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# 2201462.571.019. 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. X.H 11/3/05

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

Test ID: C22PR039

Initial weight: 11.22476 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 11.21402 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 5.14 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~ 4065196P

Test Temperature: 95°C **Thermocouple** **SN:** 334 X.H 6/7/05
Measured with **Cal:** 4/6/05 **Due:** 10/6/05
thermocouple/thermocouple meter **Thermocouple meter** **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 9252105

Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 12/3/04 **Due:** 6/3/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR05231a, C22PR0523Ea, C22PR05232b, C22PR0523Eb, C22PR0526I, C22PR0526E, C22PR0529I, C22PR0529E

Test dates: 5/23/05 ~ 6/1/05

Test time: 7.65×10^5 seconds = 8.85 days **Charge:** 32.8 coulombs

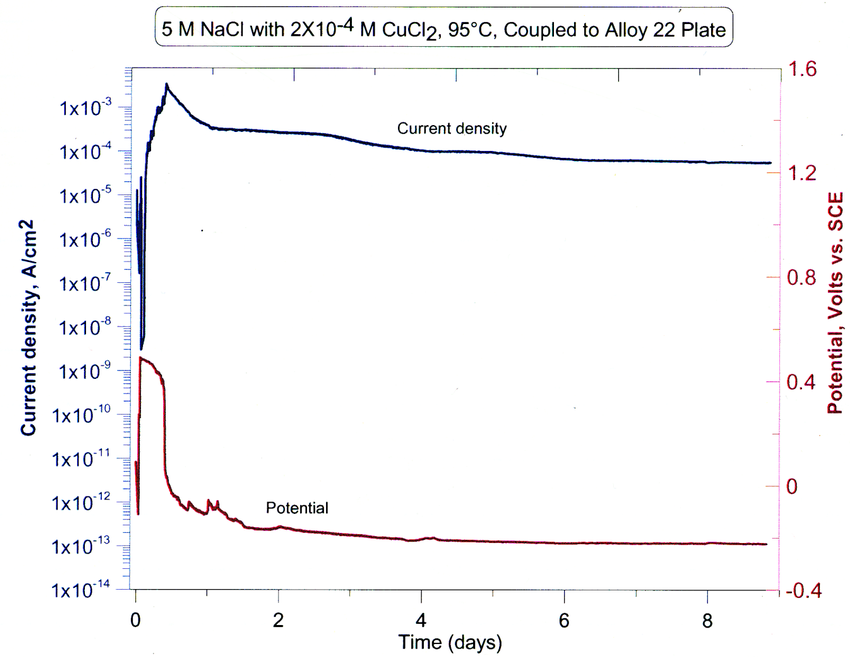
Creviced area: 20.4 mm^2

Estimated crevice corroded area: 20.4 mm^2

Maximum penetration depth: 125 μm **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
The entire creviced area is corroded. Deeper penetration is around the edge.

Xihua He 6/1/05



Xihua He 6/1/05

Xihua He 6/1/06

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.* 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: C22PR040

Initial weight: 10.80443g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 10.80005g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4}M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 3.09 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~ 4065196p

Test Temperature: 95°C **Measured with Thermometer** **SN:** H98479 x.4
Cal: 5/6/05 **Due:** 5/5/06 6/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 8238334

Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0525Ia, C22PR0525Ea, C22PR0525Ib, C22PR0525Eb

Test dates: 5/25/05 ~ 5/27/05

Test time: 1.44×10^5 seconds = 1.67 days Total charge = 16.7 coulombs

Creviced area: 11.8 mm^2

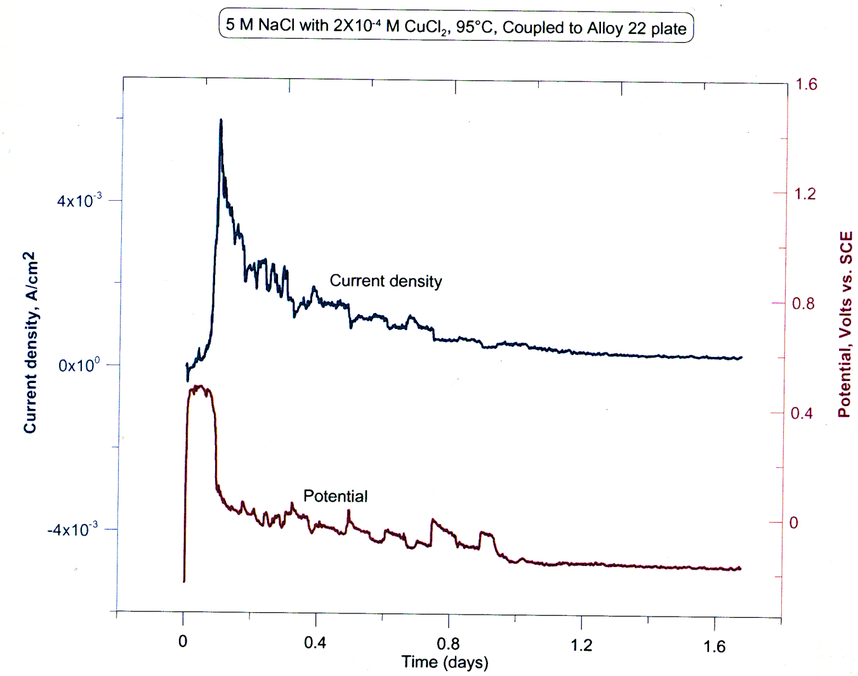
Estimated crevice corroded area: 6.46 mm^2

Maximum penetration depth: 105 μm **Measured with Olympus Metallurgical Microscope PME3** **SN:** PME3

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

Specimen examination:
The corrosion is around the edge of the creviced area. Central region is not corroded. Outside of the creviced area is etched.

