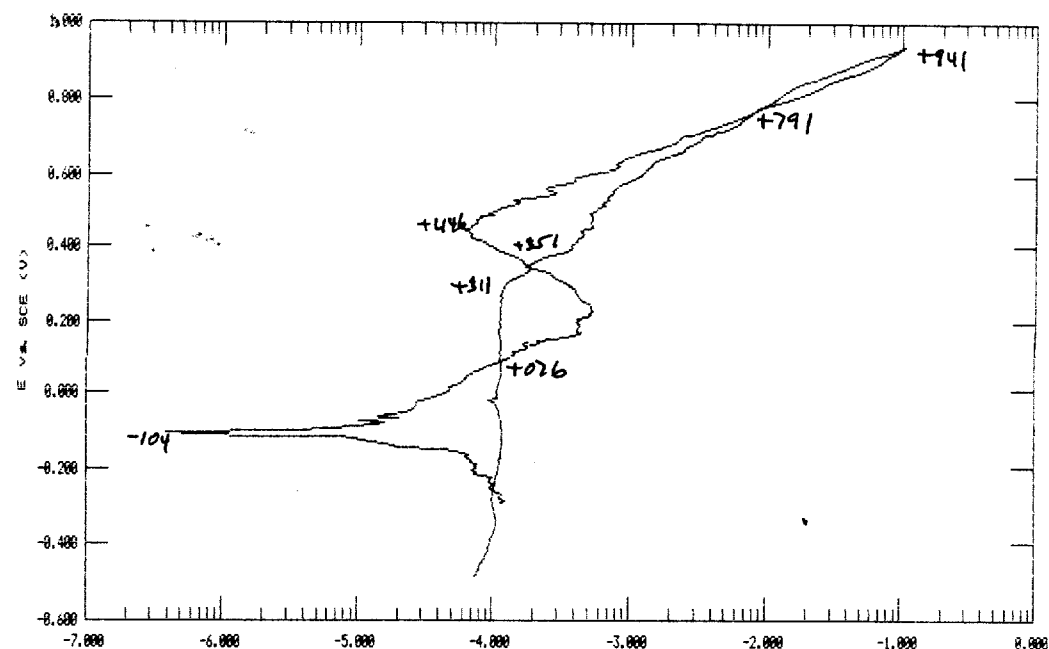
$E_{can} = -384mV$

$E_{pc} = +268mV$

Some crevice corrosion in a few areas
 gold color an area away from crevice washes

Walter J. Macchuk
 7/30/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 File Status: NORMAL
 Date Run: 07-24-97
 Time Run: 07:38:28
 Pstat: VStat() Ver 2
 CP PASS vs. R CT PASS
 SI 5.000E-03 SR 1.670E-04 IP -0.100 vs. OC ID 20 S VI 0.100 vs. OC FP -0.100 vs. OC
 FL 1 5.3Hz RT HIGH STABILITY REF 0.24150 SCE WPK SOLID AR 1.000E+00 IR NONE
 IT 1.000E+01 ITA 1.000E+00 EN 0.000E+00 DEN 8.440E+00 OC -0.384 LS YES
 Comment: Alloy C-22, 4M NaCl, 95 C



Walter J. MacKowski 7/30/95

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: bic22cpp31.dat
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-24-97

File Status: NORMAL
 Time Run: 07:38:28

Cond. Time	CT	pass	s	Initial Pot.	IP	-0.1000	V oc
Cond. Pot.	CP	pass	V	Vertex 1 Pot.	VI	0.1000	V oc
Initial Delay	ID	20	s	I Threshold	IT	0.1000	A
				Final Pot.	FP	-0.1000	V oc
Scan Rate	SR	0.1670	mV/s	Cur. Range	CR	Auto	
Scan Incr.	SI	5.000	mV	Step Time	ST	29.93	s
No. of Points	NP	533					
Line Sync.	LS	-yes		6I Time Const.	TC	Off	
Rise Time	RT	high stability		IR Mode	IR	none	
Working Elec.	WE	Solid		Filter	FL	1 5.3Hz	
Sample Area	AR	1.000	cm ²	Ref. Elec.	RE	SCE 0.2415 V	
Density	DE	8.440	g/ml	Equiv. Wt.	EN	0.0000	g
				Open Circuit	OC	-0.3840	V

Comment: Alloy C-22, 4M NaCl, 95 C

Walter J. MacKowski 7/31/95

Walter J. MacKowski
 7/30/97

CPP of C-22 11.5M LiCl, 95°C, crevice geometry

C22 cpp 32.dat

Objectives: To measure E_{cp} and E_{pit}

Specimen: Alloy C-22 lot # 2277-8-3175
 specimen dimensions see p. 24
 600 grit finish
 start wt. 31.22112g
 end wt. 31.20502g 31.19592g
 WJ MacKowski 7/30/97

Solution: 11.5M LiCl lot # 972239
 243.6 g. LiCl + DI water to 500 mL
 start pH 5.666 end pH 6.697

