C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing.*
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.
* Drawing # 20.01402.571.019

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR052

Initial weight: 12.41232 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.41231 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 3 M NaCl + 2X10^{-4} M $CuCl_2$ (Page 97, this notebook)
175.3 g NaCl lot # 050089 + DI water to 1000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/14/05 **Due:** 7/14/05
Initial pH: 7.12 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.72 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4065196P
Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter **Cal:** 2/7/05 **Due:** 8/5/05
Thermocouple meter **SN:** 415236 85
Cal: 6/7/05 **Due:** 6/7/06
X.H. 7/22/05

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 9252/05
Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 6/1/05 **Due:** 12/01/05
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR0711Ia, C22PR0711Ea, C22PR0711Ib, C22PR0711Eb, C22PR0714I C22PR0714E, C22PR0717I, C22PR0717E, C22PR0720I, C22PR0720E

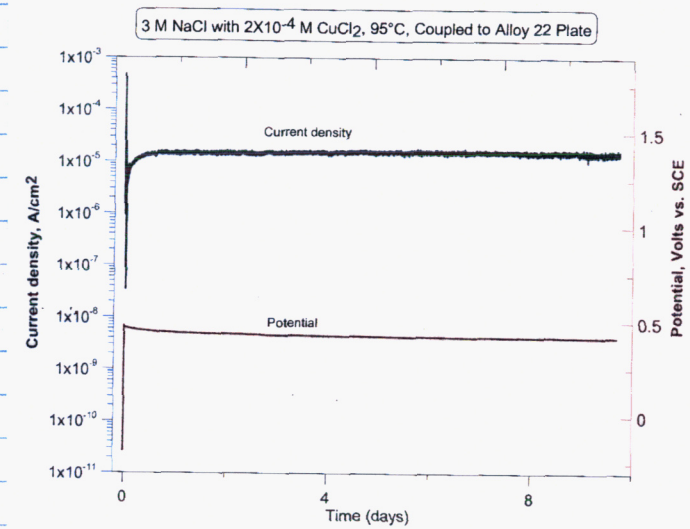
Test dates: 7/11/2005 ~ 7/21/2005
Test time: 8.40x10^5 seconds = 9.72 days
Creviced area: 9.34 mm^2
Estimated crevice corroded area: 0

Maximum penetration depth: 0 **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
No corrosion.
Specimen will be reused.

Xihua He 7/22/05

Xihua He 6/9/06



Xihua He 7/22/05

Xihua He 6/9/06

Test Summary

Test ID	NB#	Page#	Solution	Creviced area (mm^2)	Test length (days)	Potential before initiation (mV)	Potential during propagation (mV)	Potential drop (mV)	Total charge (C)	Penetration depth (μm)	Did LC stifled?
C22PR030	670	80	5M NaCl+1.37*10-4M CuCl2	10.9	18.98	452	-192	644	8.576	104	Stifled at 3.75 days
C22PR031	670	82	5M NaCl+2*10-4M CuCl2	11.3	70.94	478	-221	699	33.69	313	No
C22PR032	670	84	5M NaCl+2*10-3M CuCl2	10.9	12.68	414	90	324	147	corrosion is at the side	No
C22PR033	670	86	5M NaCl+2*10-4M CuCl2	10.9	6.92	488	-246	734	15.37	107	No
C22PR034	670	88	5M NaCl+2*10-3M CuCl2	10.3	3.77	520	283	237	3.34	115	Yes, stifled at 2.44 days
C22PR035	670	90	5M NaCl+2*10-4M CuCl2	10.9	13.1	487	-231	718	15.93	156	No
C22PR036	670	92	5M NaCl+2*10-4M CuCl2	11.4	13.8	429	-201	630	17.8	200	Yes, stifled at 9.11 days
C22PR037	670	94	5M NaCl+2*10-4M CuCl2	Data is invalid							
C22PR038	670	96	5M NaCl+2*10-4M CuCl2	10.9	11.89	509	100	409	23.66	220	Yes, stifled at 3.00 days
C22PR039	670	98	5M NaCl+2*10-4M CuCl2	20.4	8.85	490	-223	713	32.8	125	No
C22PR040	670	100	5M NaCl+2*10-4M CuCl2	11.8	1.67	475	-172	647	16.7	105	No
C22PR041	670	102	5M NaCl+2*10-4M CuCl2	11.8	3.66	480	-206	686	15.15	137	No
C22PR042	670	104	5M NaCl+2*10-4M CuCl2	11.8	0.5	489	-128	617	6.52	90	No
C22PR043	670	106	5M NaCl+2*10-4M CuCl2	10.9	4.88	488	37.5	450.5	26.45	187	Yes, stifled at 3.84 days
C22PR044	670	108	1M NaCl+2*10-4M CuCl2	19.6	12.65	500	LC is not initiated				
C22PR045	670	110	5M NaCl+2*10-4M CuCl2	10.9	3.08	510	110		14.03	143	Yes, Stifled at 2.52 days

Ale Xtel 7/29/05

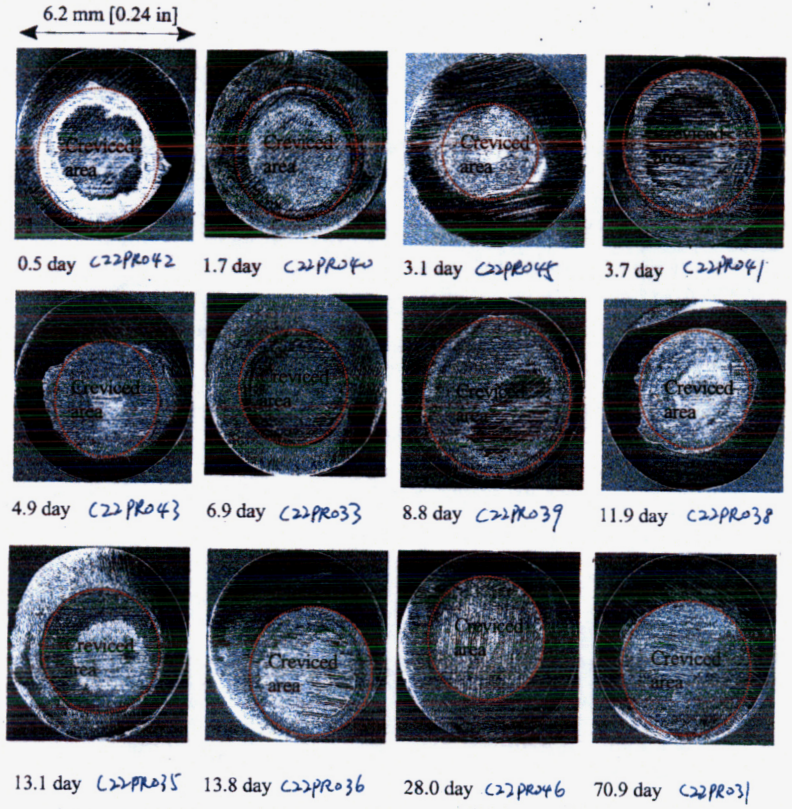
Test summary

Test ID	NB#	Page#	Solution	Creviced area (mm^2)	Test length (days)	Potential before initiation (mV)	Potential during propagation (mV)		Total charge (C)	Penetration depth (μm)	Did LC stifled?
C22PR046	670	112	5M NaCl+2*10-4M CuCl2	12.9	28	485	-233	718	52.195	x-rl 7/29/05 ~~100~~ 206	No
C22PR047	670	116	3M NaCl+2*10-4M CuCl2	8.55	6.79	510	180	330	34.38	298	Yes, Stifled at 4.13 days
C22PR048	670	118	5M NaCl+2*10-4M CuCl2 (Cathode:Anode = 4:1)	9.34	10.74	476	-172	648	23.76	224	Yes, stifled at 3.03 days
C22PR049	670	120	5M NaCl+2*10-4M CuCl2 (Cathode:Anode = 2:1)	12.3	22.6	516	0.0158	515.9842	24.2	220	No
C22PR050	670	122	4 M MgCl2+2*10-4M CuCl2	9.34	12.72	100	-167	267	-2.88	Corrosion is on cathode	
C22PR051	670	124	5M NaCl+0.5 M NaNO3 + 2*10-4M CuCl2	12.5	21.3	491	-175	666	38.15	214	Yes, stifled at 21.2 days
C22PR052	670	126	3M NaCl+2*10-4M CuCl2	9.34	9.72	478	Corrosion is not initiated				

Note: 1. If not specified, the cathode to anode area ratio is approximately 12:1. 2. red are stifled with actual test time, blues are actual propagation dates, blacks are normal without stifling

Ale Xtel 7/29/05

Optical pictures for corroded specimens

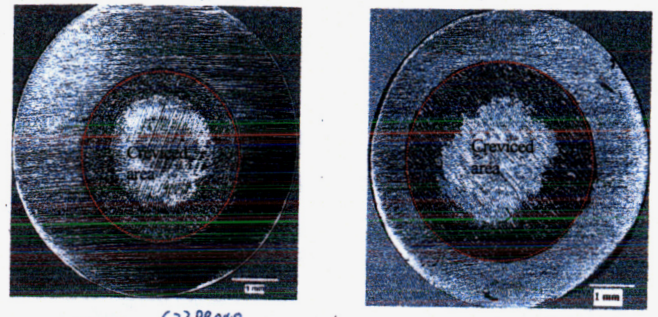


0.5 day C22PR042 1.7 day C22PR040 3.1 day C22PR044 3.7 day C22PR041

4.9 day C22PR043 6.9 day C22PR033 8.8 day C22PR039 11.9 day C22PR038

13.1 day C22PR035 13.8 day C22PR036 28.0 day C22PR046 70.9 day C22PR031

Xihua He 7/29/05



d_{max} = 224 μm C22PR048
$Area_{Cathode}$: $Area_{Anode}$ = 4:1

d_{max} = 220 μm C22PR049
$Area_{Cathode}$: $Area_{Anode}$ = 2:1

Xihua He 7/29/05

New $CuCl_2 \cdot 2H_2O$ Solution
prepared on 10/17/05

20.09g $CuCl_2 \cdot 2H_2O$ Lot# 897713
+ DI water To 100 mls
pH = 2.47
pH Measured with Orion EA940 SN# 2330
Cal: 7/25/05 Due 7/25/06
Fisher probe 13-620-296 SN# 4065196
In 300 mls Test solution Adding 51 μl (3x 17 μl) 10/17/05

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR053

Initial weight: 12.29062g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.28971g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2X10⁻⁴M $CuCl_2$ (Page 18, this notebook)
584.46 g NaCl lot #054570+ DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: ~~4/14/05~~ 7/12/05 **Due:** ~~7/14/05~~ 1/12/06
Initial pH: 5.87 **Model:** Orion EA 940 K.H 10/17/05 **SN:** 2330
Final pH: 5.21 **Cal:** 7/25/05 **Due:** 7/25/06 K.H 10/17/05
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 51046103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8131148
Potentiostat: Multi-channel SI1480
SN: 06238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} **(C22 plate) =** −217.5 mV$_{SCE}$ E_{corr} **(C22 cylinder) =** −210.4 mV$_{SCE}$
Measured with Keithley Electrometer 614 **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