Xihua He 5/27/05



Xihua He 5/27/05

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.*
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: C22PR04 I

Initial weight: 10.22873 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 10.22478 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 3.44 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~
Test Temperature: 95°C **Measured with Thermometer** **SN:** H98-179 4065196 P
Cal: 5/6/05 **Due:** 5/5/06 X.H 6/7/05

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8238334
Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05
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: C22PR0527Ia, C22PR0527Ea, C22PR0527Ib, C22PR0527Eb, C22PR0530I, C22PR0530E

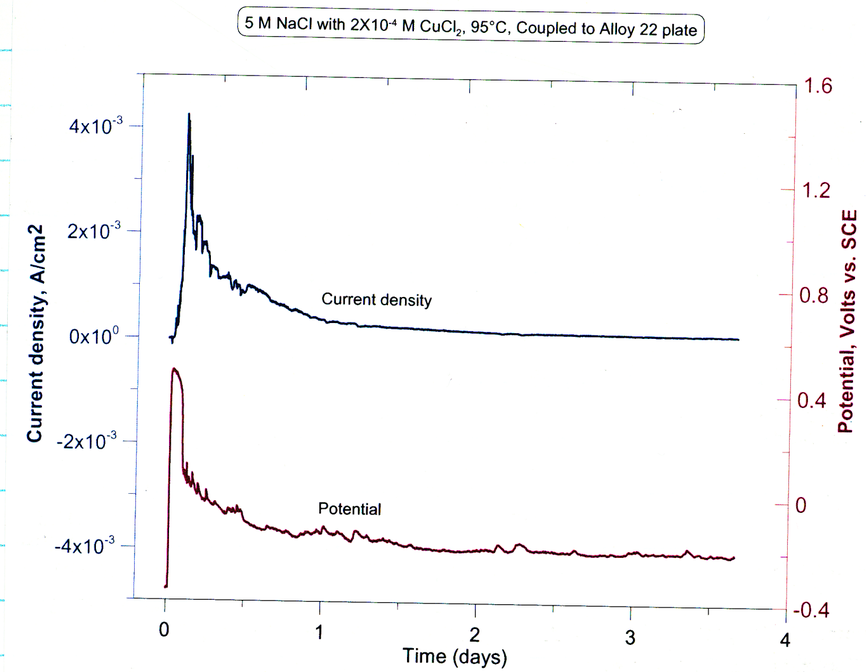
Test dates: 5/27/05 ~ 5/31/05

Test time: 3.162×10^5 seconds = 3.66 days Charge : 15.15 coulombs

Creviced area: 0.118 cm^2
Estimated crevice corroded area: 0.110 cm^2
Maximum penetration depth: 137 μm **Measured with metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Deep corrosion is around the edge of the creviced area. Central region is etched.

Xihua He 5/31/05



Xihua He 5/31/05

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.* 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 # 20.01403.571.019

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

Test ID: C22PR042

Initial weight: 10.91012 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 10.90842 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + $2X10^{-4}M$ $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 3.14 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~ 40651960 XH 6/7/05
Test Temperature: 95°C **Measured with Thermometer** **SN:** H98-179
Cal: 5/6/05 **Due:** 5/5/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 823833K
Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05
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: C22PR0531Ia, C22PR0531Ea, C22PR0531Ib, C22PR0531Eb

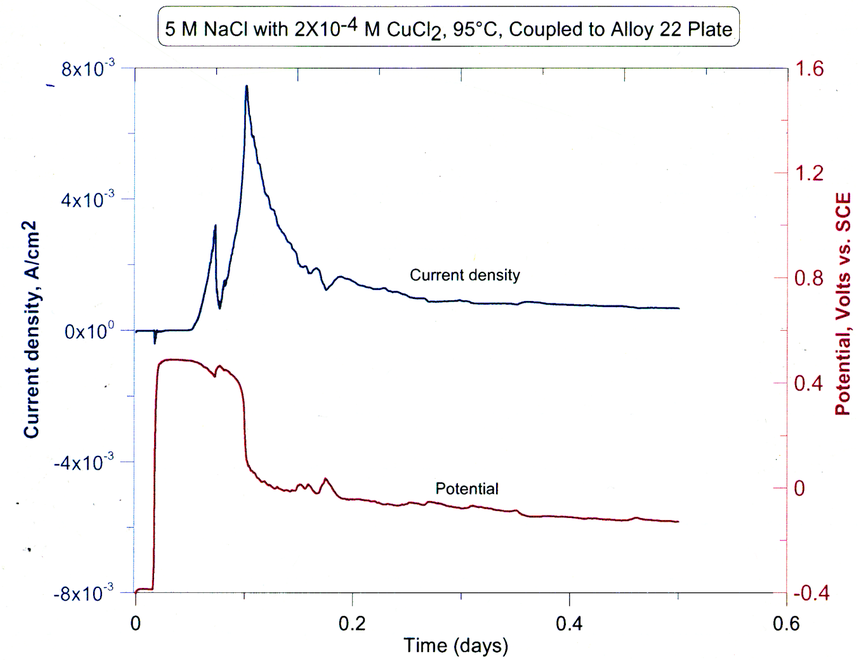
Test dates: 5/31/05 ~ 6/1/05

Test time: 43201 seconds = 0.5 day charge = 6.52 Coulombs

Creviced area: 0.118 cm^2
Estimated crevice corroded area: 7.08 mm^2
Maximum penetration depth: 90 μm **Measured with metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
The corrosion is around the edge of the creviced area. Central region is not corroded.