$T = 95^\circ\text{C}$ Hg thermometer # 183304

Reference electrode: Fisher SCE # 13-620-51 S/N 5129169

Counter electrode: Pt flag

$E_{cor} = -384 \text{ mV} - 405 \text{ mV}$
 WJ MacKowski 7/30/97

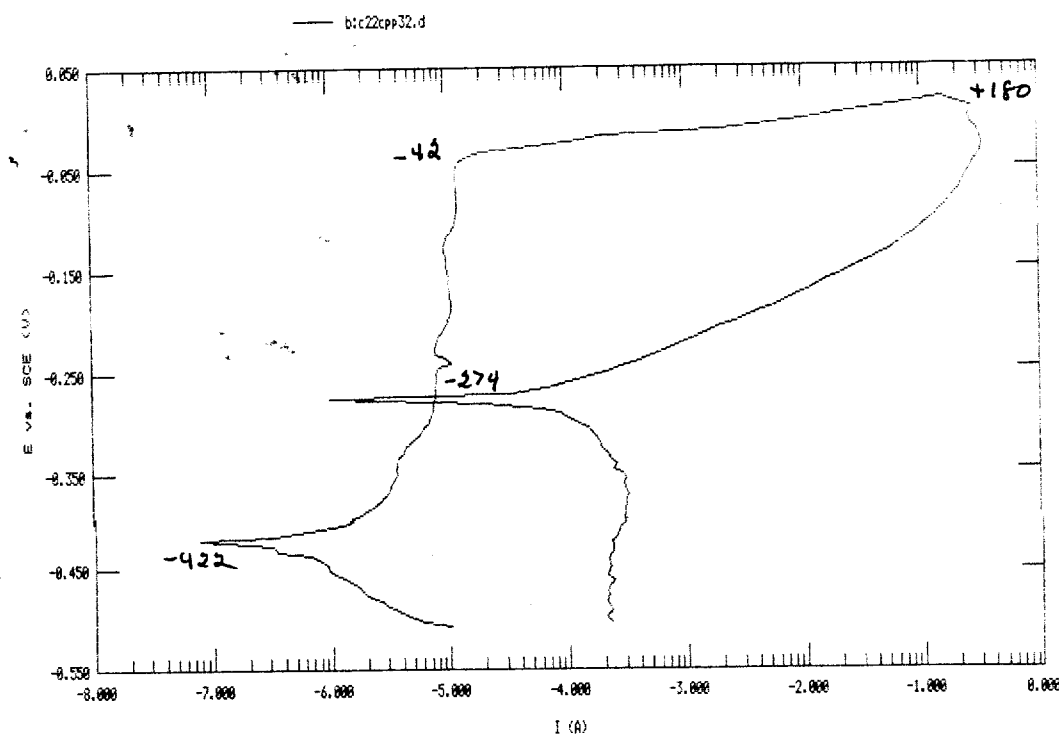
$E_{pc} = -268 \text{ mV} + 357 \text{ mV}$

no crevice or pitting corrosion

Ⓢ not accurate wt - inadvertently repolished after initial weighing and not re-weighed

Walter J. MacKowski
 7/31/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b1c22cpp32.dat
 Date Run: 07-25-97
 Time Run: 07:09:41
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 ST 1.670E-04 SR 1.670E-04
 FL 1 5.3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy C-22, 11.5M LiCl, 95 C



Walter J. Macdonald 7/31/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File: b1c22cpp32.dat
 Date Run: 07-25-97
 Time Run: 07:09:41
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 CP PASS vs. R CT PASS
 ST 1.670E-04 SR 1.670E-04
 FL 1 5.3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy C-22, 11.5M LiCl, 95 C

Walter J. Macdonald 7/31/97

Walter J. Macdonald
 7/31/97

CPP of C-22 9M LiCl, 95°C, crevice geometry

C22cpp33.dat

Objectives: To measure E_{ap} and E_{pit} .

Specimen: Alloy C-22 lot # 2277-8-3175
 specimen dimensions size 24
 600 grit finish
 start wt. 31.57601 g
 end wt. 31.55392 g

Solution: 9M LiCl
 190.7 g LiCl lot # 922239
 + DI Water to 500 mL
 start pH 6.901 end pH 5.194

$T = 95^\circ\text{C}$ Hg thermometer #183304

Reference electrode: Fisher SCE #13-620-51 S/N 5129169
 Counter electrode: Pt flag

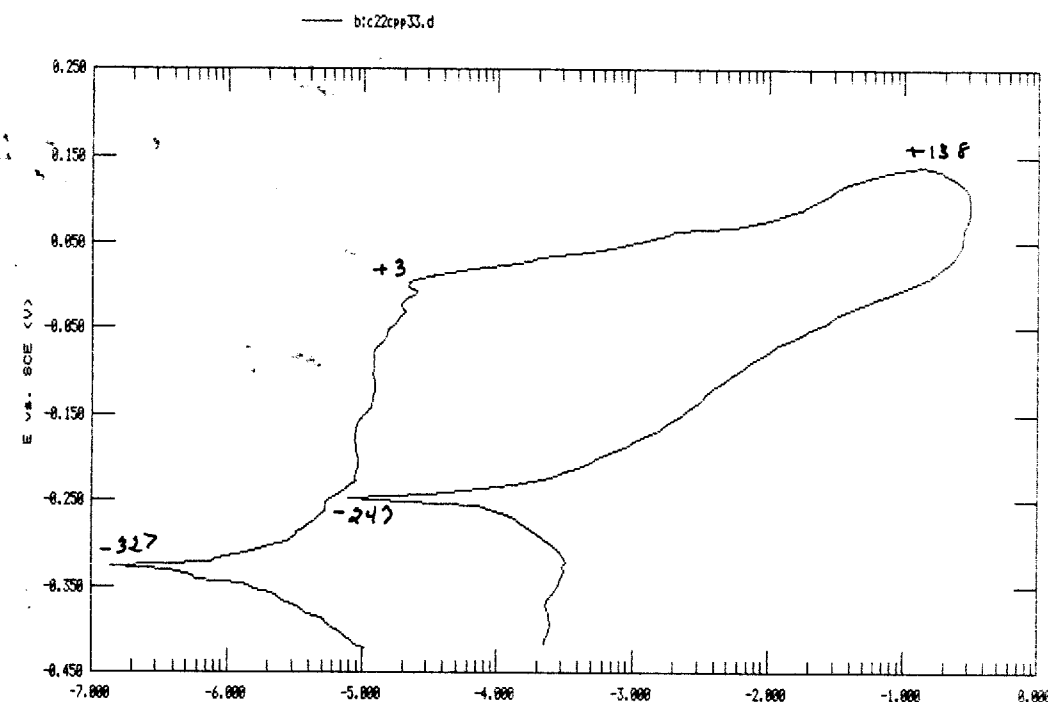
$E_{can} = -323 \text{ mV}$

$E_{pt} = +65 \text{ mV}$

widespread crevice corrosion, very shallow,
 looks similar to general attack

Walter J. Macdonald
 8/1/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Status: NORMAL
 File Name: b1c22cpp33.dat
 Date Run: 07-26-97
 Time Run: 06:53:48
 Pstat: VStat[1] Ver 2
 CP CYCLIC POLARIZATION
 Cond. Time CT PASS
 Cond. Pot. CP PASS
 Initial Delay ID 20
 Scan Rate SR 0.1670
 Scan Incr. SI 5.000
 No. of Points NP 224
 Line Sync. LS yes
 Rise time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000
 Temperature TC 0.446
 File Status: NORMAL
 Initial Pot. IP -0.1000
 Vertex 1 Pot. VI 0.1000
 I Threshold IT 0.1000
 Final Pot. FP -0.1000
 Curr. Range CR Auto
 Step Time ST 29.93
 61 Time Const. TC OFF
 IR Mode IR none
 Filter FL 1.5.3Hz
 Ref. Elec. RE SCE 0.2415 V
 Equiv. Mt. EM 0.0000
 Open Circuit OC -0.322
 Comment: Alloy C-22, 9M LiCl, 95 C