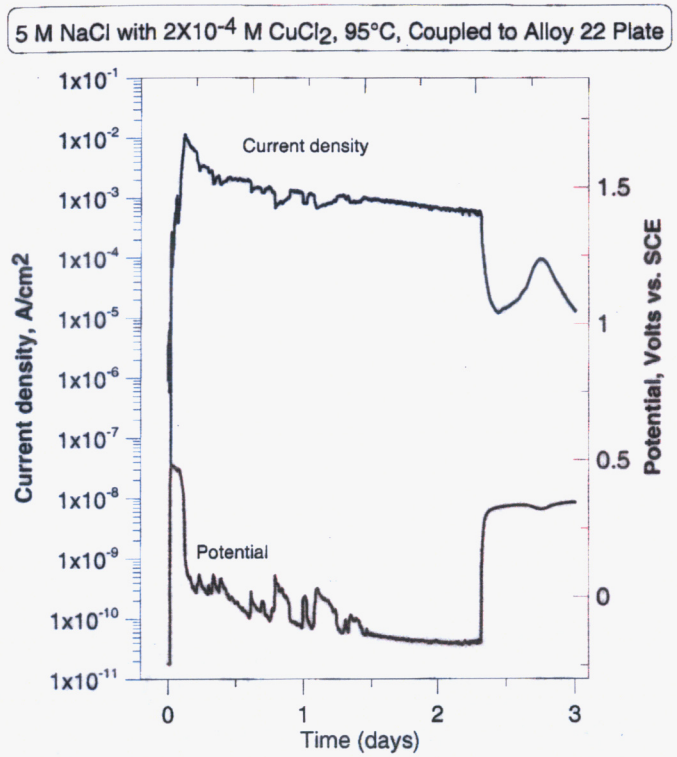
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR1018Ia_Un1Ch7, C22PR1018Ea_Un1Ch8, C22PR1018Ib_Un1Ch7, C22PR1018Eb_Un1Ch8, C22PR1020I_Un1Ch7, C22PR1020E_Un1Ch8

Test time: K.H 10/5/05 2.59×10^5 seconds = 3.0 days repassivated at 2.3 days
Creviced area: 9.1 mm^2 **Estimated crevice corroded area:** 9.1 mm^2

Maximum penetration depth: 156 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Crevice Corrosion on Ends of Specimen PTFE
Contact Area And Surface Staining on Specimen

B. K. 10/17/05



10/25/05

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR054

Initial weight: 12.40400g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.40246g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 31, this notebook)
584.46 g NaCl lot #051518 DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: ~~4/14/05~~ X.H 10/17/05 **Due:** ~~7/14/05~~ X.H 10/17/05
Initial pH: 5.87 **Model:** Orion EA 940 **SN:** 2330
Final pH: 4.70 **Cal:** 7/25/05 X 7/12/05 **Due:** 7/25/06 1/27/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 51046103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 81311157
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} **(C22 plate) =** −179.3 mV_{SCE} E_{corr} **(C22 cylinder) =** −204.9 mV_{SCE}
Measured with Keithley Electrometer 614 **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

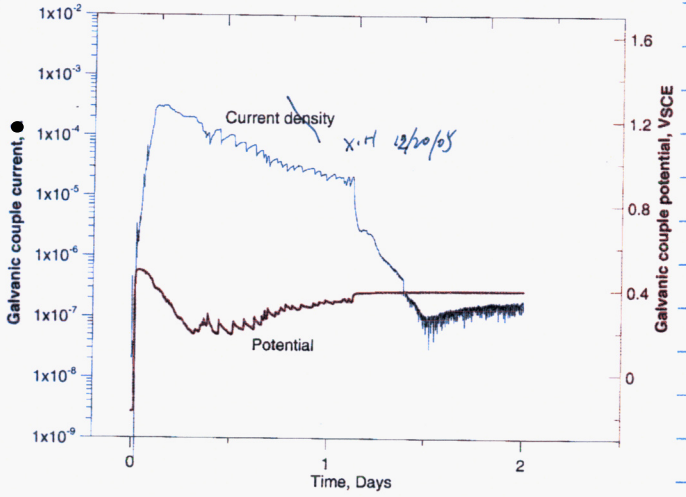
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR1018a_Un1Ch5, C22PR1018Ea_Un1Ch6, C22PR1018Ib_Un1Ch5, C22PR1018E6_Un1Ch6 X.H 10/20/05

Test time: 1.73×10^5 seconds
Creviced area: 20.4 mm^2 **Estimated crevice corroded area:** N.A

Maximum penetration depth: Difficult to determine **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05
Specimen examination:

Corrosion is at the side of the specimen.

10/12/05



X.H 12/20/05

Xihua He 10/20/05

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID:

Initial weight: 12.41236g **Model:** Sartorius Genius **SN:** 12809099
Final weight: Not Taken **Cal:** 5/11/05 **Due:** 11/11/05
Solution: 5 M NaCl + $CuCl_2$ (Page 12, this notebook)
584.46 g NaCl lot # 051510+ DI water to 2000 mL
Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: ~~4/14/05~~ V.H 10/20/05 **Due:** ~~7/14/05~~ V.H 10/27/05
Initial pH: 5.87 **Model:** Orion EA 940 7/12/05 **SN:** 2330 7/12/06
Final pH: 4.56 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065-196
Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 51046103
Cal: 6/7/05 **Due:** 6/7/06
Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8131157
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} (C22 plate) = 44.5 mV_{SCE} **E_{corr} (C22 cylinder) =** −98.1 mV_{SCE}
Measured with Keithley Electrometer 614 **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files:

X.H 10/24/05 X.H 10/24/05

Test time:
Creviced area: **Estimated crevice corroded area:** X.H 10/24/05
Maximum penetration depth: **Measured with Olympus metallurgical microscope PME3**
Cal: **Due:**
Specimen examination:
~~Edge of~~
X.H 10/24/05

10/24/05

* Note: Problem with Temperature over weekend will Break Test Cell Down - Repolish Specimen then Re Run Test

Xiuhua He 6/9/06

10/24/05

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR055

Initial weight: 12.37791 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.37365 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} m $CuCl_2$ (Page 131 this notebook)
584.46 g NaCl lot #051514 DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: ~~7/14/05~~ 7/12/05 **Due:** ~~7/14/05~~ 1/12/06
Initial pH: 5.87 **Model:** Orion EA 940 K.H 10/24/05 **SN:** 2330 Y.H 10/24/05
Final pH: 4.21 **Cal:** 7/25/05 K.H 11/2/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 406 5196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 5104 6103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8131148
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} (C22 plate) = -238 mV **E_{corr} (C22 cylinder) =** -150 mV
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

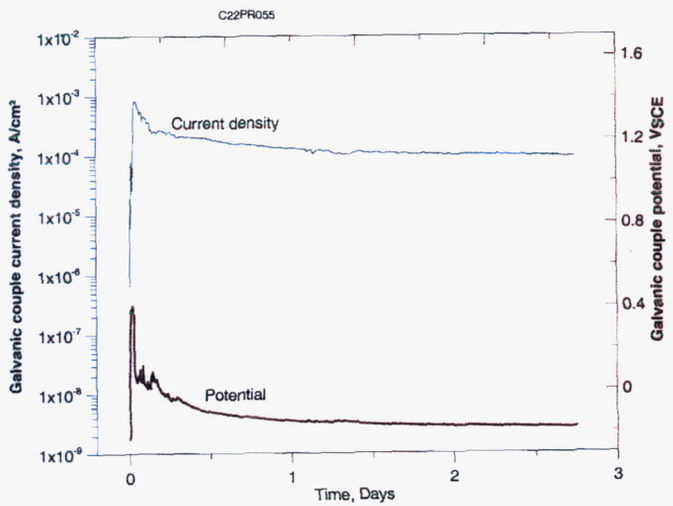
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR025Ia_Uni Ch5, C22PR025Ea_Uni Ch6,
C22PR025Ib_Uni Ch5, C22PR025Eb_Uni Ch6

Test time: 2.37×10^5 seconds = 2.7 days Q = 6.7 coulombs
Creviced area: ~~23.7~~ 16.7 mm^2 K.H 11/3/05 **Estimated crevice corroded area:** 8.3 mm^2
Maximum penetration depth: 63 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Deeper crevice corrosion is around the edge of the crevice area.

Dustin Hall 10/24/05

Xihua He 6/9/06



Xihua He 6/9/06

Xihua He 11/3/05

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR056

Initial weight: 12.36447 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.35632 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 13 this notebook)
584.46 g NaCl lot #051514 DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: ~~7/14/05~~ 7/12/05 **Due:** ~~7/14/05~~ 1/12/06
Initial pH: 5.87 **Model:** Orion EA 940 KM 10/24/05 **SN:** 2330
Final pH: 5.07 **Cal:** 7/25/05 **Due:** 7/25/06 KM 10/24/05
pH Probe: #13-620-296 **SN:** 406 5196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 5104 6103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8131157
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} **(C22 plate) =** -138 mv E_{corr} **(C22 cylinder) =** -243 mv
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR1025Ia_Un1Ch7, C22PR1025Ea_Un1Ch8, C22PR1025Ib_Un1Ch7, C22PR1025Eb_Un1Ch8

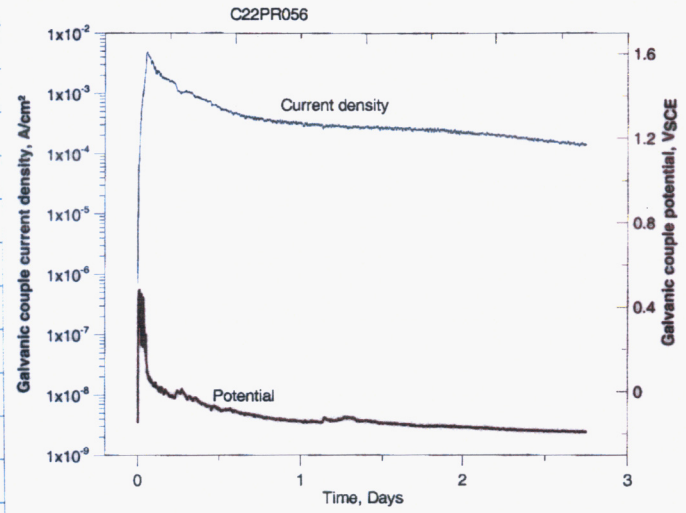
Test time: ~~2.73~~ KM 11/3/05 2.37×10^5 seconds = 2.7 days Q = 26.5 coulombs
Creviced area: 23.3 mm^2 **Estimated crevice corroded area:** 12.7 mm^2

Maximum penetration depth: 61 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Edge of the crevice area and side are corroded.