Xihua He 6/1/05



Xihua He 6/1/05

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.* 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: C22PR043

Initial weight: 10.3557 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 10.3524 2 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 5.34 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~ 4065196P

Test Temperature: 95°C **Thermocouple** **SN:** 333 X.H 6/7/05
Measured with **Cal:** 7/7/05 **Due:** 8/5/05
thermocouple/thermocouple meter **Thermocouple meter** **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 0199568

Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 6/1/05 **Due:** 12/1/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0601Ia, C22PR0601Ea, C22PR0601Iaa, C22PR0601Eaa, C22PR0601Ib, C22PR0601Eb, C22PR0604I, C22PR0604E

Test dates: 6/1/05 ~ 6/6/05

Test time: 4.22×10^5 seconds = 4.88 days **Charge:** 26.45 coulombs

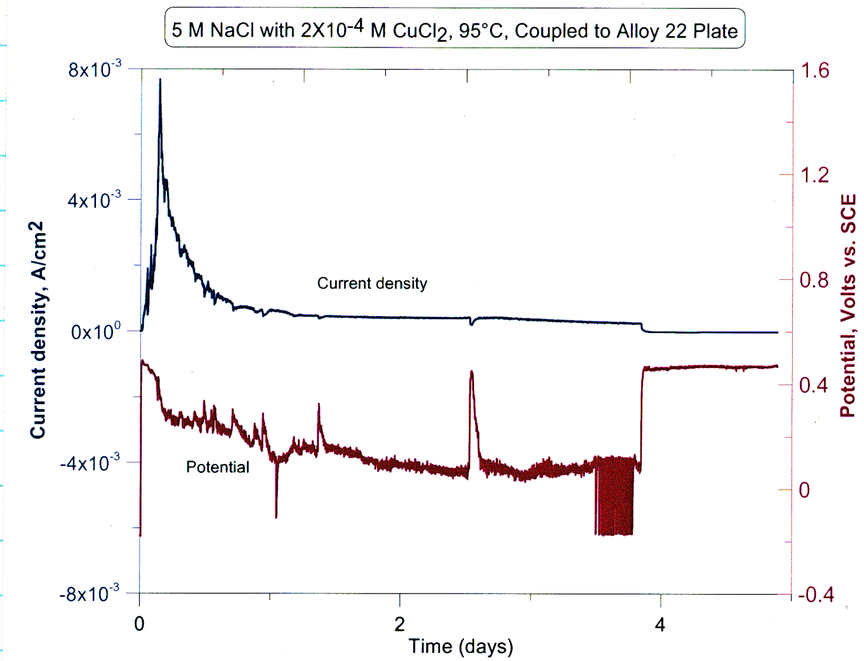
Creviced area: 10.9 mm^2

Estimated crevice corroded area: 10.9 mm^2

Maximum penetration depth: 187 μm **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
The entire creviced area is corroded. Deeper penetration is around the edge.

Xihua He 6/6/05



Xihua He 6/6/05

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.* 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: C22PR044

Initial weight: 11.01760 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 11.01754 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 1 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
58.44 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~~ 7.24 X.H 6/1/05 **Model:** Orion EA 940 **SN:**2330
Final pH: 4.70 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079120P~~ 4065196P X.H 6/7/05

Test Temperature: 95°C **Measured with Thermometer** **SN:** H98-179
Cal: 5/6/05 **Due:** 5/5/06

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

Reference Electrode: Fisher 13-620-52 **SN:** 8238334

Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0601Ia, C22PR0601Ea, C22PR0601Ib, C22PR0601Eb, C22PR0604I, C22PR0604E, C22PR0607E, C22PR0607I, C22PR0610I, C22PR0610E, C22PR0613I, C22PR0613E

Test dates: 6/1/05 ~ 6/14/05

Test time: 1.093×10^{6} seconds = 12.65 days Charge = 0.89 coulombs

Creviced area: 19.6 mm^2

Estimated crevice corroded area:

Maximum penetration depth:

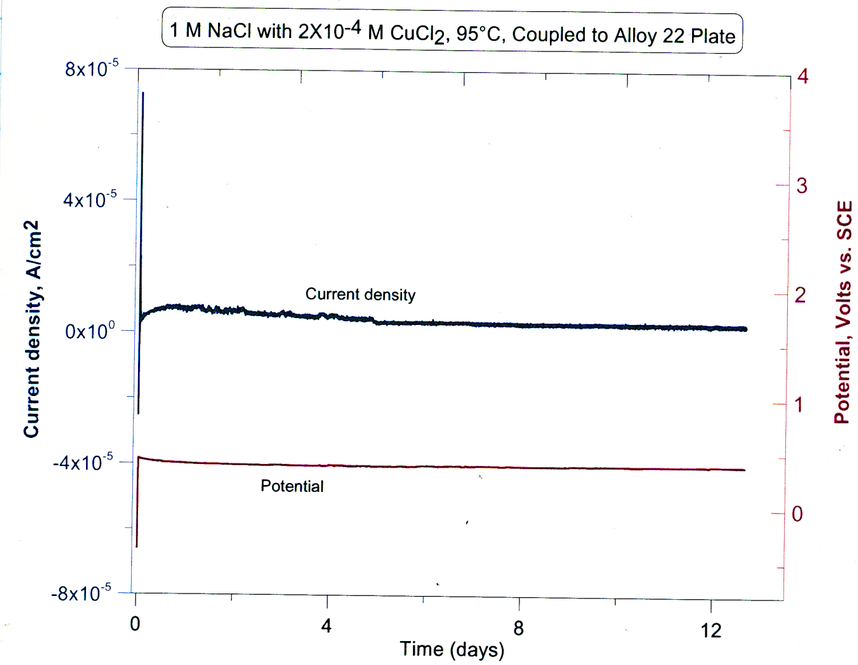
Measured with Olympus Metallurgical Microscope PME3
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:

Edge of the creviced area is etched. No visible damage.

Specimen will be polished for future use.

Xihua He 6/14/05



Xihua He 6/14/05

Xihua He 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.* 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: C22PR045

Initial weight: 10.60542 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 10.60067 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + $2X10^{-4}$ M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 4.06 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4065196P

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with **Cal:** 2/7/05 **Due:** 8/5/05
thermocouple/thermocouple meter **Thermocouple meter** **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 0199568
Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 6/1/05 **Due:** 12/1/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0607Ia, C22PR0607Ea, C22PR0607I, C22PR0607E

Test dates: 6/7/2005 ~ 6/10/2005

Test time: 2.66×10^5 seconds = 3.08 days **Charge:** 14.03 coulombs

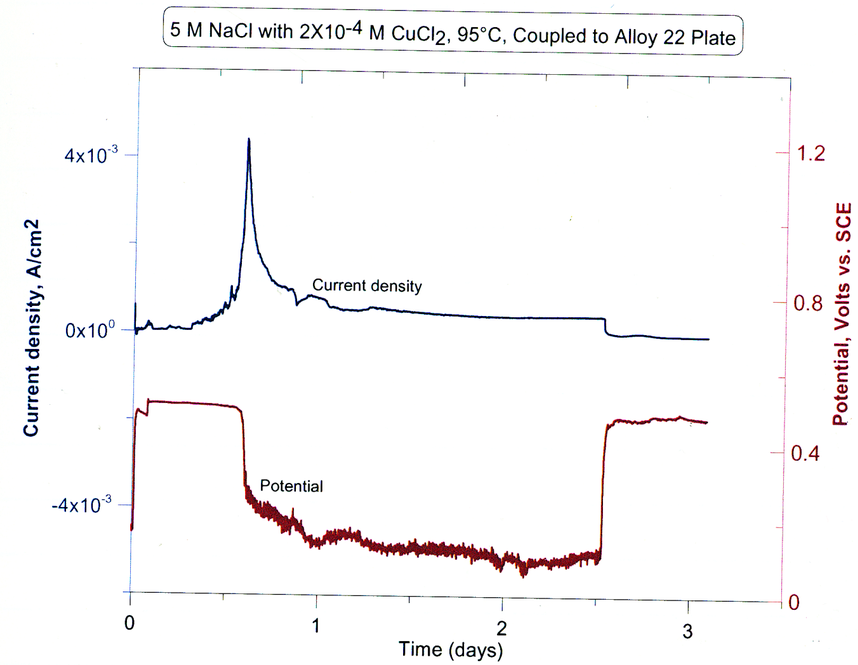
Creviced area: 10.9 mm^2

Estimated crevice corroded area: 9.85 mm^2

Maximum penetration depth: 143 μm **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Except for a tiny spot in the central region, most of the creviced area is corroded

Xihua He 6/10/05



Xihua He 6/10/2005

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.* 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: C22PR046

Initial weight: 10.40742 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 10.39600 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 5.39 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4065196P

Test Temperature: 95°C **Thermocouple** **SN:** 334
Measured with **Cal:** 4/6/05 **Due:** 10/6/05
thermocouple/thermocouple meter **Thermocouple meter** **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 925/05
Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 6/1/05 **Due:** 12/1/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0607aI, C22PR0607aE, C22PR0607bI, C22PR0607bE, C22PR0608I, C22PR0608E, C22PR0611I, C22PR0611E, C22PR0614I, C22PR0614E, C22PR0617E, C22PR0617I, C22PR0620Ech5, C22PR0620Ech6, C22PR0623I, C22PR0623E, C22PR0626I, C22PR0626E, C22PR0629I, C22PR0629E, C22PR0702I, C22PR0702E