Walter J Machurak

8/1/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: b1c22cpp33.dat
 Pstat: VStat[1] Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-26-97
 Time Run: 06:53:48
 Cond. Time CT PASS
 Cond. Pot. CP PASS
 Initial Delay ID 20
 Scan Rate SR 0.1670
 Scan Incr. SI 5.000
 No. of Points NP 224
 Line Sync. LS yes
 Rise time RT high stability
 Working Elec. WE Solid
 Sample Area AR 1.000
 Temperature TC 0.446
 File Status: NORMAL
 Initial Pot. IP -0.1000
 Vertex 1 Pot. VI 0.1000
 I Threshold IT 0.1000
 Final Pot. FP -0.1000
 Curr. Range CR Auto
 Step Time ST 29.93
 61 Time Const. TC OFF
 IR Mode IR none
 Filter FL 1.5.3Hz
 Ref. Elec. RE SCE 0.2415 V
 Equiv. Mt. EM 0.0000
 Open Circuit OC -0.322
 Comment: Alloy C-22, 9M LiCl, 95 C

Walter J Machurak 8/1/97

Walter J Machurak
 8/1/97

CPP of C-22 4M LiCl, 95°C, crevice geometry

C22cpp34.dat

Objective: To measure E_{ap} and E_{pit} .

Specimen: Alloy C-22 Rt # 2277-8-3125
 specimen dimension see p. 24
 600 grit finish
 start wt. 31.56623 g
 end wt. 31.55100 g

Solution: 4M LiCl
 84.80g LiCl lot # 972239
 + DI water to 500 mL
 start pH 7.355 end pH 6.060

$T = 95^\circ\text{C}$ Hg thermometer # 183304

Reference electrode: Fisher SCE # 13620-51 S/N 5129169
 Counter electrode: Pt flag

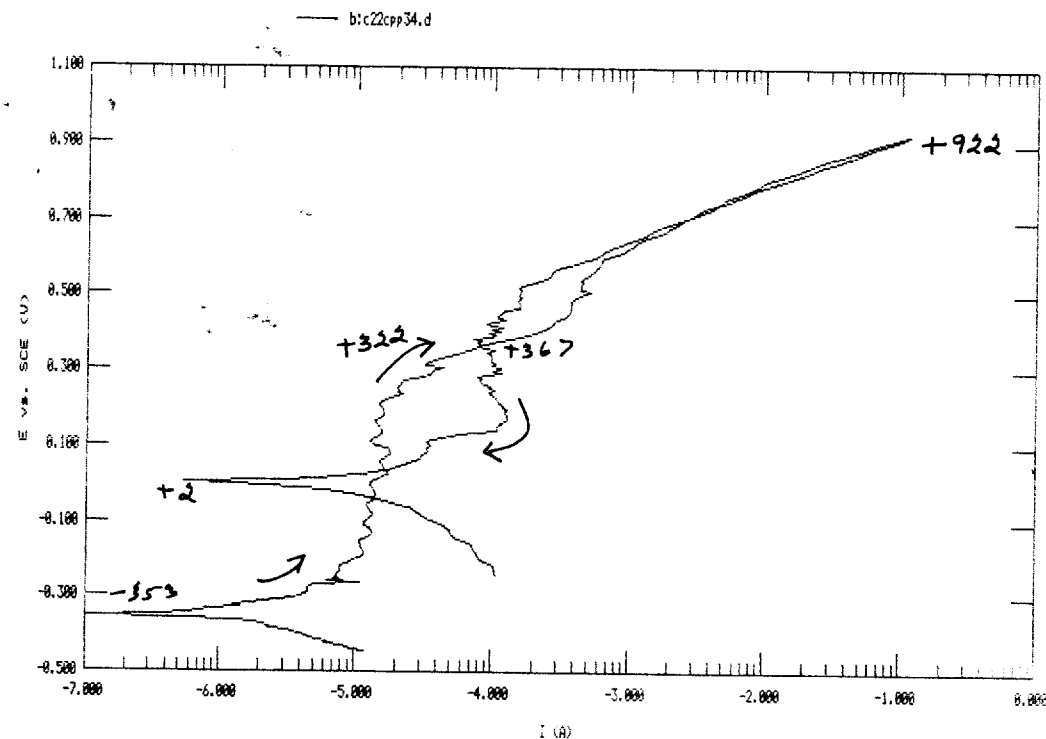
$E_{can} = -345 \text{ mV}$

$E_{pe} = +320 \text{ mV}$

slight crevice corrosion in 2 places
 gold color on areas away from crevice washers

Walter J Machurak
 8/4/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION
 File Status: NORMAL
 Date Run: 07-27-97
 Time Run: 07:11:43
 Pstat: VStat() Ver 2
 CP PASS vs. R CT PASS
 SI 5.000E-03 SR 1.670E-04
 FL 1.5, 3Hz RT HIGH STABILITY
 IT 1.000E-01 ITA 1.000E+00
 Comment: Alloy C-22, 4M LiCl, 95 C
 File Name: bic22cpp34.dat
 ID 20 S
 VI 0.100 vs. OC
 MP 507
 NR 1.000E+00
 OC -0.343
 IP -0.100 vs. OC
 ST 2.993E+01
 CR AUTO
 REF 0.24159 SCE
 WRK SOLID
 DEN 8.440E+00
 EN 0.000E+00
 FP -0.100 vs. OC
 IR NONE
 LS YES



Walter J. Mocharowski 8/4/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 File Name: bic22cpp34.dat
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-27-97
 Time Run: 07:11:43

Cond. Time CT Pass s
 Cond. Pot. CP Pass V
 Initial Delay ID 20 s
 Initial Pot. IP -0.1000 V oc
 Vertex 1 Pot. VI 0.1000 V oc
 I Threshold IT 0.1000 A
 Final Pot. FP -0.1000 V oc

Scan Rate SR 0.1670 mV/s
 Scan Incr. SI 5.000 mV
 No. of Points NP 507

Line Senc. LS yes
 Rise Time RT High stability
 Working Elec. WE Solid
 Sample Area SA 1.000 cm²
 Density DE 8.440 g/ml
 G1 Time Const. TC Off
 IR Mode IR none
 Filter FL 1.5, 3Hz
 Ref. Elec. RE SCE 0.2415 V
 Equiv. Wt. EW 0.0000 g
 Open Circuit OC -0.3430 V

Comment: Alloy C-22, 4M LiCl, 95 C

Walter J. Mocharowski 8/4/97

Walter J. Mocharowski
 8/4/97

CPP of C-22 1M NaCl 95°C cyclic growth

C22 cpp35.dat

Objective: To measure E_{ap} and E_{pit} .