Dwayne Mell 10/24/05

Xihua He 6/9/06



Xihua He 6/9/06

Xihua He 11/3/05

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Proto 6104 **Cal:** 10/24/05 **SN:** 139072 **Due:** 4/24/06

Test ID: C22PR057

Initial weight: 12.28928g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 12.28851g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 131, this notebook)

584.41 g NaCl lot # 051310 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06
Model: Orion EA 940 **SN:**2330
Cal: 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Initial pH: 6.04
Final pH: 3.97

Test Temperature: 95°C **Thermocouple** **SN:**

Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter Fisher **SN:** 51046103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 8131148

Potentiostat: Multi-channel SI1480 **Due:** 12/1/05

SN: 00238265 **Cal:** 6/1/05

E_{corr} (C22 plate) = -230mv **E_{corr} (C22 cylinder) =** -142mv

Measured with Keithley Electrometer **SN:** 0555368

Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR1108Ia, Un1Ch5, C22PR1108Ea, Un1Ch6, C22PR1108Ib, C22PR1108Eb, C22PR1109I, C22PR1109E, C22PR1112I, C22PR1112E, C22PR1115I, C22PR1115E, C22PR1118I, C22PR1118E

Test time: 1.09×10^6 seconds = 12.6 days charge = 36.92 coulombs

Creviced area: 15.0 mm^2 **Estimated crevice corroded area:** 11.0 mm^2

Maximum penetration depth: 95 µm **Measured with metallurgical microscope PME3**

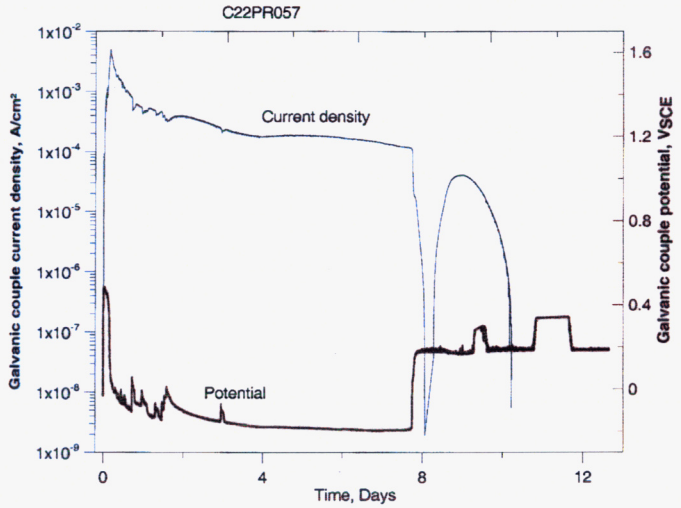
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:

No corrosion on sides of specimen. Corrosion is at outer edge of creviced area.

Xihua He 11/21/05

Crevice corrosion repassivated at 7.7 days.



Xihua He 11/21/05

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Proto 6104 **SN:** 139072
Cal: 10/24/05 **Due:** 4/24/06

Test ID: C22PR058

Initial weight: 12.39480g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.38502g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 131 , this notebook)
584.41 g NaCl lot # 051510 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06
Initial pH: 6.04 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.27 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:**
Measured with thermocouple/thermocouple meter #333 **Cal:** 7/26/05 **Due:** 1/26/06
Thermocouple meter **SN:** 51046103
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8131157
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 6/1/05 **Due:** 12/1/05
E_{corr} (C22 plate) = -1.2mv **E_{corr} (C22 cylinder) =** -74mv
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22PR1108Ia_Unich7, C22PR1108Ea. Unich8, C22PR1108Ib, C22PR1108Eb, C22PR1109I, C22PR1109E, C22PR1112I, C22PR1112E, C22PR1115E, C22PR1115I, C22PR1118I, C22PR1118E

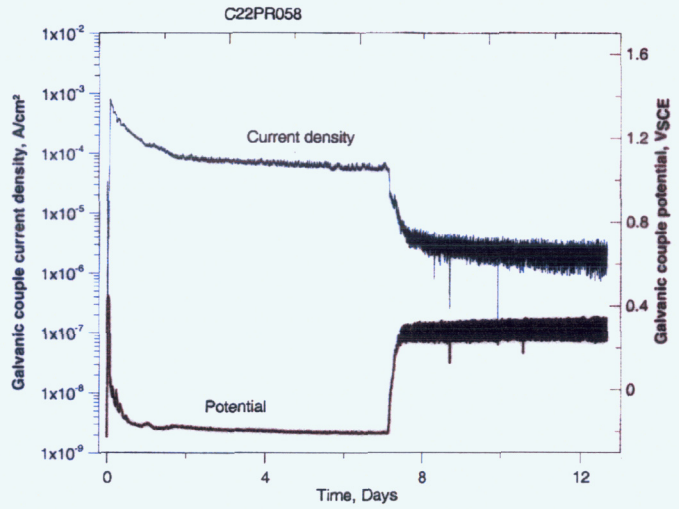
Test time: 1.09×10^6 seconds = 12.6 days Q = 6.25 coulombs
Creviced area: 9.95 mm^2 **Estimated crevice corroded area:** 9.95 mm^2

Maximum penetration depth: 189 μm X.H 11/21/05 **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
No Corrosion on Sides of Specimen - Gold tint Surface staining
Corrosion on Edge of PTFE Crevice Bolt

11/8/05

Crevice corrosion repassivated at 7.1 days.



Xihua He 11/21/05

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/02/05 **Due:** 5/02/06

Test ID: C22Ti701

Initial weight: 12.46473 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.45652 g **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 131 this notebook ~~744~~ 1/24/06)
584.60 g NaCl lot # 05276 + DI water to 2000 mL

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

Initial pH: 7.733 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.08 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 328
Measured with thermocouple/thermocouple meter #329 **Cal:** 1/16/06 **Due:** 7/14/06
specimen immersed in solution = 1.5 cm^2 **Thermocouple meter** Omega **SN:** 3130980
Cal: 1/13/06 **Due:** 7/13/06

Counter Electrode: ~~Titanium~~ titanium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2 X.H 1/23/06
Reference Electrode: Fisher 13-620-52 **SN:** 728237
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 12/21/05 **Due:** 6/21/06
E_{corr} (Ti Gr.7 plate) = ~ 227 mV SCE **E_{corr} (C22 cylinder) =** -345 mV SCE
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti70123Ia, C22Ti70123Ea, C22Ti70123Ib, C22Ti70123Eb, C22Ti70126I, ~~C22~~ C22Ti70129I, C22Ti70129E, C22Ti70201I, C22Ti70201E, C22Ti70204I, C22Ti70204E X.H 2/13/06

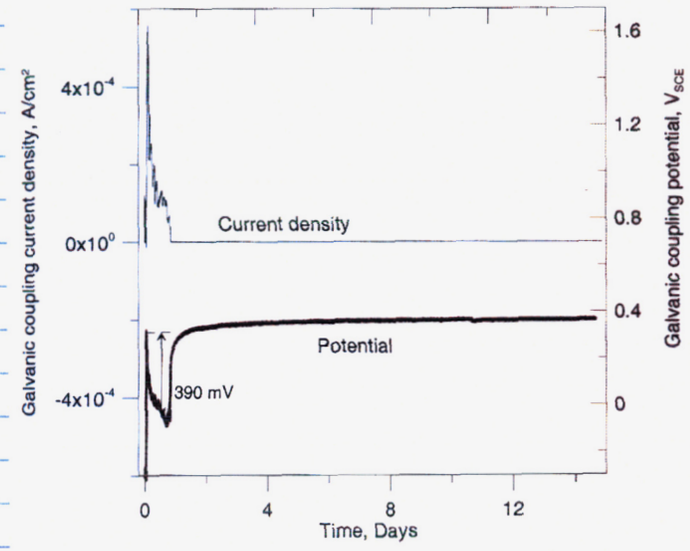
Test time: 1/23/06 ~ 2/7/06 (14.) days Q = 16.14 coulombs
Creviced area: 15.2 mm^2 **Estimated crevice corroded area:** 15.2 mm^2

Maximum penetration depth: 172 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06 X.H 2/21/06

Specimen examination:
The creviced area is corroded

1/23/06

Xihua He 6/9/06



Xihua He 2/13/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA 50 In-oz **SN:** 1001200319
Cal: 11/02/05 **Due:** 5/02/06

Test ID: C2271702

Initial weight: 12.44685g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.43394g **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 31, this notebook) 2/2/06
584.60g NaCl lot #05276+ DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/5/06 **Due:** 7/5/06
Model: Orion EA 940 **SN:**2330
Cal: 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065146

Initial pH: 7.753
Final pH: 5.384

Test Temperature: 95°C **Thermocouple** **SN:** 335
Measured with thermocouple/thermocouple meter 335 **Cal:** 10/18/05 **Due:** 4/18/06
Thermocouple meter Omega **SN:** 3130900
Cal: 1/13/06 **Due:** 7/13/06

Counter Electrode: Ti7 plate HH# CN 2775 Surface Area 60 cm²
Reference Electrode: Fisher 13-620-52 **SN:** 8131148
Potentiostat: Multi-channel SI1480
SN: 0023826 5 **Cal:** 12/21/05 **Due:** 6/21/06

E_{corr} (~~C22 plate~~ Ti7 plate) = -122 mV SCE **E_{corr} (C22 cylinder) =** -276 mV SCE
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C2271TI0206_Ch1Ch5, C2271TE0206_Ch1Ch6, 0209, 0212, 0215, 0218

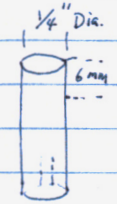
Test time: 2/6/06 - 2/20/06 1.21×10^6 seconds = 14.0 days
Creviced area: 30 mm² **Estimated crevice corroded area:** 20.3 mm²

Maximum penetration depth: 182 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06

Specimen examination:

Specimen is corroded in creviced area. Central region is slightly etched.