Test dates: 6/7/05 ~ 7/6/05

Test time: 2.418×10^6 seconds = 28.0 days **Charge:** 52.195 coulombs

Creviced area: 12.9 mm^2

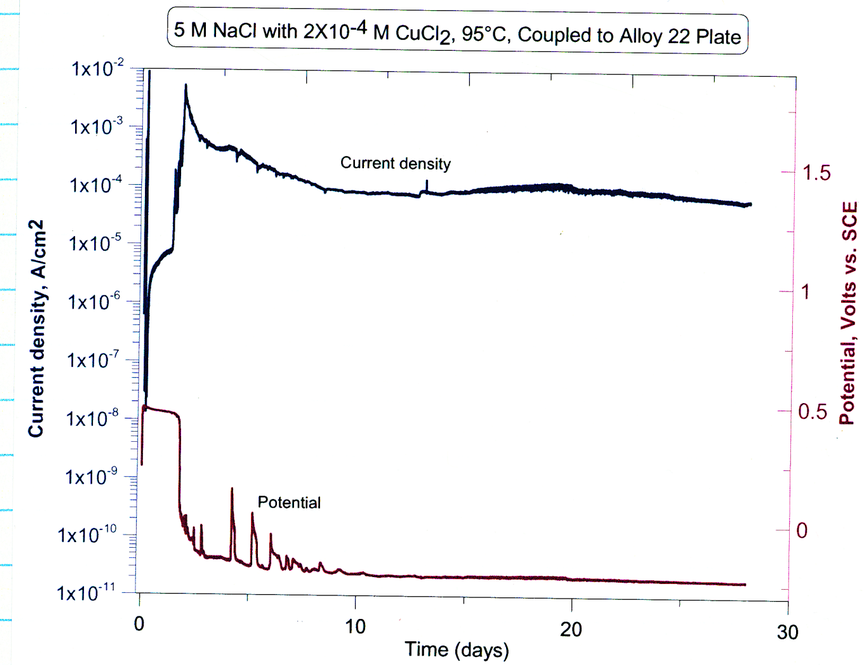
Estimated crevice corroded area: 12.9 mm^2

Maximum penetration depth: ~~196 μm~~ 206 **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

X.H 7/6/05

Specimen examination:
The edge of the creviced area is heavily corroded. Central region is slightly corroded.

Xihua He 7/6/05



Xihua He 7/6/05

Xihua He 6/9/06

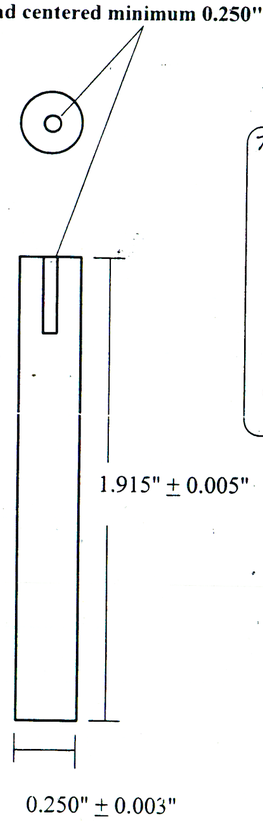
Project 1.20.06002.01.322

Darrell S. Dunn
SwRI-CNWRA
Phone: (210) 522-6090
Fax: (210) 522-5184

Cylindrical Test Specimen

CNWRA Drawing 20.01402.571.019

#5-40 thread centered minimum 0.250" deep



This information is to be completed at time of fabrication

Material: C-22

Heat #: 2277-3-3266

Specimen Orientation: Perpendicular to rolling direction

Other:

Procedure TOS w1.82/
Project # 20
TOTAL PCS. INSPECTED 20
TOTAL PCS. ACCEPTED 20
TOTAL PCS. REJECTED 0
"NR #" IF REJECTS NA
INSPECTOR
DATE JUN 27 2005
LOCATION CC 31 WS
J.C. # 81542
EQUIPMENT
Cal. 00509 Due 9-13-05
Tag Gas 00276 Due 11-9-07

Darrell S. Dunn 10/15/01
Initiated by. D. Dunn Date

Mark R. Shumstern for 10/15/01
QA Approval B. Mabrito Date

10/15/01
Reviewed by V. Jain Date

Xihua He 6/27/05

Specimen Machining Documentation Form			
Purchase/Work Order Number		JC # 81542	
Material Identification Alloy 22			
Material Heat Number 2277-3-3266			
CNWRA Requestor Xihua He			
Vendor SwRI machine shop			
Specimen Description (CNWRA Drawing Number, ASTM Standard) 20.01402.571.019			
To be Completed Prior to Order		To be Completed upon Receipt of Order	
Date	6/6/2005	Date	6/27/05
Material Supplied to Vendor (Y/N)	Y	Remaining Stock Material Returned From Vendor (Y/N)	Y
Material Marked with Heat Number and Rolling Direction (Y/N)	Y	Remaining Stock Material Marked with Heat Number and Rolling Direction (Y/N)	Y
Dimensions of Material stock provided (L x W x H)	19"x 8.3"x 0.5"	Remaining Stock Material Dimensions (L x W x H)	19" 6" 8 3/4" 12" 7" 0.5" thick
Specimen Quantity Ordered	20	Specimen Quantity Received	20
Dimensional Inspection Required (Y/N)	Y	Dimensional Inspection Provided (Y/N)	Y
Marked Containment Provided (Y/N)	Y	Marked Containment Used (Y/N)	Y
Documented in Scientific Notebook Number/Page Number 670/115			
NCR Number (if applicable)			

He 6/28/05
Signature Date

Xihua He 6/28/05

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.* 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: C22PR047

Initial weight: 10.78067 g **Model:** Sartorius Genius **SN:** 12809099

Final weight: 10.77004 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 3 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
87.66 g NaCl lot # 045904 + DI water to 500 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: 5.44 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4065196P

Test Temperature: 95°C **Thermocouple** **SN:** 333
Measured with **Cal:** 2/7/05 **Due:** 8/5/05
thermocouple/thermocouple meter **Thermocouple meter** **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

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

Reference Electrode: Fisher 13-620-52 **SN:** 0199568

Potentiostat: Multi-channel SI1480
SN: 00186634 **Cal:** 6/1/05 **Due:** 12/1/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0613Ia, C22PR0613Ea, C22PR0613Ib, C22PR0613Eb, C22PR0616I, C22PR0616E, C22PR0619I, C22PR0619E,

Test dates: 6/13/05 ~ 6/20/05

Test time: 5.864×10^5 seconds = 6.79 days **Charge:** 34.385 coulombs

Creviced area: 8.55 mm^2

Estimated crevice corroded area: 8.55 mm^2

Maximum penetration depth: 298 μm **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
The entire creviced area is severely corroded. The surrounding area is etched.