Specimen: Alloy C-22 lot # 2277-8-3175
 spec. dimension see p. 24
 600 grit finish
 start wt. 31.72355 g
 end wt. 31.70109 g

Solution: 1M NaCl
 58.46678 g NaCl lot # 960780
 dilute to 1000 mL w/ DI water

start pH 7.940 end pH 6.337

$T = 95^{\circ}\text{C}$ Hg thermometer # 183304

Reference electrode: Fisher SCE #13-620-51 S/N 5129169
 Counter electrode: Pt flag

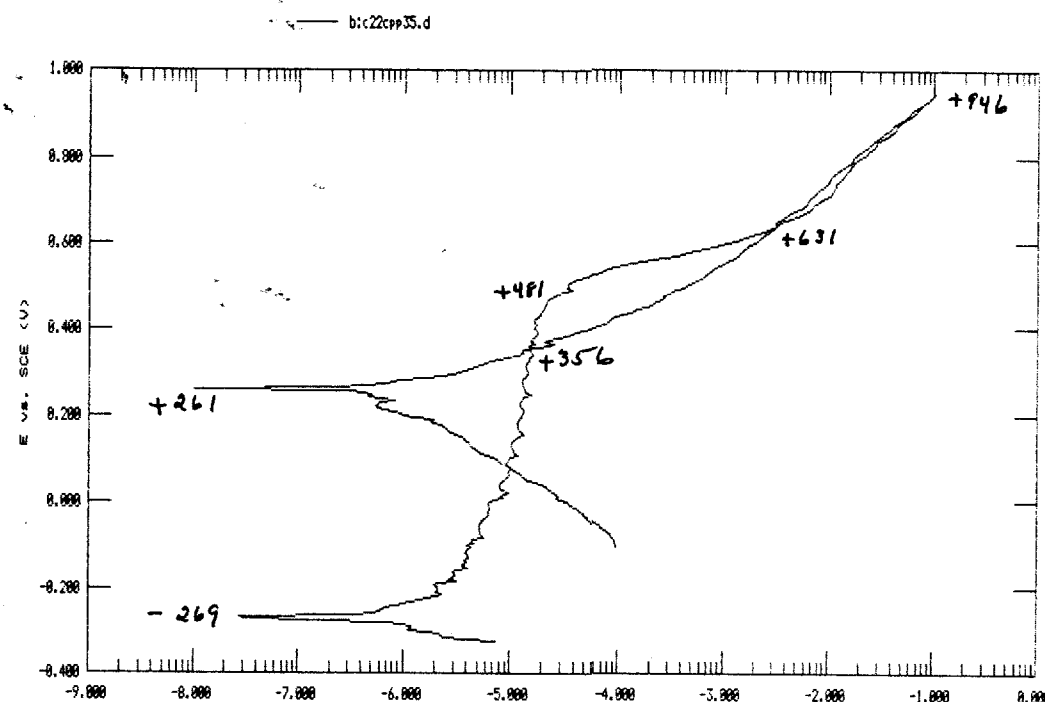
$E_{com} = -325 \text{ mV}$

$E_{pg} = +675 \text{ mV}$

No cyclic corrosion or pitting

Walter J. Mocharowski
 8/7/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 CP CYCLIC POLARIZATION File Status: NORMAL Date Run: 07-28-97 Time Run: 08:03:07 Pstat: VStat() Ver 2
 CP PASS vs. R CT PASS IP -0.100 vs. OC ID 20 S VI 0.100 vs. OC FP -0.100 vs. OC
 SI 5.000E-03 SR 1.670E-04 ST 2.993E+01 CR AUTO NP 465 IR NONE
 FL 1.5.3Hz RT HIGH STABILITY REF 0.24150 SCE MRK SOLID AR 1.000E+00 LS YES
 IT 1.000E-01 ITR 1.000E+00 EW 0.000E+00 DEN 0.440E+00 OC -0.224
 Comment: Alloy C-22, 1M NaCl, 95 C



Walter J. Mackowski 8/7/97

Model 352/252 Corrosion Analysis Software, v. 2.01
 Filename: b1c22cp35.dat
 Pstat: VStat() Ver 2
 CP CYCLIC POLARIZATION
 Date Run: 07-28-97
 File Status: NORMAL
 Time Run: 08:03:07
 Cond. Time CT pass s Initial Pot. IP -0.1000 V oc
 Cond. Pot. CP pass V Vertex 1 Pot. VI 0.1000 V oc
 Initial Delay ID 20 s I Threshold IT 0.1000 A
 Final Pot. FP -0.1000 V oc
 Scan Rate SR 0.1670 mV/s Curr. Range CR Auto
 Scan Incr. SI 5.000 mV Step Time ST 29.93 s
 No. of Points NP 465
 Line Sync. LS yes GI Time Const. TC Off
 Rise Time RT high stability IR Mode IR none
 Working Elec. WE Solid Filter FL 1.5.3Hz
 Sample Area AR 1.000 cm² Ref. Elec. RE SCE 0.2415 V
 Density DE 8.440 g/ml Open Circuit OC -0.2240 V
 Comment: Alloy C-22, 1M NaCl, 95 C

Walter J. Mackowski 8/7/97

Walter J. Mackowski
8/7/97

C-22 Repassivation Potential

Objective: Measure E_{RP} of C-22

6/23/99

Specimen: Alloy C-22 #2277-8-3715
 polished to 600 grit (re-used from C22RP20
 p. 298 NB 086)

19 wires

PTFE crevice gasket, total immersion

start wt. 37.44912 g

end wt. 37.18126 g

Solution: 4M Cl⁻ 85 ppm HCO₃⁻
 20 ppm SO₄²⁻ 10 ppm NO₃⁻ 2 ppm F⁻
 467.52 g NaCl #986519
 0.25736 g NaHCO₃ #897789
 40 ml SO₄²⁻
 20 ml NO₃⁻ } 5/99 NB 086 p. 284
 4 ml F⁻
 + DI water to 2000 mL

start pH 7.450 end pH 7.504
 95°C de-aerated w/zero Na

Potentiostat: KEPC 273 S/N 41108

Counter electrode: Pt flag

Ref: SCE 13-620-51 S/N 9214074

E_{can} -501 mV Keithly 614 SN 704934

E_{RP} -141 mV

held c +800 mV for ~ 2 1/2 days

black smut, still transpassive dissolution

same as C22RP20.DAT

6/23/99

Walter J. Mackowski

C-22 Repassivation Potential

Objective: Measure E_{rep} of C22

Specimen: C-22 same specimen as p.139 re-polished
to 600 grit
neoprene gasket; fully immersed!
PTFE crevice washer @ 100 in.-oz