2/2/06

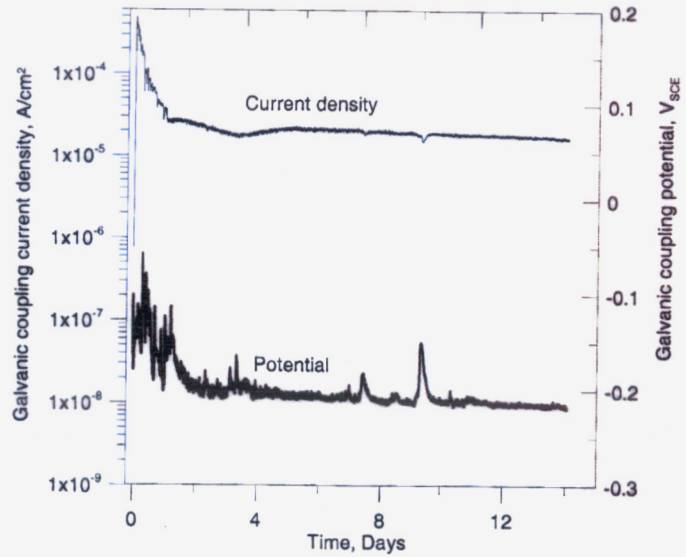


specimen immersed in solution

Surface area in solution

$$= 2\times3.14\times6\times\frac{6.35}{2} + 3.14\times\left(\frac{6.35}{2}\right)^2$$

$$= 1.5\ cm^2$$



Xiuhua He 3/10/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA 50 In-Oz **SN:** 1001200319
Cal: 11/08/05 **Due:** 5/02/06

Test ID: C22Ti703

Initial weight: 12.38913g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.36298g **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 2 X 10^-4 M $CuCl_2$ (Page 31, ~~this~~ notebook) ~~7/6/06~~ X.H 2/13/06
584.60 g NaCl lot #05216 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/5/06 **Due:** 7/5/06
Initial pH: 7.733 **Model:** Orion EA 940 **SN:**2330
Final pH: 3.398 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:**
Measured with thermocouple/thermocouple meter #329 **Cal:** 1/16/06 **Due:** 7/14/06
Thermocouple meter **SN:** 3130900
Cal: 6/13/06 **Due:** 7/13/06

Counter Electrode: Ti 7 plate HT# CW2775 Surface Area 60 cm²
Reference Electrode: Fisher 13-620-52 **SN:** 7282317
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 12/21/05 **Due:** 6/21/06
E_{corr} (~~C22 plate~~ Ti7 plate 2/8/06) = -0.1764 V$_{SCE}$ X.H 4/3/06 E_{corr} (C22 cylinder) = 0.1054 V$_{SCE}$ X.H 4/3/06
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti70208Ia, C22Ti70208Ea, C22Ti70208Ib, C22Ti70208Eb, C22Ti70211I, C22Ti70211E, C22Ti70214I_UniCh1, C22Ti70214E_UniCh2, 0217, 0220, 0223, 0226, 0301, 0304

Test time: 2/8/06 – 3/7/06 2.34×10^6 seconds = 27.1 days

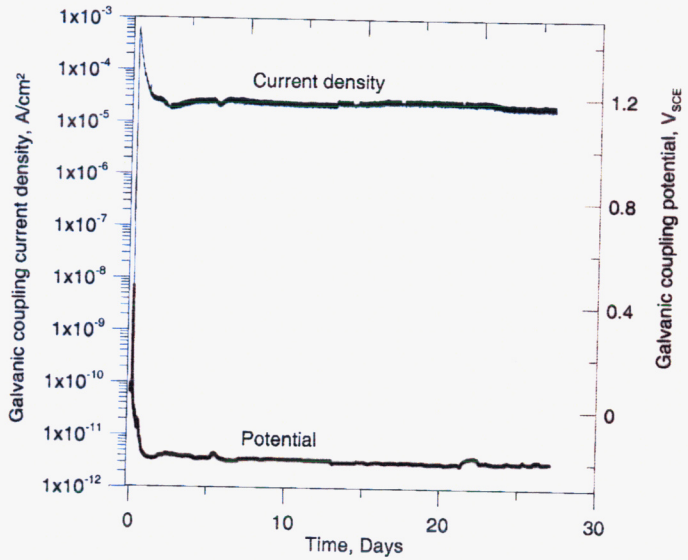
Creviced area: 20 mm² **Estimated crevice corroded area:** 20.5 mm²

Maximum penetration depth: 364 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06

Specimen examination:
Creviced area is corroded.

2/13/06

Xihua He 6/9/06



Xihua He 3/10/06

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

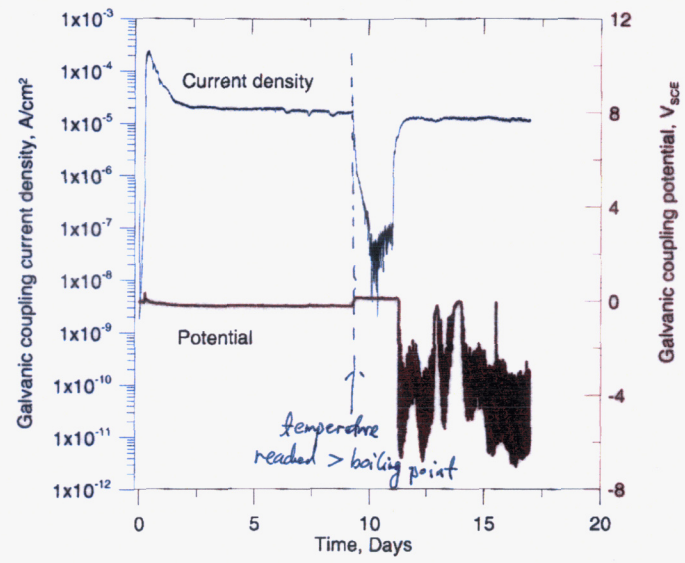
Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/2/05 **Due:** 5/2/06

Test ID: C22Ti704

Initial weight: 12.48032g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.46868g **Cal:** 11/14/05 **Due:** 5/12/06
Solution: 5 M NaCl + 2x10^-4 $CuCl_2$ (Page 131, this notebook)
584.60 g NaCl lot # 05276 + DI water to 2000 mL
Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/5/06 **Due:** 7/5/06
Initial pH: 6.583 **Model:** Orion EA 940 **SN:** 2330
Final pH: 5.601 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196
Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter 333 **Cal:** 1/12/06 **Due:** Jul/12/06
Thermocouple meter **SN:** 41523645
Cal: 6/7/05 **Due:** 6/7/06
Counter Electrode: Ti7 plate HT# CN2775 Surface Area = 60 cm²
Reference Electrode: Fisher 13-620-52 **SN:** 8131148
Potentiostat: Multi-channel SI1480
SN: 06238265 **Cal:** 12/21/05 **Due:** 6/21/06
E_{corr} ~~(C22 plate)~~ Ti7 Plate measurement = −193 mV$_{SCE}$ **E_{corr} (C22 cylinder) =** −175 mV$_{SCE}$
Measured with Keithley Electrometer **SN:** 0555368
Cal: 9/14/05 **Due:** 3/14/06
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22Ti7I0228-Un1Ch5, C22Ti7E0228-Un1Ch6, C22Ti7I0303-Un1Ch5, C22Ti7E0303-Un1Ch6, C22Ti7I0306-Un1Ch5, C22Ti7E0306-Un1Ch6, C22Ti7I0309-Un1Ch5, C22Ti7E0309-Un1Ch6, 0312, 0315
Test time: 2/28/06 ~ 3/20/06
Creviced area: 18.9 mm² **Estimated crevice corroded area:** 15.8 mm²
Maximum penetration depth: 108 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06
Specimen examination: Corrosion on Crevice Area And Corrosion Etching on Side of Specimen from Possible overheating Allowing solution To Seep Around specimen

Temperature reached above boiling point of solution at 9.2 days.
Lost Heat Controller over shot Temperature And Boiled solution Test shut down Early

3/27/06



Xihua He 6/3/06

Xihua He 6/9/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/02/05 **Due:** 5/02/06

Test ID: C22 Ti705

Initial weight: 12.49491g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.48685 **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 2×10^4 $CuCl_2$ (Page 131, this notebook)
584.60 g NaCl lot #05276 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/5/06 **Due:** 7/5/06
Model: Orion EA 940 **SN:** 2330
Initial pH: 6.583 **Cal:** 7/25/05 **Due:** 7/25/06
Final pH: 9.31 **pH Probe:** #13-620-296 **SN:** 4065156

Test Temperature: 95°C **Thermocouple** **SN:**
Measured with thermocouple/thermocouple meter #329 **Cal:** 1/16/06 **Due:** 7/14/06
Thermocouple meter **SN:** 3130900
Cal: 1/13/06 **Due:** 7/13/06

Counter Electrode: Ti 7 plate HT# CN2775 Surface Area 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 7282317
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 12/21/05 **Due:** 6/21/06

E_{corr} (~~C22 plate~~ Ti 7 plate 6/13/06) = −102 mV SCE **E_{corr} (C22 cylinder) =** −206 mV SCE
Measured with Keithley Electrometer **SN:** 467374
Cal: 1/12/06 **Due:** 1/12/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti70310Ia-UnlCh1, C22Ti70310Ea-UnlCh2, C22Ti70310Ib-UnlCh1, C22Ti70310Eb, C22Ti70313I, 0313E, 0316I, 0316E, 0319I, 0319E, 0322E, 0322I, 0325I, 0325E, 0328E, 0328I, 0331E, 0331I

Test time: 3/10/06 ~~4/3/06~~, 2.07×10^6 seconds = 24.0 days

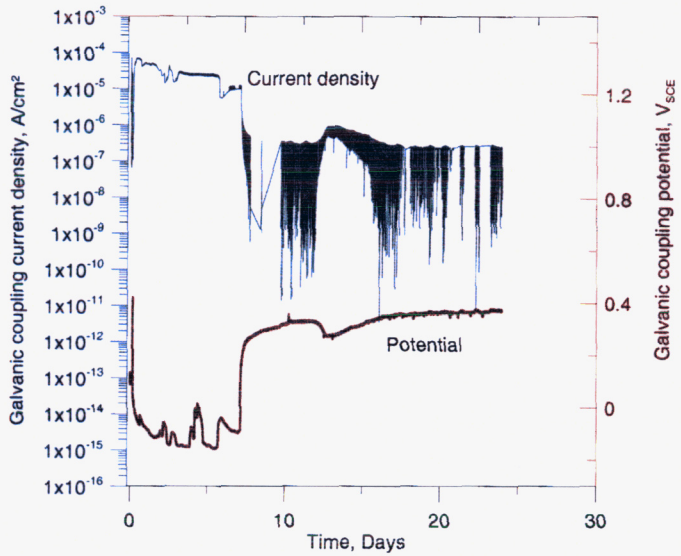
Creviced area: ~~189 mm²~~ X.M 4/3/06 **Estimated crevice corroded area:** ~~15.8 mm²~~ X.M 4/3/06

Maximum penetration depth: N/A **Measured with Olympus metallurgical microscope PME3**
Corrosion occurred at the side
Cal: 12/13/05 **Due:** 6/13/06

Specimen examination: Surface Staining on Tip Under PTFE Crevice bolt
No Corrosion - Corrosion on Side of Specimen solution Seeped In
Around O-Ring on Side of Specimen

3/13/06

Xihua He 4/3/06



Xihua He 4/3/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/2/05 **Due:** 5/2/06

Test ID: C22Ti706

Initial weight: 12.45376g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.41854g **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 24 10^{-4} $CuCl_2$ (Page 121 this notebook)
58482 g NaCl lot # 052761+ DI water to 2000 mL