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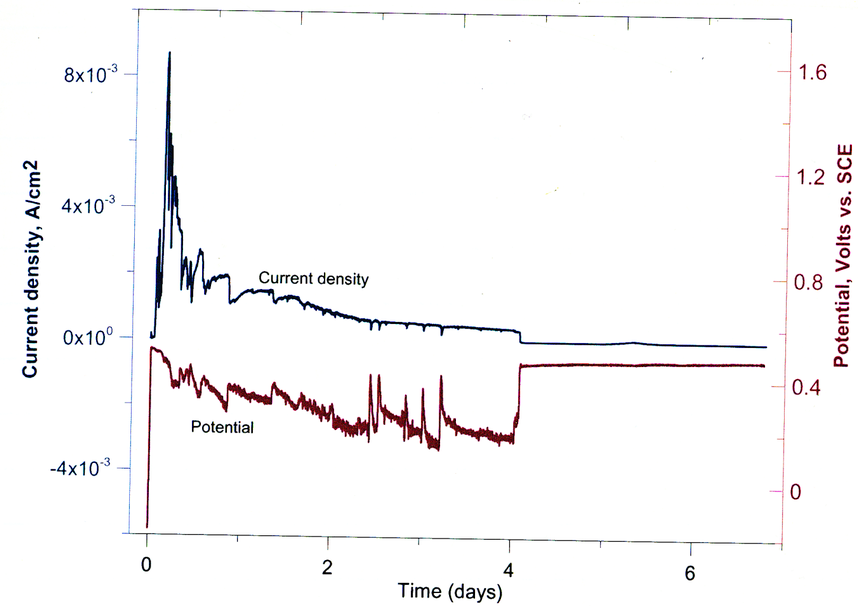
Test C22PR047, 3M NaCl + 2×10^{-4} M $CuCl_2$ Alloy 22 coupled to large Alloy 22 plate



Xihua He 6/20/05

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.* 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: C22PR048

Initial weight: 10.84620 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 10.83770 **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + $2X10^{-4}$ M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 5.00 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** ~~4079126P~~ 40651969

Test Temperature: 95°C **Measured with Thermometer** **SN:** H98-179 X.H
Cal: 5/6/05 **Due:** 5/5/06 6/27/05

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 20 cm^2

Reference Electrode: Fisher 13-620-52 **SN:** 8238334
Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05

Cell set up: Two channels for each electrode, one channel to measure the coupling current, the other to measure the coupling potential

Data Files: C22PR0616Ia, C22PR0616Ea, C22PR0616Ib, C22PR0616Eb, C22PR0617I, C22PR0617E, C22PR0620I, C22PR0620E, C22PR0623I, C22PR0623E

Test dates: 6/16/05 ~ 6/27/05

Test time: 9.278×10^5 seconds = 10.74 days Charge = 23.76 Coulombs

Creviced area: 9.34 mm^2

Estimated crevice corroded area: 9.34 mm^2

Maximum penetration depth: 224 μm **Measured with Olympus Metallurgical Microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
Deeper penetration is around the edge. The central region is slightly corroded.

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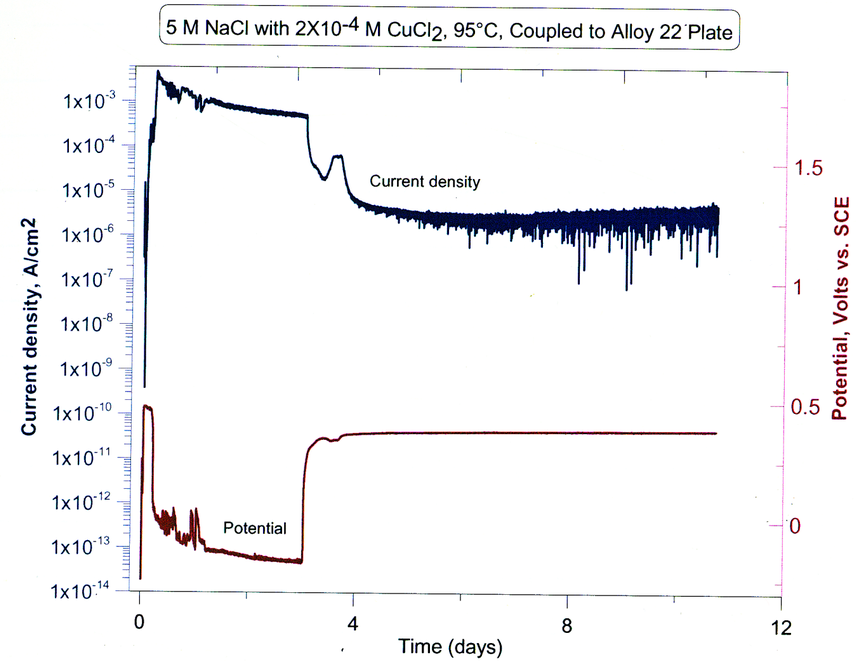


Xihua He 6/27/05

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.*
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.