Solution: Saturated NaCl pH 3

600g NaCl Lot # 986519
+ DI water to 2000 mL
adjust pH w/HCl Lot # 971828

95°C de-aerated w/gro N₂

Potentiostat: EG&G 273 S/N 41108

Counter electrode: Pt flag

Reference: SCE 13-620-51 S/N 9214074

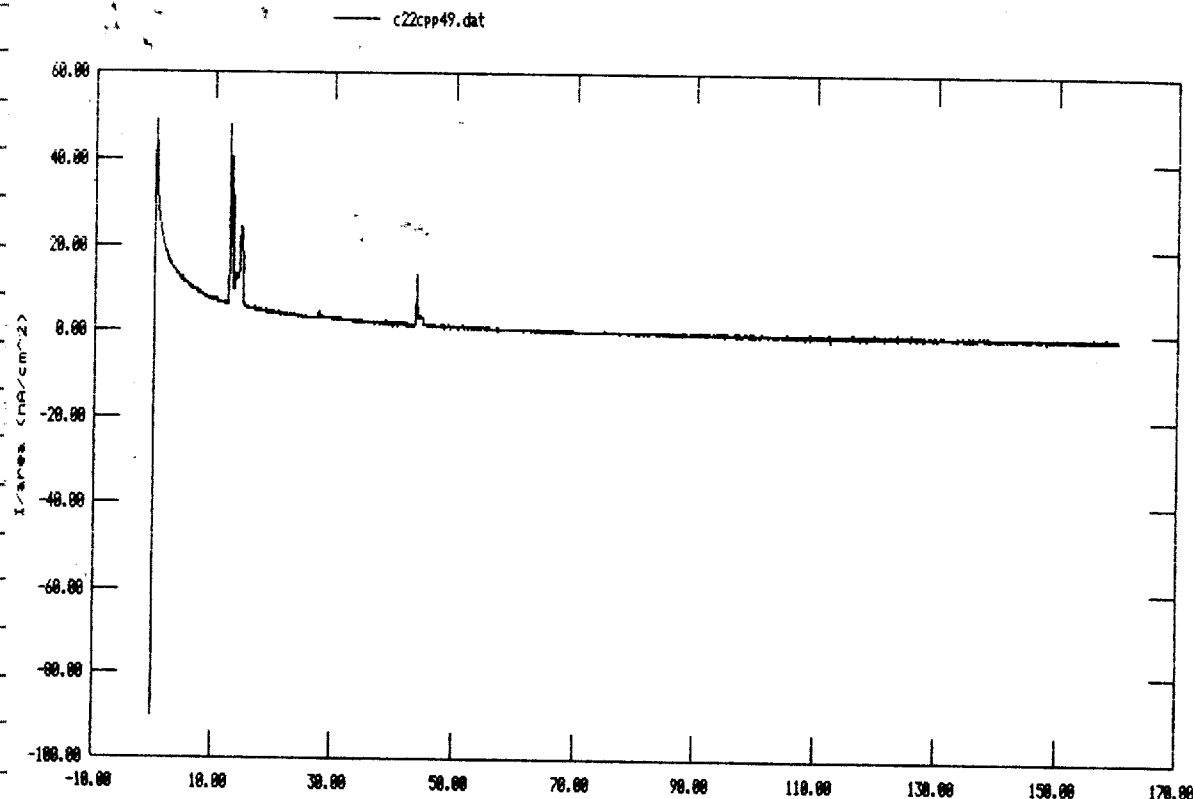
E_{com} -347mV Keithly 614 S/N 704934
E_{pt} -347mV " " "

take up to +850 and come down immediately to
+750 and hold for ~6 days
end pH 4.701

Samuel D.
6/28/99

Samuel D.
6/28/99

Model 352/252 Corrosion Analysis Software, v. 2.30
 PS POTENTIOSTATIC File Status: NORMAL Date Run: 06-07-99 Time Run: 06:03:51
 CP PASS vs. R CT PASS IP -0.200 vs. R ID 5 S TP 5.333E+01 T1 1.600E+05
 CR AUTO MP 3000 SQ Pass IR NONE FL 1 5.3Hz RT HIGH STABILITY
 REF 0.24150 SCE WPK SOLID AR 8.000E+00 LS YES EN 0.000E+00 DEN 8.900E+00 AU NO
 DC -0.056
 Comment: Alloy C-22 2277-0-3175 treated @ 870°C FOR 4 HRS; 4M Cl 95°C; -200mV



6/28/99 Walter J. Machowski

Model 352/252 Corrosion Analysis Software, v. 2.30
 Filename: a:\c22cpp49.dat
 Pstat: VStat[] Ver 2
 PS POTENTIOSTATIC
 Date Run: 06-07-99 File Status: NORMAL Time Run: 06:03:51

Cond. Time	CT	pass	s	Initial Pot.	IP	-200.0E-3	V
Cond. Pot.	CP	pass	V	Time Step 1	T1	160.0E3	s
Initial Delay	ID	5	s	Stop On	SO	Pass	
Time/Pt.	TP	53.33	s	Curr. Range	CR	Auto	
No. of Points	MP	3000					

Line Sync.	LS	yes	IR Mode	IR	none
Rise Time	RT	high stability	Filter	FL	1 5.3Hz
Working Elec.	WE	Solid	Ref. Elec.	RE	SCE 241.5E-3V
Sample Area	AR	8.000	Equiv. Wt.	EN	0.0000 g
Density	DE	8.900	AUX A/B	AU	no
Open Circuit	OC	-56.00E-3	V		

Comment: Alloy C-22 2277-0-3175 treated @ 870°C FOR 4 HRS; 4M Cl 95°C; -200mV

6/28/99 Walter J. Machowski

C-22 Passive Current Density

Specimen: C-22 Heat 2277-0-3175
 polished to 600 grit heat treated 870°C 1/4 hrs
 and water quenched