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

Initial pH: 8.216 **Model:** Orion EA 940 **SN:** 2330
Final pH: 5.22 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 40651196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with
thermocouple/thermocouple meter 333 **Cal:** 1/12/06 **Due:** 7/12/06
Thermocouple meter **SN:** 41523645
Cal: 6/7/05 **Due:** 6/7/06

Counter Electrode:
Reference Electrode: Fisher 13-620-52 **SN:** 81311148
Potentiostat: Multi-channel S1480
SN: 00233265 **Cal:** 12/21/05 **Due:** 6/21/06

E_{corr} (~~C22 plate~~ Ti7 plate gao 3/21/06) = −191 mV_{SCE} E_{corr} (C22 cylinder) = −145 mV_{SCE}
Measured with Keithley Electrometer **SN:** 467374
Cal: 6/12/06 **Due:** 1/12/07

Cell set up; Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

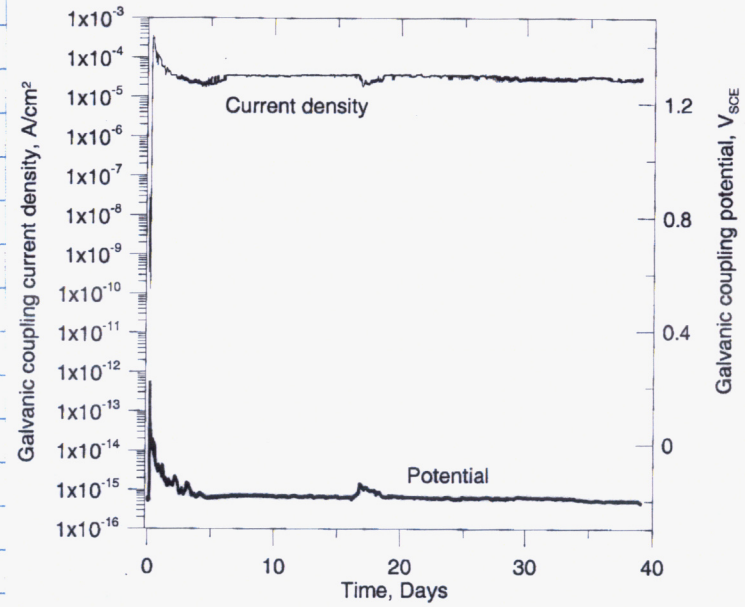
Data Files: C22Ti7I0322-Unlch5, C22Ti7E0322-Unlch6, C22Ti7I0325, C22Ti7E0325, C22Ti7I0328, C22Ti7E0328, 0331, 0403, 0406, 0409, 0412, 0415, 0418, 0421, 0424, 0427, 0501, 0504

Test time: 3/21/06 – 5/14/06 Test length: 3.37×10^6 seconds = 39.0 days
Creviced area: 28.26 mm^2 **Estimated crevice corroded area:** 28.26 mm^2

Maximum penetration depth: 327 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06

Specimen examination: Corrosion under PTFE Crevice bolt- No Corrosion on Sides of specimen. Milo Gold tint staining.

3/21/06



K. Thomas 6/19/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/02/05 **Due:** 5/02/06

Test ID: C22Ti707

Initial weight: 12.93332g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.43951g **Cal:** 11/14/05 **Due:** 5/12/06

Solution: 5 M NaCl + 2x10^-4 $CuCl_2$ (Page31, this notebook)
584.42 g NaCl lot #[illegible] + DI water to 2000 mL

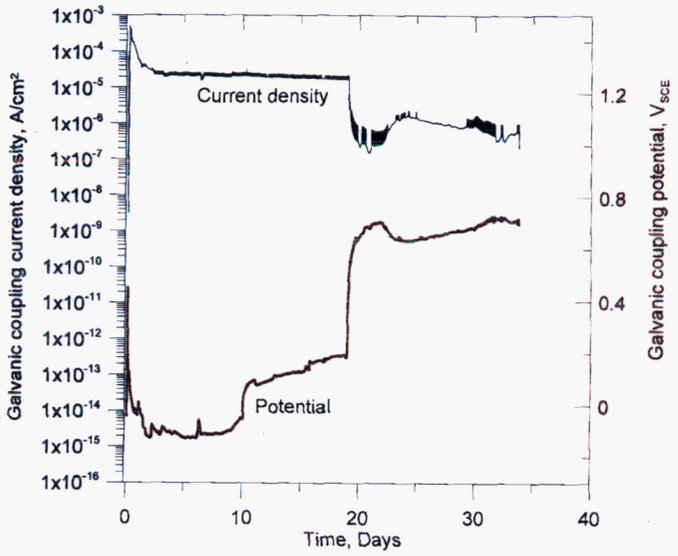
Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/5/06 **Due:** 7/5/06
Initial pH: 8.219 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.92 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065756

Test Temperature: 95°C **Thermocouple** **SN:**
Measured with thermocouple/thermocouple meter #329 **Cal:** 1/16/06 **Due:** 7/14/06
Thermocouple meter **SN:** 3130900
Cal: 1/12/06 **Due:** 7/12/06

Counter Electrode: Ti 7 plate MT# CN2775 Surface Area 60 cm²
Reference Electrode: Fisher 13-620-52 **SN:** 7282317
Potentiostat: Multi-channel S1480
SN: 00239265 **Cal:** 12/21/05 **Due:** 6/21/06
E_{corr} (Ti7 plate) = -38 mV **E_{corr} (C22 cylinder) =** -111 mV
Measured with Keithley Electrometer **SN:** 467374
Cal: 1/12/06 **Due:** 1/12/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22Ti0411Ia-UnCh1, C22Ti0411Ea-UnCh2, C22Ti0411Ib, C22Ti0411Eb, C22Ti0414Z, C22Ti0414E, 0417, 0420, 0421, 0423, 0426, 0429, 0502, 0505, 0508, 0511, 0514
Test time: 33.77 days = 2.918x10^6 seconds
Creviced area: ~~28.25 mm²~~ 19.6 mm² X.H 6/9/06 **Estimated crevice corroded area:** ~~28 mm²~~ 19.6 mm² X.H 6/9/06
Maximum penetration depth: 234 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/13/05 **Due:** 6/13/06
Specimen examination: Crevice or Surface Corrosion Under PTFE Crevice Screw/Bolt Some Surface Corrosion on one side of Specimen. Gold tint Surface staining

[illegible] 4/11/06



6/9/06
X. Silva

$CuCl_2$ solution prepared on 8/28/2006

$CuCl_2 \cdot 2H_2O$ X.H 8/28/06

~~20.078 g $CuSO_4 \cdot 5H_2O$ + D.I to 500 mls~~

Lot # ~~951540~~ 897713

X.H 8/28/06

pH = 2.44

Xiuhua He 8/28/2006

1/18/07

1/18/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/1/06 **Due:** 11/1/06

Test ID: C22Ti708

Initial weight: 12.3666 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.3402 g **Cal:** 5/9/06 **Due:** 11/9/06

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook 670)
292.27 g NaCl lot # 05276 + DI water to ~~2000 mL~~ 1000 mls

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

Initial pH: 6.68 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.30 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 0003
Measured with thermocouple/thermocouple meter **Cal:** 6/7/06 **Due:** 12/1/06
Thermocouple meter Omega **SN:** 313 0900
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 KH. 6/6/07 **SN:** 4250074
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 9/11/06 **Due:** 3/11/07
E_{corr} (Ti Gr.7 plate) = -81 mV vs SCE **E_{corr} (C22 cylinder) =** -115 mV vs SCE
Measured with Keithley Electrometer **SN:** 0704634
Cal: 7/6/06 **Due:** 7/6/07

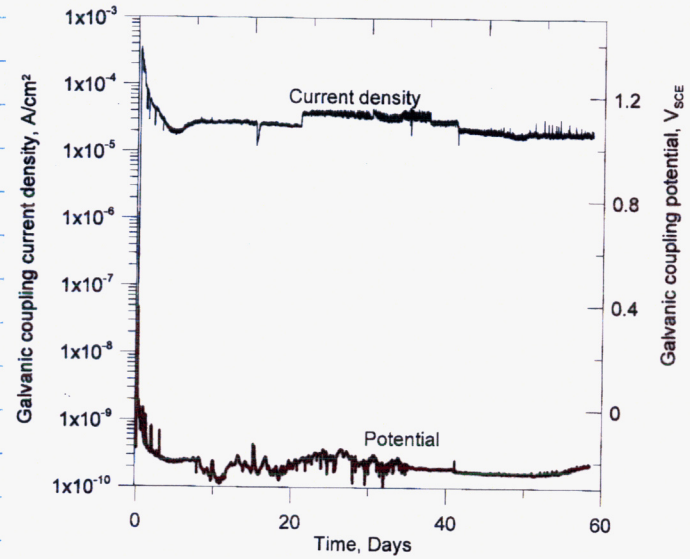
Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22Ti709,10Ia, C22Ti709,12Ea - Ua(Ch2, C22Ti709,12Ib, Eb, 0919I 0919E
0926I, 0926E, 1003I, 1003E, 1010I, 1010E, 1017I, 1017E, 1024I, 1024E, 1031I, 1031E, 1107I, 1107E

Test time: started 9/10/06 ended 11/17/2006 5.05×10^6 seconds = 58.4 days
Creviced area: not available **Estimated crevice corroded area:** $\pi(\frac{5.85}{2})^2\ mm^2 = 26.7\ mm^2$

Maximum penetration depth: 445 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 6/15/06 **Due:** 12/15/06

Specimen examination:
The crevice area is severely corroded. No corrosion at the side.
Solution: some of the solution evaporated. salt deposited out.

9/11/06



11/16/06

11/16/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/1/06 **Due:** 11/1/06

Test ID: C22Ti709

Initial weight: 11.76389g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 11.75458g **Cal:** 5/9/06 **Due:** 11/9/06

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook 670)
292.27 g NaCl lot # 05276 + DI water to ~~2000~~ mL 1000mL 09/20/06

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

Initial pH: 6.68 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.75 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 0003
Measured with
thermocouple/thermocouple meter **Cal:** 6/2/06 **Due:** 12/01/06
Thermocouple meter Omega **SN:** 313090
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 66.0 cm^2 X.H 11/8/06
Reference Electrode: Fisher 13-620-52 **SN:** R028038
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 9/11/06 **Due:** 7/11/07

E_{corr} **(Ti Gr.7 plate) =** ~ 6 mV$_{SCE}$ E_{corr} **(C22 cylinder) =** ~ 3 mV$_{SCE}$
Measured with Keithley Electrometer **SN:** 0704434
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22Ti70922Ia, C22Ti70922Ea, C22Ti70922Ib, C22Ti70922Eb, C22Ti70926I, E, C22Ti710031, E, C22Ti71010I, E

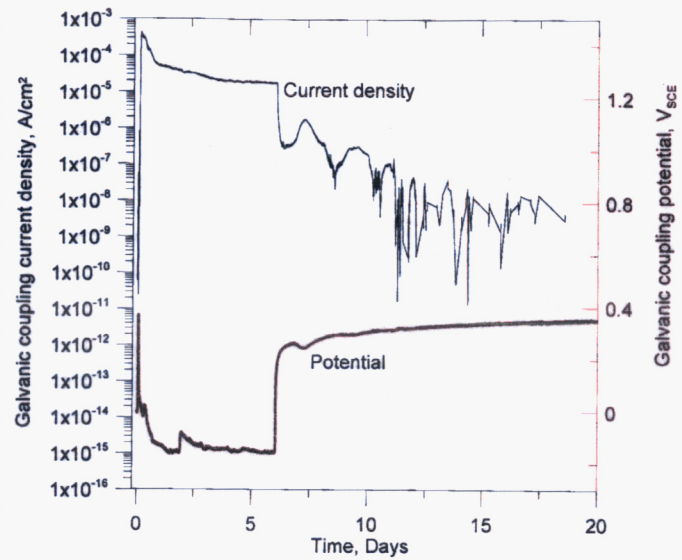
Test time: Start: 9/20/06 Total test time: 1.72 X 10^6 seconds = 20 days

~~**Grevieed area:**~~ ~~**Estimated crevice corroded area:**~~ X.H 11/8/06

Maximum penetration depth: 132 μm **Measured with Olympus metallurgical microscope PME3**
(from the plates) **Cal:** 6/15/06 **Due:** 12/15/06

Specimen examination:
The crevice area and the side were corroded.