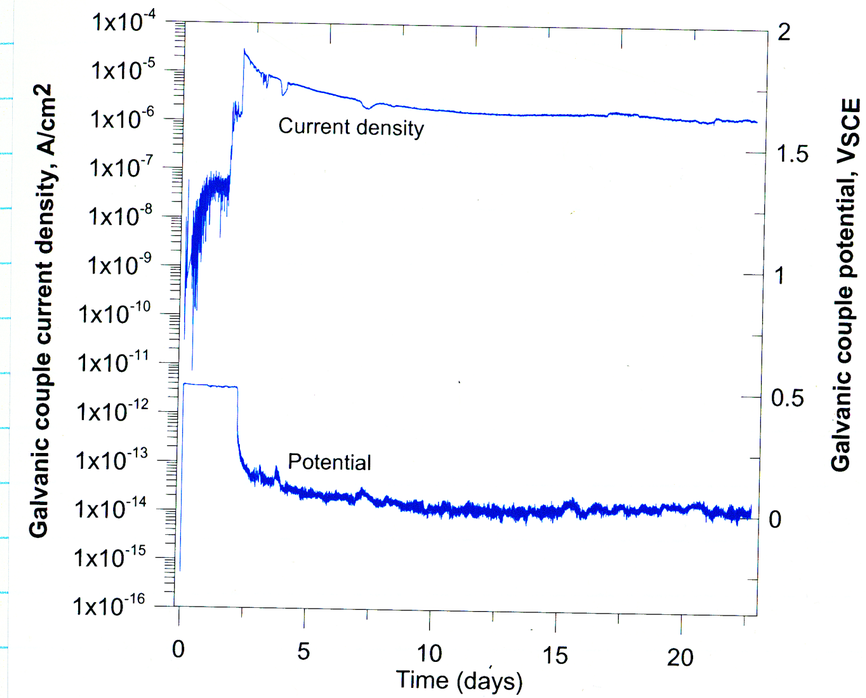
Torque Screwdriver: Snap-on USA **SN:** 1001200319
Cal: 5/4/05 **Due:** 11/4/05

Test ID: C22PR049
Initial weight: 11.00818 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 11.00158 g **Cal:** 5/11/05 **Due:** 11/11/05
Solution: 5 M NaCl + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
584.4 g NaCl lot # 050089 + DI water to 2000 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: 5.09 **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:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 972.9 mm^2
Reference Electrode: Fisher 13-620-52 **SN:** 0199568
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: C22PR0620Ia, C22PR0620Ea, C22PR0620Ib, C22PR0620Eb, C22PR0623I, C22PR0623E, C22PR0626I, C22PR0626E, C22PR0629I, C22PR0629E, C22PR0702I, C22PR0702E, C22PR0705I, C22PR0705E, C22PR0708I, C22PR0708E, C22PR0711I, C22PR0711E
Test dates: 6/20/05 ~ 7/13/05
Test time: 1.96×10^6 seconds = 22.6 days charge = 224.2 coulombs
Creviced area: 12.3 mm^2
Estimated crevice corroded area: 8.00 mm^2

Maximum penetration depth: 220 μm **Measured with Olympus metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05
Specimen examination:
Corrosion is around the edge. Central region is not corroded



Xihua He 7/13/05

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.*
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: C22PR050

Initial weight: 12.34449 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 12.34455 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4 M $MgCl_2$ + 4×10^{-4} M $CuCl_2$ (Page 97, this notebook)
813.78 g MgCl2 lot # 049972 + DI water to 1000 mL

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 1/14/05 **Due:** 7/14/05
Initial pH: 2.74 **Model:** Orion EA 940 **SN:** 2330
Final pH: 4.71 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4065196P

Test Temperature: 110°C **Thermocouple** **SN:** 329
Measured with thermocouple/thermocouple meter **Cal:** 2/2/05 **Due:** 8/2/05
Thermocouple meter **SN:** 3130900
Cal: 1/7/05 **Due:** 7/7/05

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 92520074
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: C22PR0622Ia, C22PR0622Ea, C22PR0622Ib, C22PR0622Eb, C22PR0625I, C22PR0625E, C22PR0628I, C22PR0628E, C22PR0701I, C22PR0701E, C22PR0704I, C22PR0704E