Solution: 4M Cl⁻ 85 ppm H₂O₂⁻
 20 ppm SO₄²⁻ 10 ppm NO₃⁻ 2 ppm F⁻
 467.52g NaCl # 985302
 0.23588g NaH₂O₂ # 897789
 40 ml SO₄²⁻
 20 ml NO₃⁻ } 6/99 NB 218 p.145
 4 ml F⁻
 + DI water to 2000 mL

stat pH 7.483

start wt. 12.31662 g

95°C de-aerated w/gew N₂

Potentiostat: Versastat # 20104

Counter: PT flag

Reference: SCE 13-620-51 g/w 8122010

E_{can} -346 mV Keithly 614 g/w 704936

E_{pt} -136 mV

E_{applied} -200 mV SCE

specimen still shiny + uncorroded
 current density ~ -0.2 → +0.2 nA
 checks on p.142

6/28/99
 Walter J. Machowski

6/28/99
 Walter J. Machowski

6/99

Stock Solutions

1000 ppm SO_4^{2-} as Na_2SO_4 1.47745 g Na_2SO_4 Lot # 901213

+ DI water to 1 liter

prep 6/24/99

exp 7/24/99

1000 ppm NO_3^- as NaNO_3 1.38059 g NaNO_3 Lot # 961772A

+ DI water to 1 liter

prep 6/24/99

exp 7/24/99

1000 ppm F^- as NaF 2.21871 g NaF Lot # 876405

+ DI water to 1 liter

prep 6/24/99

exp 7/24/99

Quell Q
5/31/2000

6/24/99

Walter J Mackowski

C-22 Passive Current Density

Specimen C-22 same on as p. 143 re-immersedSolution: Same as p. 143 used for continuation95°C de-aerated w/zero N₂

Potentiostat: Versastat #20104

Counter: PX flag

Reference: SCE 13-620-51 s/n 8122010

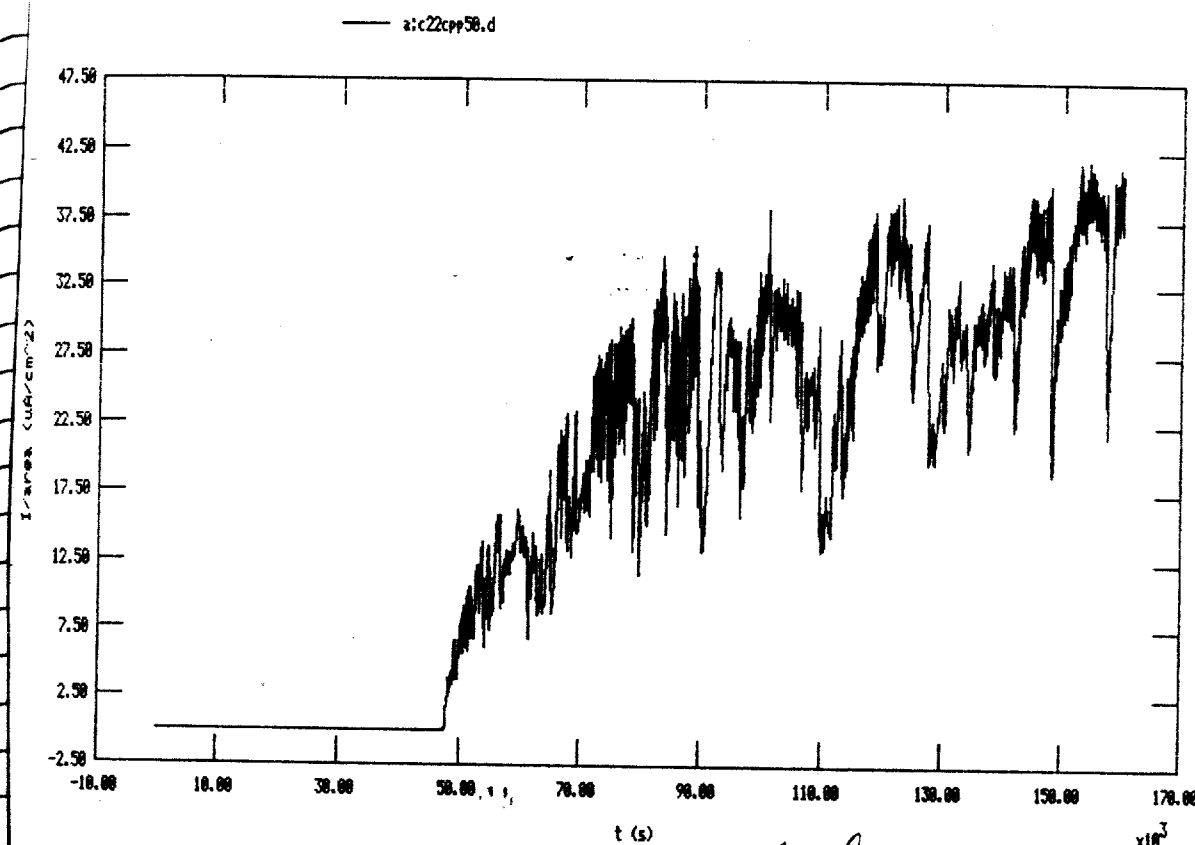
E_{can} -203 mV Keithly 614 s/n 704936E_{PX} -172 mVE_{applied} 0 mV SCE

specimen has crevice attack at the TPE interface

6/9/99

Walter J. Machorski

Model 352/252 Corrosion Analysis Software, v. 2.38
 PS POTENTIOSTATIC File Status: NORMAL Date Run: 06-09-99 Time Run: 10:25:01
 CP PASS vs. R CT PASS IP 0.000 vs. R ID 5 S TP 5.333E+01 T1 1.600E+05
 CR AUTO HP 3000 SD Pass IR NONE FL 1 5.3Hz RT HIGH STABILITY
 REF 0.24150 SCE WPK SOLID AR 0.000E+00 LS YES EN 0.000E+00 DEN 0.900E+00 AU NO
 OC -0.184
 Comment: Alloy C-22 2277-0-3175 treated @ 870°C for 4 hrs; 4M Cl 95°C; 0mV



7/5/99 Walter J. Machorski

Model 352/252 Corrosion Analysis Software, v. 2.38
 Filename: a:c22cpp58.d
 Pstat: VStat() Ver 2
 PS POTENTIOSTATIC
 Date Run: 06-09-99