9/22/06



Xihua He 10/20/06

X.H 11/8/06

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/1/06 **Due:** 11/1/06

Test ID: C22Ti710

Initial weight: 12.19511 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.19509 g **Cal:** 5/9/06 **Due:** 11/9/06

Solution: 5 M NaCl + 2 X 10^{-2} M $CuCl_2$ (Page 160 ,notebook 670)
292.25g NaCl lot # 052716 + DI water to ~~2000~~ mL 1000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/5/06 **Due:** 1/5/07
Model: Orion EA 940 **SN:**2330
Cal: 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Initial pH: 5.96
Final pH: 4.59

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter **Cal:** 7/17/06 **Due:** 1/17/07
Thermocouple meter Omega **SN:** 3130900
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2 xH 6/6/07
Reference Electrode: Fisher 13-620-52 **SN:** 4028038
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 9/11/06 **Due:** 3/11/07

E_{corr} (Ti Gr.7 plate) = −167 mV SCE xH 6/6/07 **E_{corr} (C22 cylinder) =** −128 mV SCE xH 6/6/07
Measured with Keithley Electrometer **SN:** 0704534
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files:

C22Ti710 17Eb-Ual Ch4
C22Ti710 17Ib-Ual Ch3

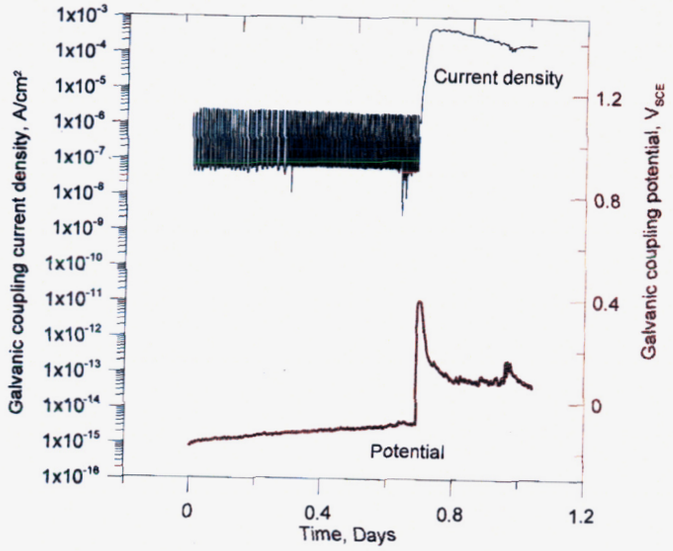
Test time: 90200 seconds
Creviced area: Not measured See Below **Estimated crevice corroded area:** not measured see below xH 6/6/07

Maximum penetration depth: Not measured **Measured with Olympus metallurgical microscope PME3**
Cal: 12/21/06 **Due:** 6/21/07

Specimen examination:

Corrosion Developed on the Sides of Specimen
No Corrosion Under PTFE Crevice Bolt

10/12/06



Xihuaite 10/20/06

xH 6/6/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/1/06 **Due:** 11/1/06

Test ID: C22Ti711

Initial weight: 12.39145 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.33885 g **Cal:** 5/9/06 **Due:** 11/9/06

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook 670) 1000 10/23/06
292.25 g NaCl lot # 05276 + DI water to ~~2000~~ mL 1000 mL

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

Initial pH: 5.96 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.24 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter **Cal:** 7/17/06 **Due:** 1/17/07
Thermocouple meter Omega **SN:** 3130900
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 4028025
Potentiostat: Multi-channel SI1480 Y.M 6/6/07
SN: 00238265 **Cal:** 9/11/06 **Due:** 3/11/07

E_{corr} (Ti Gr.7 plate) = -0.183 V_{SCE} **E_{corr} (C22 cylinder) =** -0.437 V_{SCE}

Measured with Keithley Electrometer **SN:** 0704934
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti711024Ia_Unich3, C22Ti711024EA_Unich4, 1024E, 1024I, 1031E, 1031I, 1107I, 1107E, 1114I, 1114E, 1121I, 1121E, 1128I, 1128E, 1205I, 1205E, 1212, 1219, 1226

Test time: Starting Test: 10/23/06 Test Ended 1/2/2007 70 days

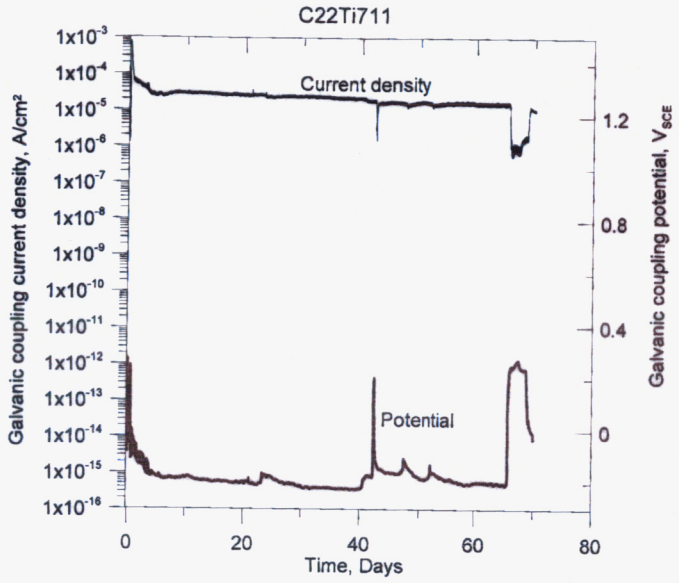
Creviced area: 24.7 mm^2 **Estimated crevice corroded area:** 100% corroded

Maximum penetration depth: 379 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/21/06 **Due:** 6/21/07

Specimen examination:

Corrosion Developed Under PTFE Crevice Bolt And on Sides of the Specimen Also Specimen Has Staining on All Surface Areas that were Exposed To Solution: Ti7 CE Are OK No Corrosion And will Be Repolished for Next Test.

10/23/06



Xichuan Ha 1/10/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/7/06 **Due:** 5/7/07

Test ID: C22Ti712

Initial weight: 12.31393g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.26630g **Cal:** 11/8/06 **Due:** 5/8/07

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook ~~570~~ 670)
584.40 g NaCl lot # 054171 + DI water to 2000 mL

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

Initial pH: 7.33 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.27 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with thermocouple/thermocouple meter **Cal:** 7/17/06 **Due:** 1/17/07
Thermocouple meter Omega **SN:** 3130900
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 9250074
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 5/11/06 **Due:** 3/11/07

E_{corr} (Ti Gr.7 plate) = -223 mV Vs SCE **E_{corr} (C22 cylinder) =** -222 mV vs SCE

Measured with Keithley Electrometer **SN:** 0704934
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti71117Ia-Ua1Ch1, C22Ti71117Ea-Ua1Ch2, Ib, Eb, 1124, 1201, 1208, 1215, 1222, 1229, 0105, 0112, 0118, 0126Ia, Ea, 0202, 0209, 0216, 0223Ia, Ea, 0302, 0309, 0316Ia, Ea, 0323, 0330

Test time: 11/16/06–4/2/07 Total time: 135.9 days

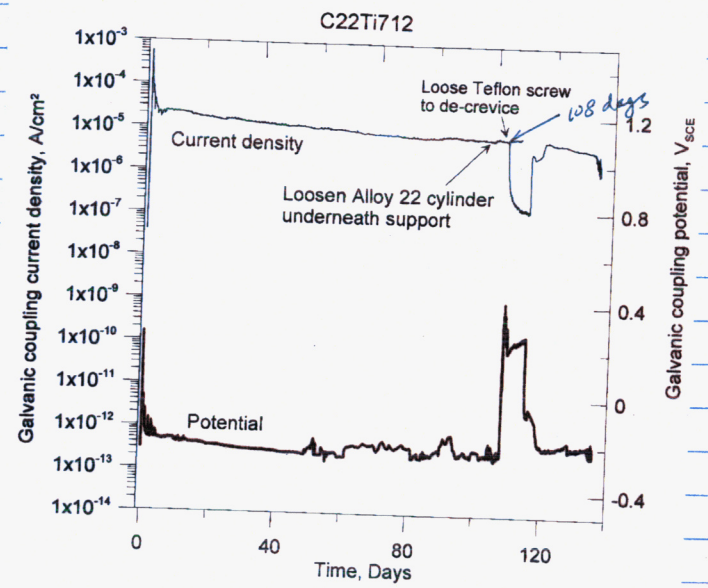
~~**Creviced area:**~~ ~~**Estimated crevice corroded area:**~~ X.M 4/23/07

Maximum penetration depth: 460 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/21/06 **Due:** 6/21/07

Specimen examination:
Under PTFE Corrosion Appears to be Deeper on Tip of Specimen Surface Etching Down the Side of the Cylinder Specimen Also Staining. Ti7 plates Dull but staining on All Surfaces No Sign of Corrosion

11/17/06

On 3/6/07 remove Alloy 22 cylinder underneath support (file C22Ti702231a at C22Ti70223Ea 1259 points)
on 3/5/07 loose Teflon screw to relieve crevice between Alloy 22 cylinder and Teflon screw (file C22Ti703021, C22Ti70302E 855 points)



X.Huang 4/23/07

Information for the corroded specimens is on p.180 & 181, this notebook.