Test dates: 6/22/05 ~ 7/5/2005

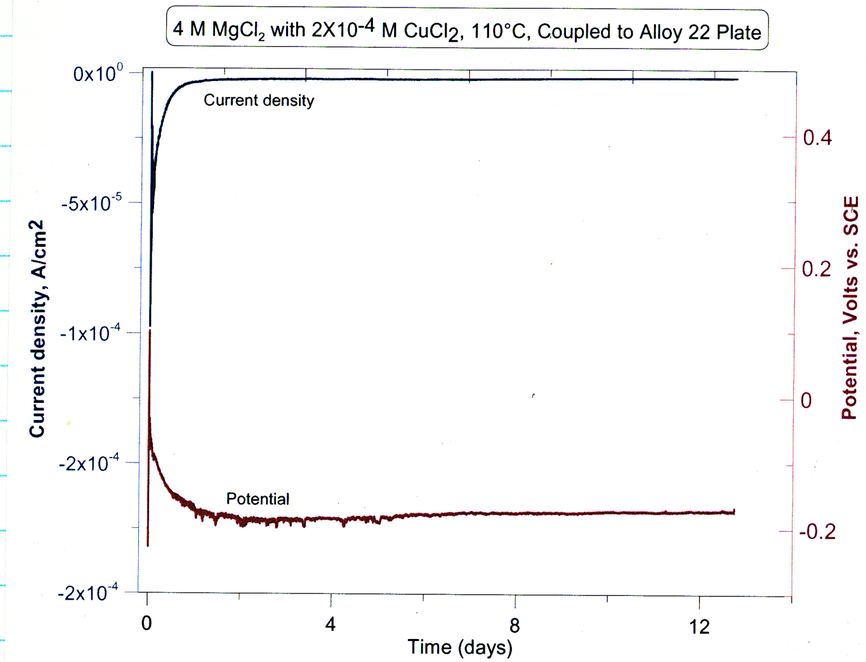
Test time: 1.099×10^6 seconds = 12.72 days Q = -2.88 coulombs

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:
Specimen is not corroded. The corrosion is at the joint point of the Alloy 22 wire and large Alloy 22 plate. Alloy 22 cylindrical specimen will be polished for future use.

He 7/6/2005



Corrosion was initiated instantaneously after the addition of $CuCl_2$, but the corrosion was on Alloy 22 cathode.

Xihua He
7/6/2005

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.*
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: C22PR051

Initial weight: 11.26789 g **Model:** Sartorius Genius **SN:** 12809099
Final weight: 11.25659 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 5 M NaCl + 0.25 M $NaNO_3$ + 2×10^{-4} M $CuCl_2$ (Page 97, this notebook)
146.1 g NaCl lot # 045904 + 106 g $NaNO_3$ Lot # 020809 + DI water to 500 mL

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 1/14/05 **Due:** 7/14/05
Initial pH: 7.02 **Model:** Orion EA 940 **SN:**2330
Final pH: 5.18 **Cal:** 7/21/04 **Due:** 7/21/05
pH Probe: #13-620-296 **SN:** 4079126P
Test Temperature: 95°C **Measured with Thermometer** **SN:** H98-179 **Cal:** 5/6/05 **Due:** 5/5/06

Counter Electrode: Alloy 22 plate (Heat # 2277-1-3133) with surface area of 60 cm^2
Reference Electrode: Fisher 13-620-52 **SN:** 8238334
Potentiostat: Multi-channel SI1480
SN: 00240551 **Cal:** 4/27/05 **Due:** 10/27/05
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: C22PR0628Ia, C22PR0628Ea, C22PR0628Ib, C22PR0628Eb, C22PR0701I, C22PR0701E, C22PR0704I, C22PR0704E, C22PR0707I, C22PR0707E, C22PR0710I, C22PR0710E, ~~C22PR~~ C22PR0713I, C22PR0713E, C22PR0714I, C22PR0714E, C22PR0716I, C22PR0716E, C22PR0719I, C22PR0719E
Xi'hua 7/22/05

Test dates: 6/28/05 ~ 7/21/05

Test time: 1.84×10^6 seconds = 21.3 days Q = 38.15 coulombs

Creviced area: 12.5 mm^2
Estimated crevice corroded area: 12.5 mm^2

Maximum penetration depth: 214 μm **Measured with metallurgical microscope PME3**
Cal: 5/23/05 **Due:** 11/23/05

Specimen examination:
All the creviced area is corroded. The surrounding area is etched.

Xi'hua He 7/21/05

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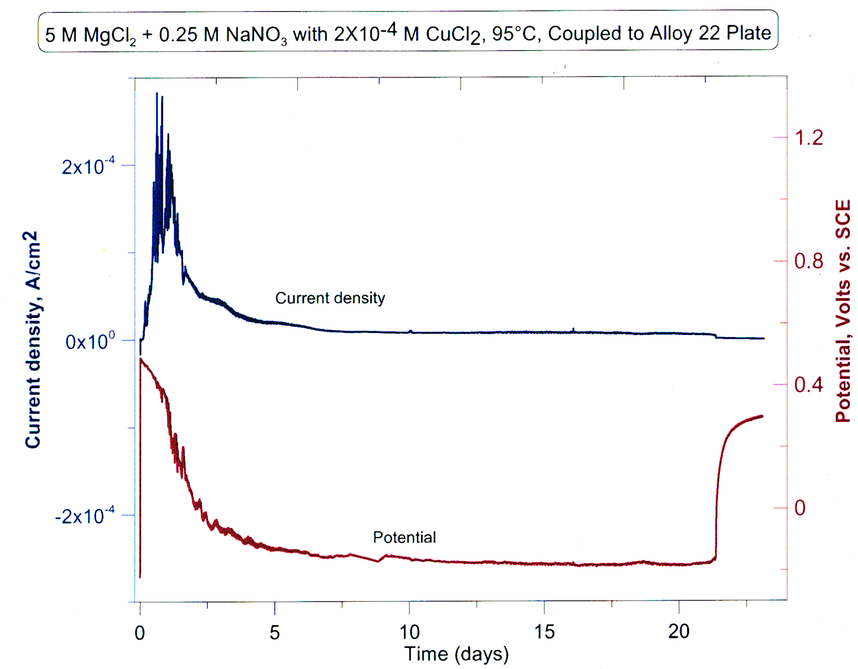

Xi'hua He 7/22/05

Xi'hua He 6/9/06