File Status: NORMAL
 Time Run: 10:25:01

Cond. Time	CT	pass	s	Initial Pot.	IP	0.0000	V
Cond. Pot.	CP	pass	V	Time Step 1	TS	1.00	SEC
Initial Array	IA			Stop On	SO	REAS	s
Time/Pt.	TP	53.33	s	Curr. Range	CR	Auto	
No. of Points	NP	3000					

Line Sync.	LS	yes		IR Mode	IR	none	
Rise Time	RT	high stability		Filter	FL	1 5.3Hz	
Working Elec.	WE	Solid		Ref. Elec.	RE	SCE 241.5E-3V	
Sample Area	SA	0.000	cm²	Equiv. Wt.	EW	0.0000	g
Density	DE	0.900	g/ml	AUX A/B	AU	no	
Open Circuit	OC	-104.0E-3	V				

Comment: Alloy C-22 2277-0-3175 treated @ 870°C for 4 hrs; 4M Cl 95°C; 0mV

7/5/99 Walter J. Machorski

7/5/99

Walter J. Machorski

Passive Current Density

Specimen: C-22 h# 2277-8-3175
treated @ 870°C / 8 hrs + water quenched
600 grit polished

Start int. 12.31345

Solution: 4M Cl^- 85 ppm HNO_3^-
20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-
467.52 g NaCl # 985302
0.23588 g NaHCO_3 # 897789
40ml SO_4^{2-}
20ml NO_3^- } 6/99 p. 145
4ml F^-
+ DI water to 2000 mL

Start pH 7.400 end pH 8.691

95°C de-aerated w/ spg H_2

Potentiostat: Vinstat # 20104

Counter: PT flag

Reference: SCE 13-620-51 S/N 8122010

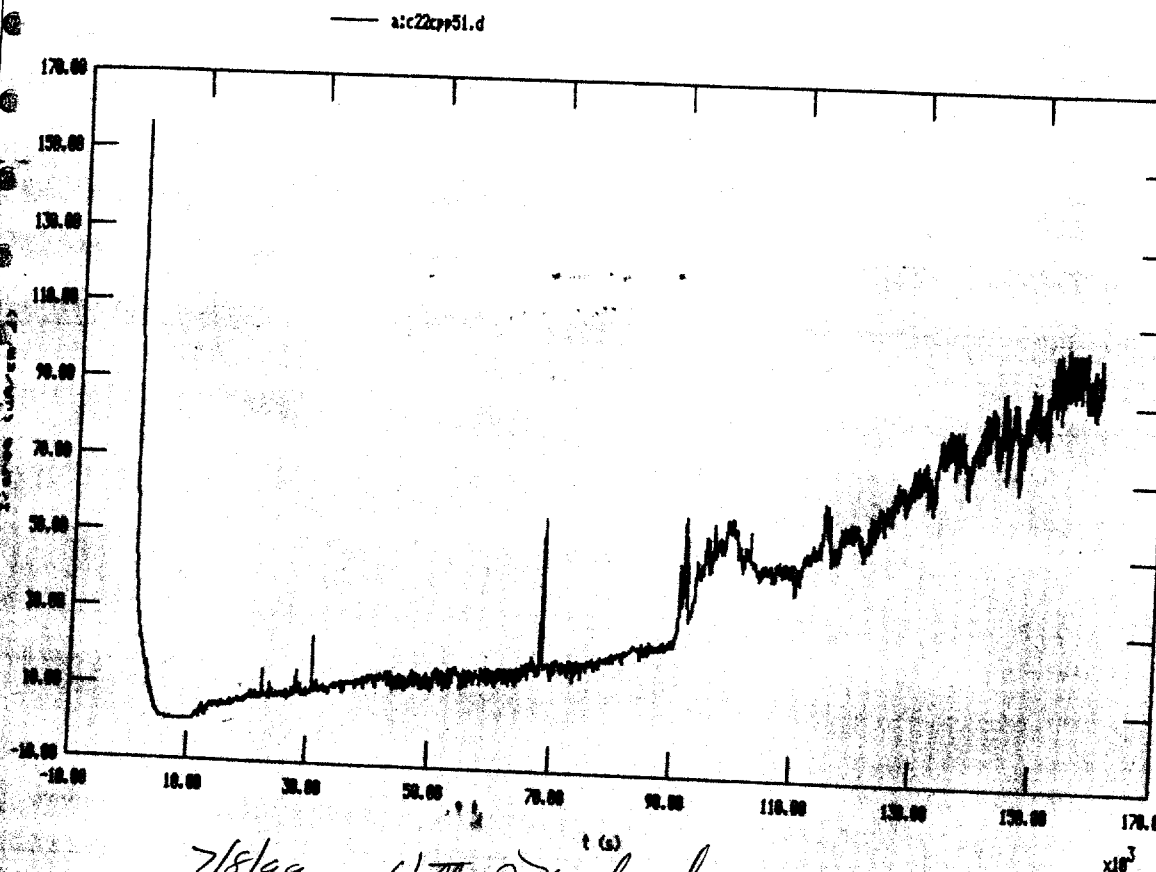
E_{corr} -150 mV Ruthly 614 S/N 704936
 E_{pt} -624 mV

Exptl +400 mV SCE

specimen has crevice attack at TFE interface

7/8/99
Walter J. Machurak

Model 352/252 Corrosion Analysis Software, v. 2.38
PS POTENTIOSTATIC File Status: NORMAL Date Run: 06-10-99 Time Run: 14:16:14
CP PASS vs. R CT PASS IP 0.400 vs. R ID 5 S TP 5.333E+01 T1 1.600E+05
CR AUTO MP 3000 SO Pass IR NONE FL 1 5.3Hz RT HIGH STABILITY
REF 0.24158 SCE WAX SOLID AR 8.000E+00 LS YES EN 8.000E+00 MEN 8.000E+00 AU NO
Comment: C-22 h# 2277-8-3175 treated @ 870°C for 8 hrs; 4M Cl 95°C; +400mV sce



7/8/99 Walter J. Machurak

Model 352/252 Corrosion Analysis Software, v. 2.38
Filename: a/c22cyp51.d
Pstat: VStat() Ver 2
PS POTENTIOSTATIC
Date Run: 06-10-99 File Status: NORMAL Time Run: 14:16:14
Cond. Time CT pass s Initial Pot. IP 400.0E-3 V
Cond. Pot. CP pass V Time Step 1 T1 160.0E3 s
Initial Delay ID 5 s Stop On SO Pass
Time/Pt. TP 53.33 s Curr. Range CR Auto
No. of Points MP 3000
Line Sync. LS yes IR Mode IR none
Rise Time RT high stability Filter FL 1 5.3Hz
Working Elec. ME Solid Ref. Elec. RE SCE 241.5E-3V
Sample Area AR 8.000 cm² Equiv. Wt. EN 8.0000 g
Density DE 8.900 g/ml AUX A/B AU no
Open Circuit OC -615.0E-3 V