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/7/06 **Due:** 5/7/07

Test ID: C22Ti713

Initial weight: 12.45394 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.44349 g **Cal:** 11/8/06 **Due:** 5/8/07

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook 520 670)
584.40 g NaCl lot # 054171 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/2/07 **Due:** 7/2/07

Initial pH: 7.19 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.34 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 331
Measured with thermocouple/thermocouple meter **Cal:** 11/15/06 **Due:** 5/15/07
Thermocouple meter **SN:** 3130900
Cal: 7/6/06 **Due:** 1/6/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2
XH 6/6/07
Reference Electrode: Fisher 13-620-52 **SN:** 4028038
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 9/4/06 **Due:** 3/4/07

E_{corr} (Ti Gr.7 plate) = -317 mV vs SCE **E_{corr} (C22 cylinder) =** -256 mV vs SCE

Measured with Keithley Electrometer **SN:** 0704924
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti70108Ia-Un1Ch3, C22Ti70108Ea-Un1Ch4, C22Ti70115I-Un1Ch3, C22Ti70115E-Un1Ch4, 0118Ia, 0118Ea, 0122Ia, 0122Ea, 0129Ia, 0129Ea, 0205I, 0205E

Test time: ~~Started~~ 1/08/07 end on 2/6/07 Total time: 2.5096 x10^6 seconds = 29.0 days

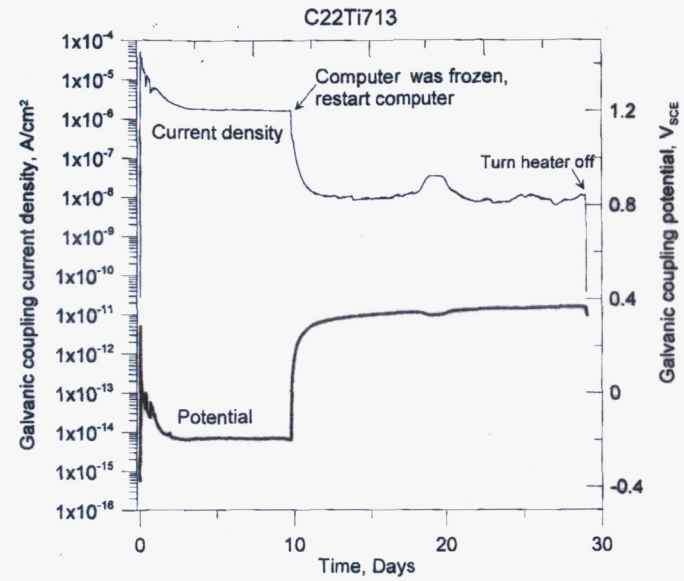
~~Creviced area:~~ XH 3/26/07 **Estimated crevice corroded area:** 21.5 mm^2

Maximum penetration depth: 164 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 12/21/06 **Due:** 6/21/07

Specimen examination:

The creviced area is corroded widely.

1/8/07



Xihua He
3/2/07

XH 3/26/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/7/06 **Due:** 5/7/07

Test ID: C22Ti714

Initial weight: 12.46843g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.45943g **Cal:** 11/8/06 **Due:** 5/8/07

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 160 ,notebook 670)
584.40 g NaCl lot # 034101 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/2/07 **Due:** 7/2/07
Initial pH: 7.21 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.37 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 371
Measured with thermocouple/thermocouple meter **Cal:** 11/07/06 **Due:** 5/15/07
Thermocouple meter **SN:** 3130900
Cal: 2/2/07 **Due:** 8/2/07

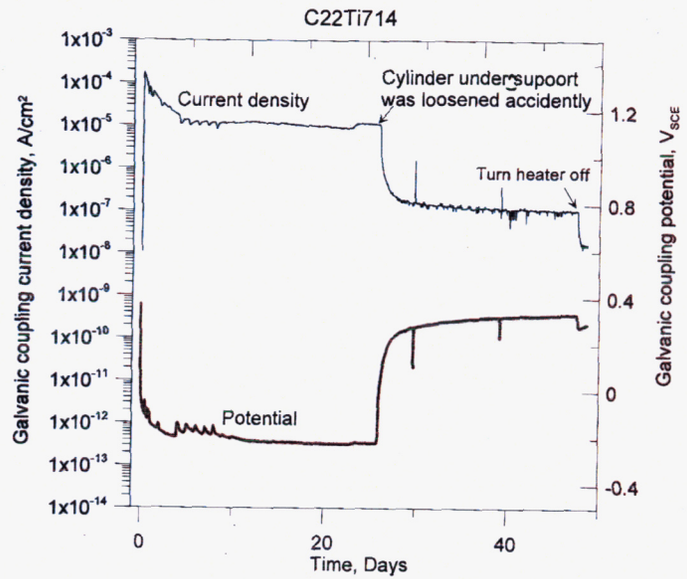
Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 6.0 cm^2 X.H. 6/8/07
Reference Electrode: Fisher 13-620-52 **SN:** 4028038
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 9/11/06 **Due:** 3/11/07
E_{corr} (Ti Gr.7 plate) = -166 mV Vs SCE **E_{corr} (C22 cylinder) =** -146 mV Vs SCE
Measured with Keithley Electrometer **SN:** 0704934
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential
Data Files: C22Ti70209Ia - dalCh3, C22Ti70209EA - UnlCh4, C22Ti70209Ib, Eb, 0212, 0219, 0226, 0305, 0312, 0319, 0326

Test time: start: 2/7/07 Ended: 3/30/07 Total days: 48.7 days
~~**Creviced area:**~~ ~~**Estimated crevice corroded area:**~~ X.H 4/23/07
Maximum penetration depth: ~~140~~ 125 µm **Measured with Olympus metallurgical microscope PME3**
X.H 4/23/07 **Cal:** 12/21/06 **Due:** 6/21/07

Specimen examination:
Uneven PTFE Surface Corrosion - Very mild Etching on Outside of Specimen
Surface staining on Specimen - Ti.7 Material Dull tint staining - No Corrosion

[illegible] 3/7/07



X. Huerta 4/3/07

X.H 7/12/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266
Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319 **Cal:** 11/7/06 **Due:** 5/7/07

Test ID: C22Ti715

Initial weight: 12.4800g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.4800g **Cal:** 11/8/06 **Due:** 5/8/07

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 177 ,notebook 670)
584.40 g NaCl lot # 034171 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 1/2/07 **Due:** 7/2/07

Initial pH: 7.19 **Model:** Orion EA 940 **SN:** 2330
Final pH: 4.46 **Cal:** 7/6/06 **Due:** 7/6/07

pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 331
Measured with thermocouple/thermocouple meter **Cal:** 11/15/06 **Due:** 5/15/07

Thermocouple meter Omega **SN:** 3130900
Cal: 2/7/07 **Due:** 8/7/07

Counter Electrode: Titanium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 9250074
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 4/2/07 **Due:** 10/2/07

E_{corr} **(Ti Gr.7 plate) =** -100 mV vs SCE E_{corr} **(C22 cylinder) =** -224 mV vs SCE

Measured with Keithley Electrometer **SN:** 0704924
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: ~~C22Ti0419Ea#3~~ - Unich3, C22Ti0419Ea#4 - Unich4, 0419I, 0419E, ~~0426Ia, 0426Eb, 0503I, 0503E, 0510I, 0510E, 0517I, 0517E~~ XH 6/6/07
0419Ia, 0419Ea-Unich2, 0419I-Unich1, 0419E-Unich2, 0426Ia, 0426Ea, 0503, 0510, 0517

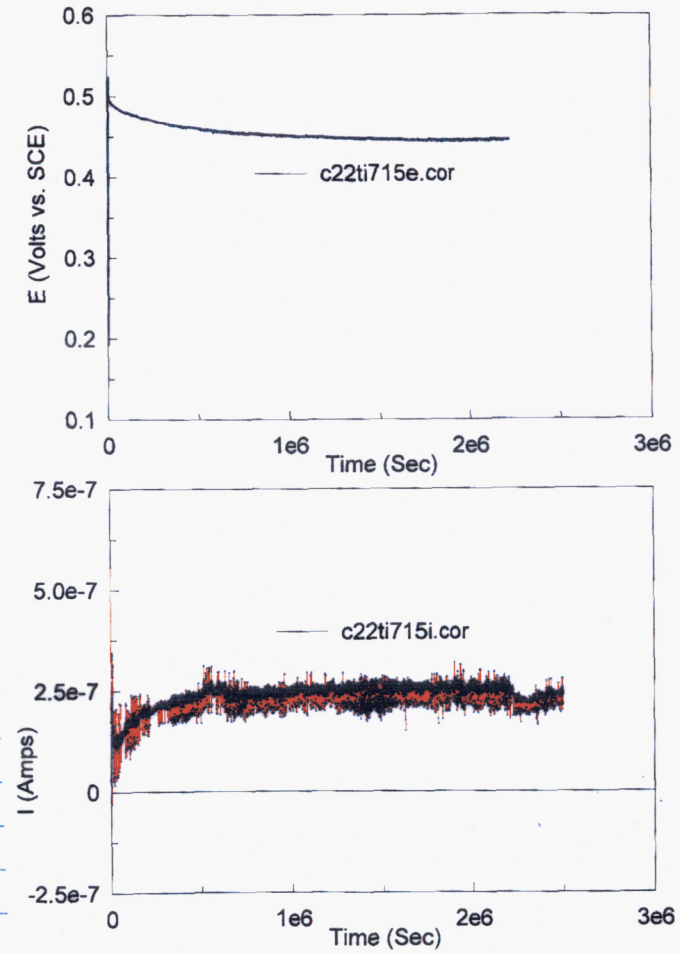
Test time: Test Started 4/4/07 Test Ended 5/10/07

~~**Creviced area:**~~ ~~**Estimated crevice corroded area:**~~

~~**Maximum penetration depth:**~~ ~~**Measured with Olympus metallurgical microscope PME3**~~
X.H 6/6/07 ~~**Cal:**~~ ~~**Due:**~~

Specimen examination:
No Corrosion on Specimen Very mild surface staining will Repolish And Re Use specimen for further Testing

4/4/07



* New $CuCl_2 \cdot 2H_2O$ Solution Made 4/18/07
$CuCl_2 \cdot 2H_2O$ Solution
20.06g $CuCl_2 \cdot 2H_2O$ Lot# 897713
+ DI to 100 mls pH = 2.49 pH meter Orion 2330 SN# cal: 7/6/06 due: 7/6/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 11/7/06 **Due:** 5/7/07

Test ID: C22Ti 7/6

Initial weight: 12.36755g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.36735g **Cal:** 11/8/06 **Due:** 5/8/07

Solution: 5 M NaCl + 2 X 10^{-4} M $CuCl_2$ (Page 177 ,notebook 670)
584.40 g NaCl lot # 054171 + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/2/07 **Due:** 7/2/07

Initial pH: 7.19 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.77 **Cal:** 7/6/06 **Due:** 7/6/07
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 334
Measured with thermocouple/thermocouple meter **Cal:** 4/2/07 **Due:** 10/2/07
Thermocouple meter Omega **SN:** 3130900
Cal: 2/7/07 **Due:** 8/7/07

Counter Electrode: Titanium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 4028038
Potentiostat: Multi-channel SI1480
SN: 00238265 **Cal:** 4/2/07 **Due:** 10/2/07

E_{corr} **(Ti Gr.7 plate) =** -110 mV vs SCE E_{corr} **(C22 cylinder) =** -227 mV vs SCE

Measured with Keithley Electrometer **SN:** 0704934
Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti0419Ia # 3-UnlCh3, Ga#4-UnlCh4, 0419I, 0419E, 0426Ib, 0426Eb, 0503I, 0503E, 0510I, 0510E, 0517I, 0517E.

Test time: Test started 4/4/07 Test Ended 5/11/07

~~**Creviced area:**~~ ~~**Estimated crevice corroded area:**~~

~~**Maximum penetration depth:**~~ ~~**Measured with Olympus metallurgical microscope PME3**~~
~~**Cal:**~~ ~~**Due:**~~

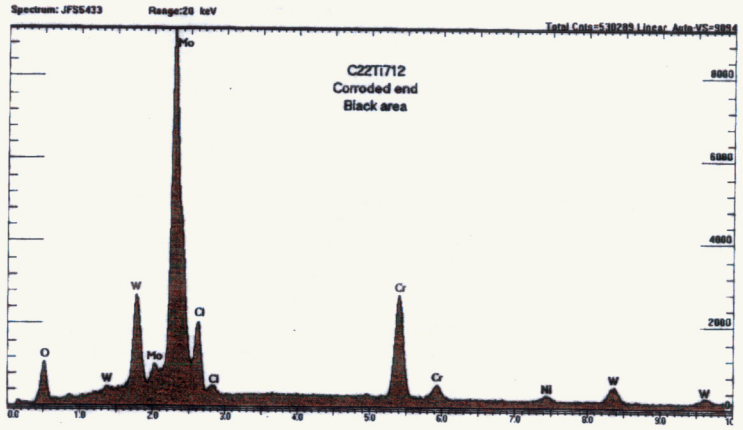
Corrosion was not initiated. xH 6/6/07

Specimen examination:

No Corrosion on Specimen Very mild surface Staining will Repolish for Further Testing

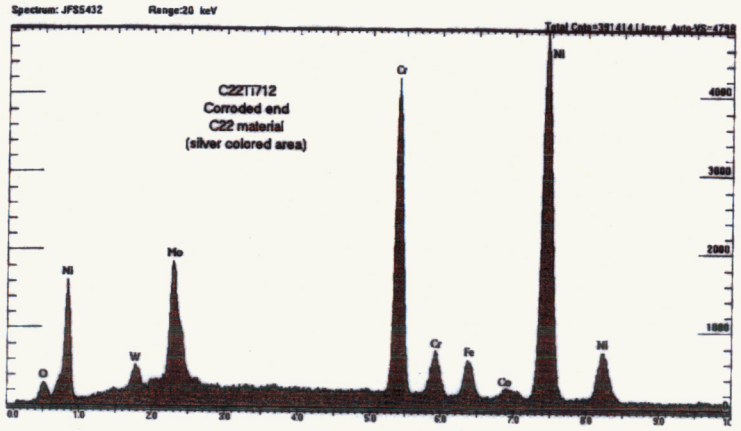
4/4/07

xH 6/6/07



Element	Line	Weight%	K-Ratio	Cnts/s	Atomic%
Cl	Ka	6.60	0.0408	92.30	15.21
Cr	Ka	14.91	0.1384	169.85	23.43
Ni	Ka	1.06	0.0112	7.83	1.48
Mo	La	62.46	0.5231	466.84	53.22
W	Ma	14.97	0.1243	112.30	6.66

Xihua He 4/20/07



Element	Line	Weight%	K-Ratio	Cnts/s	Atomic%
Cr	Ka	23.16	0.2335	267.67	27.25
Fe	Ka	3.75	0.0388	34.30	4.11
Co	Ka	1.14	0.0109	8.35	1.19
Ni	Ka	55.41	0.5470	356.22	57.74
Mo	La	13.83	0.0997	83.16	8.82
W	Ma	2.71	0.0149	12.54	0.90

Xihua He 4/20/07

XH 9/24/07

C-22 Localized Corrosion Propagation Rate Measurement

Alloy/Specimen: C22 with Heat # 2277-3-3266

Specimen Preparation: Specimen machined to dimensions 1.917"*0.250"specified in CNWRA Drawing 20.01402.571.019. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone and rinsed in DI water. PTFE crevice forming bolt pressed against specimen using torque screwdriver to 50 in-oz.

Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 4/27/07 **Due:** 10/27/07

Test ID: C22Ti717

Initial weight: 12.44549 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 12.44056 g **Cal:** 5/11/07 **Due:** 11/11/07

Solution: 5 M NaCl + 2 X 10^{-3} M $CuCl_2$ (Page 177 ,notebook 670)

584.40 g NaCl lot # + DI water to 2000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/2/07 **Due:** 7/2/07

Initial pH: 7.21 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.97 **Cal:** **Due:**
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Thermocouple** **SN:** 334

Measured with thermocouple/thermocouple meter **Cal:** 4/2/07 **Due:** 10/2/07

Thermocouple meter Omega **SN:** 3130900
Cal: 2/7/07 **Due:** 8/7/07

Counter Electrode: Titanu=ium Grade-7 plate (Heat # CN2775) with surface area of 60 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 3328225

Potentiostat: Multi-channel SI1480

SN: 00238265 **Cal:** 4/2/07 **Due:** 10/2/07

E_{corr} (Ti Gr.7 plate) = 204 mV_{SCE} **E_{corr} (C22 cylinder) =** -73 mV_{SCE}

Measured with Keithley Electrometer **SN:** 0704934

Cal: 7/6/06 **Due:** 7/6/07

Cell set up: Two channels for curent and potential measurement, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22Ti70522Ia-Un1Ch1, C22Ti70522Ea-Un1Ch2, C22Ti70522I-Un1Ch1, C22Ti70529E-Un1Ch2, 0529I, 0605E, 0605I, 0612E, 0612I, 0619E, 0619I, 0626E, 0626I, 0703E

Test time: Test started 5/21/07 ended 7/2/07 Total test time 3.54 x10^6 seconds = 41.1 days

~~**Creviced area:**~~ ~~**Estimated crevice corroded area:**~~

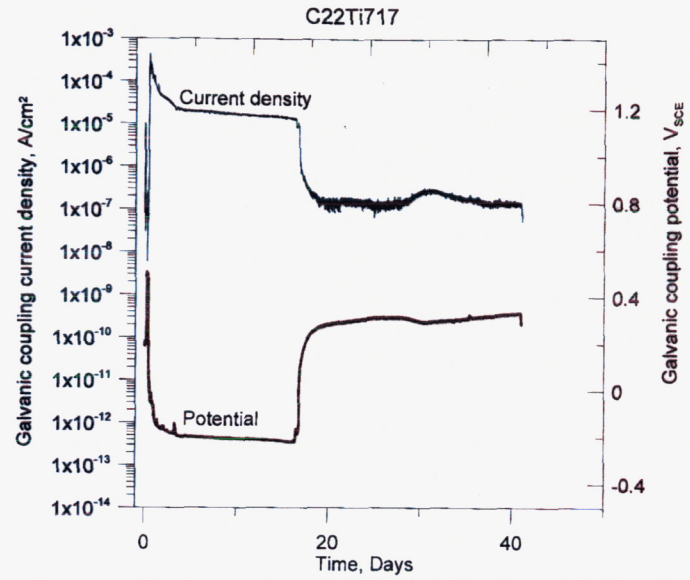
XH 7/12/07

Maximum penetration depth: 240 um **Measured with Olympus metallurgical microscope PME3**

XH 7/19/07 **Cal:** 7/17/07 **Due:** 7/16/08

Specimen examination: The crevice area is corroded. no corrosion at other place

5/21/07



Xihua He 7/2/07

XH 9/24/07

9/24/07

9/04/05

9/24/07

9/24/07

9/24/07

9/24/87

9/24/07

9/24/00

9/24/07

9/24/07

9/24/07

9/20/07

9/24/05

Initial Scientific Notebook Entry for Alloy 22 Localized Corrosion Propagation Rate Measurements

revised 5/26/05
X.H

Title: Alloy 22 Localized Corrosion Propagation Rate Measurement

Tests Performed by: Xihua He, Div. 20; Brian Derby, Div. 18

Objectives: Determine the localized corrosion propagation rate of Alloy-22 as functions of time, temperature, solution composition, and cathode material

Proposed approach or procedure for achieving the objectives: Compress Teflon to Alloy 22 specimen to form an artificial crevice, then galvanically couple Alloy 22 specimen to Pt or a large Alloy 22 plate to initiate crevice corrosion. Localized corrosion propagation depths after various test durations are used to calculate propagation rate

Equipment: Electrochemical test cell with single crevice (Pages 6&7), Solartron 1287 and 1480 multi-channel potentiostats, thermocouple/thermocouple meter, temperature controller, microscope, pH mater, balance, torque screwdriver
Calibration and due dates are provided in data sheet for each test.

Materials: Alloy 22. Material heats to be added prior to testing

Specimen Specifications: Cylindrical specimens 0.250"×1.915", CNWRA drawing number 20.01402.571.019

Measurement Parameters: Temperature and time of exposure, Potential and Current of specimen during test, penetration depth per ASTM standard G46. Standard Guide for Examination and Evaluation of Pitting Corrosion (microscopic method 1 division = 1 μm)

Required Level of Accuracy: Temperature ±2°C, Time of exposure ±1 minute, Potentials ±1 mV, Current ±0.01 microamp.

Uncertainty and Sources of Error: Current density calculated as current divided by creviced specimen area. Actual current density of corroding areas is not determined. Current density measurement error can occur because the actively corroding area changes with time and is not the same as the creviced area of the test specimen.

GEOSCIENCES AND ENGINEERING DIVISION

SCIENTIFIC NOTEBOOK REVIEW CHECKLIST RECORD

Scientific Notebook No. 670 Project Numbers: 20.06002.01.222

Accomplished

KA	1. Initial entries per QAP-001
KA	2. Dating of entries
KA	3. Corrections (crossed out, one line through w/initials/date)
KA	4. No White out used
KA	5. Page number visible on copy or original notebook
KA	6. In process entries per QAP-001
KA	7. Figure information present
KA	8. Text readable
NA	9. Copyrighted material is identified
KA	10. Permanent ink or type only
KA	11. Signing of entries (not required on each page)
KA	12. Electronic media in the scientific notebook properly labeled
NA	13. NRC Supplementary Scientific Notebook Questions are addressed.
✓	14. The independent, two person verification required by AP-019, Section 5.2.1.2(b) is complete

Any discrepancies must be resolved before notebook closeout.

==========

I have reviewed this scientific notebook and find it in agreement with QAP-001.

K Allen 10-2-07

Manager's Signature Date

Attach this completed form to the last page of the notebook.

Form QAP-01 (03/2007)