Comment: C-22 h# 2277-8-3175 treated @ 870°C for 8 hrs; 4M Cl 95°C; +400mV sce

7/8/99 Walter J. Machurak

7/8/99

Walter J. Machurak

LT 825 P5

Specimen: Alloy 825 Mt. 4371FC

Start Wt. 39.08451 g

End Wt. 39.07482 g

2 PTFE crevice washers @ 100 in-oz

Solution: 1000 ppm Cl^- 85 ppm HCO_3^- 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

1.64138 g NaCl # 986519

0.11863 g NaHCO_3 # 89778920 ml SO_4^{2-} 10 ml NO_3^- } 6/99 NB 218 p.1452 ml F^-

+ DI water to 1000 mL

Start pH 7.705 End pH 8.294

Temp 95°C Hg thermometer #0323007

Potentiostat: ESC 440 #1 Channel #1

Counter Electrode: Pt flag

Reference: Fisher SCE 13-620-51 S/N 8122010

 E_{can} + 25 mV KEITHLEY 617 5N 537418 E_{Pt} + 246 mV " E_{applied} + 100 mV

Durrell D. 12/15/99

C22 L7C

Specimen: C-22 Heat # 2277-E-3715

Start Wt. 47.41868 g

End Wt.

2 PTFE crevice washers @ 100 in-oz

Solution: 4M Cl^- 85 ppm HCO_3^- 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

467.52 g NaCl # 985302

0.123617 g NaHCO_3 # 89778940 ml SO_4^{2-} 20 ml NO_3^- } 6/99 NB 218 p.1454 ml F^-

+ DI water to 2000 mL

Start pH 7.237 End pH 8.827

Temp 95°C Hg thermometer 7/16/99

Potentiostat: ESC 440 #1 Channel #2

Counter Electrode: Pt flag

Reference: Fisher SCE 13-620-51 S/N 3106345

 E_{can} - 22 mV KEITHLEY 617 5N 537418 E_{Pt} + 172 mV " E_{applied} + 300 mV

Durrell D. 12/15/99

C22L5A

Specimen: C-22 Welded

Start wt. 38.99176 g

End wt.

2 PTFE crucibles @ 100 in. air

Solution: 4M Cl^- 85 ppm HCO_3^- 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

467.52 g NaCl # 985302

0.23467 g NaHCO_3 # 89778940 ml SO_4^{2-} 20 ml NO_3^- } 6/99 NB 218 p.1454 ml F^-

+ DI water to 2000 mL

Start pH 7.176 End pH 8.200 $T = 95^\circ\text{C}$

Potentiostat: ESC 440 #1 Channel #3

Counter electrode: Pt flag

Reference: Fisher SCE 13-620-51 S/N 0165403

 $E_{\text{can}} -300 \text{ mV}$ R6ITN64 617 8N 537418 $E_{\text{Pt}} +193 \text{ mV}$ $E_{\text{applied}} 0.400 \text{ V}_{\text{SCE}}$

Durrell D 12/15/99

C22L3C

Specimen: C-22 Heat 2277-8-3175

Start wt. 47.21603 g

End wt. 47.21857 g

2 PTFE crucibles @ 100 in. air

Solution: 1000 ppm Cl^- 85 ppm HCO_3^- 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

2.29100 g NaCl # 986519

0.23335 g NaHCO_3 # 89778940 ml SO_4^{2-} 20 ml NO_3^- } 6/99 NB 218 p.1454 ml F^- + DI water to 2000 mL 4/ 7/16/99
normStart pH 7.155
 $T = 95^\circ\text{C}$ aerated w/ new air

Potentiostat: ESC 440 #1 Channel #5

Counter electrode: none

Reference: Fisher SCE 13-620-51 S/N 9214083

 $E_{\text{can}} -136 \text{ mV SCE}$ R6ITN64 617 5N 537418 $E_{\text{Pt}} +61 \text{ mV SCE}$ $E_{\text{applied}} \Rightarrow$ open circuitSolution: 4M Cl^- 85 ppm HCO_3^- 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-

467.52 g NaCl # 985302

0.23527 g NaHCO_3 # 89778940 ml SO_4^{2-} 20 ml NO_3^- } 6/99 NB 218 p.1454 ml F^-

+ DI water to 2000 mL Durrell D 12/15/99

END pH 9.05

OC 825C I AA

Specimen: Alloy 825 HT. # 4371 FC
 Start wt. 39.29845 g
 End wt. 39.29057 g

2 PTFE crucible washers @ 100 in-oz

Solution: 1000 ppm Cl^- 85 ppm HCO_3^-
 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-
 3.29100 g NaCl # 986519
 0.23335 g NaHCO_3 # 897789
 40 ml SO_4^{2-}
 20 ml NO_3^- } 6/99 NB 218 p.145
 4 ml F^- }
 + DI water to 2000 mL

Start pH 7.874 End pH 8.417

$T = 95^\circ\text{C}$ Hg thermometer 183302
 aerated w/ gaseous air

Potentiostat: ESC 440 #1 Channel #5

Counter Electrode: none

Reference: Fisher SCE 13620-51 S/N 5129169

E_{corr} -311 mV REVERBY 617 SN 587418
 E_{PT} +136 mV

$E_{\text{applied}} \Rightarrow$ open circuit

Daniel D. 12/15/99

Passive Current Density

Specimen: C-22 HT. 2277-8-3915
 treated @ 870°C for 12 hrs water quenched
 600 grit polished
 Start wt. 12.26784 g

Solution: 4M Cl^- 85 ppm HCO_3^-
 20 ppm SO_4^{2-} 10 ppm NO_3^- 2 ppm F^-
 467.52 g NaCl # 985302
 0.23356 g NaHCO_3 # 897789
 40 ml SO_4^{2-}
 20 ml NO_3^- } 6/99 NB 218 p.145
 4 ml F^- }

+ DI water to 2000 mL

Start pH 7.137

TEST WAS NOT
 CONDUCTED

Daniel D.

12/15/99

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