308 - - - Q200510070001

Scientific Notebook No. 729: Corrosion of Dissimilar Metal Crevices as a Function of Solution, Torques, Area, and Dissimilar Metals, Continues in Scientific Notebook No. 744 (08/9/2005 through 09/22/2005)

LABORATORY NOTEBOOK

CNWRA/SwRI

CNWRA
CONTROLLED

COPY_____

NOTEBOOK NO. 729
ISSUED TO XIHUA HE
ON _____ **20**____
DEPARTMENT _____
RETURNED _____ **20**____

Project #: 06002.01.322

Xihua He	Div. 20	X.H	He
Brian K. Derby	Div 18	BKD	Bi

SCIENTIFIC NOTEBOOK COMPANY
2831 LAWRENCE AVENUE
STEVENSVILLE, MICHIGAN 49127
(800) 537-3028 - http://www.snco.com

TITLE

From Page No.

Initial Scientific Notebook Entry for Corrosion of Dissimilar Metal Crevices as a Function of Solution, Torque, Area, and Dissimilar Metals

Title: Corrosion of Dissimilar Metal Crevices as a Function of Solution, Torque, Area, and Dissimilar Metals

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

Objectives: Determine the corrosion potential, crevice corrosion repassivation potential, and crevice corrosion penetration depths of dissimilar metal crevices as a function of solution, torque, area, and dissimilar metals

Proposed approach or procedure for achieving the objectives: Tests are conducted in a glass test cell using a multiple crevice assembly consisting of a number of grooves and plateaus in accordance with ASTM G78. In this assembly, the serrated crevice former machined from base Alloy 22 or Titanium Grade-7 contacts with the crevice specimen to form an artificial crevice with 24 crevice sites. Then immerse the crevice assembly in solution to monitor the corrosion potential and perform cyclic polarization to obtain crevice corrosion repassivation potential (see reference 1 below). Penetration depths are obtained by galvanically coupling the crevice assembly to larger cathodes to initiate localized corrosion. The crevice specimens tested are mill-annealed base Alloy 22, welded + solution annealed Alloy 22, 316L stainless steel. By varying the surface area of the crevice former, torque between dissimilar metal contact, and combination of dissimilar metal contacts, the corrosion of dissimilar metal crevices can be studied as a function of torque, area, and dissimilar metals.

Equipment: Electrochemical test cell with multiple crevice assembly, Solartron 1287 and 1480 multi-channel potentiostats, temperature controller, thermometer, pH mater, balance, torque screwdriver, caliper, microscope.
Calibration and due dates are provided in data sheet for each test.

Materials: mill-annealed base Alloy 22, welded Alloy 22, 316L stainless steel, titanium Grade-7. Material heats to be added prior to testing

Specimen Specifications: crevice specimens CNWRA drawing #20.06002.01.322.002 and crevice former CNWRA drawing #20.06002.01.322.006, #20.06002.01.322.008.A, #20.06002.01.322.011, bolt and nut CNWRA drawing # 20.06002.01.322.007, #20.06002.01.322.010

Measurement Parameters: Temperature, open circuit potential, potential and current of specimen during polarization, penetration depth per ASTM standard G46. X.H 10/4/05

X.H 10/4/05

Required Level of Accuracy: Temperature ±2°C, Potentials ±~~5~~ 1 mV, Current ±1 microamp.

Uncertainty and Sources of Error: Open circuit potential changes with time. Current measurement error can occur for localized corrosion processes because the actively corroding area is not the same as the surface area of the test specimen.

1. D.S. Dunn, Y.-M. Pan, K. Chiang, L. Yang, G.A. Cragnolino, **X. He**, "The localized corrosion resistance and mechanical properties of alloy 22 waste package outer containers", *Journal of Metals*, 57 (2005) 49-55.

Witnessed & Understood by me, | Date | Invented by | Date 8/9/05
Recorded by

From Page No.

Requisition: 05027776
Requisitioner: He, Xihua
Req Organization: 1.20.01.50
Phone: (210) 522-5194

SOUTHWEST RESEARCH INSTITUTE

Suggested Supplier: Tricor Metals (Texas)
City/State: Conroe/Texas
Contact: Bill Austin
Phone: 1-888-987-4267 Fax: 936-273-2669

Page 1 of 1
Date Printed: 07/18/2005
Date Created: 07/05/2005
Requisition Date: 07/06/2005

Special Instructions: The procurement plan is attached.

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
1	Titanium Grade-7 plate with dimension 12"X1 2"X0.5" with tolerance 0.125", total weight 12.316 pounds	LBS	7/14/2005	12.32	50.77	625.28

Deliver To: Xihua He/Building 57
Account: 753-104 Organization: 1.20 Project: OHD20.131 Allocation Pct: 100.00
Total Estimated Cost: $625.28

Quality Assurance?: YES ASL Required: NO Inspection Criteria: Dimensional inspection only

Approvals: Requestor: Xihua He 7/5/2005 5:06:55 PM Department/Division Management: Vijay Jain 7/6/2005 9:04:26 AM
Patrick C Mackin 7/6/2005 1:48:24 PM Quality Assurance: Robert D Brient 7/5/2005 4:25:08 PM

Submitted By: Shirlee Garcia 7/6/2005 5:06:19 PM

To Page No.

Witnessed & Understood by me, | Date 7/12/2005 | Invented by | Date
Recorded by He

From Page No.

TRICOR
INDUSTRIAL, INC.

CORPORATE OFFICE
3000 Old Airport Rd.
P.O. Box 752
Wooster, Ohio 44691
(800) 421-5141
(330) 264-3299
FAX (330) 262-6678

INDUSTRIAL BRANCH OPERATION
823 West Bowman Street
Wooster, Ohio 44691
(800) 421-5141
(330) 264-3299
FAX (330) 262-7311
sales@tricorindustrial.com

INDUSTRIAL BRANCH OPERATION
5169 Guernsey Street
Bellaire, Ohio 43906
(740) 676-5010
FAX (740) 676-2401

OHIO METALS DIVISION
3000 Old Airport Road
Wooster, Ohio 44691
(800) 421-5141
(330) 264-3299
FAX (330) 264-1181
sales@tricormetals.com

TEXAS METALS DIVISION
101 S. Trade Center Pkwy.
Conroe, Texas 77385
(888) 987-4267
(936) 273-2661
FAX (936) 273-2669
ho@tricormetals.com

INDUSTRIAL FASTENERS AND SUPPLIES

PREMIUM METALS FABRICATION AND MILL PRODUCTS

TRICOR METALS DIVISION

CERTIFICATE OF TESTS

CUSTOMER: SOUTHWEST RESEARCH INSTITUTE CUSTOMER PO#: 544447G

REPORT DATE: 10/28/03 SHIP DATE: 7/12/05 HEAT #: CN2775
LOT/TEST: 4-J5302-1-1 & 2-1

SIZE: .500"THK X 12" X 12"
FINISH: TITANIUM PLATE

MATERIAL SPECS. ASTM B: 265-98(A00), 01
ASME SB: 265-02 ALLOY: GRADE 7
EN10204 3.1.B

LBS/FT/PCS: 12.5 LBS ORDER #: 198825

CHEMICAL ANALYSIS %

C: .010/.010 H: 3/2/14 PPM O: .137/.139

N: .006/.007 Fe: .07/.08 Ti: BAL Pd: .15/.15

Hf: Fe+Cr: Zr+Hf: Ru:

MECHANICAL PROPERTIES

KSI-L	KSI-T
YIELD: 41/42	YIELD : 56/56
TENSILE: 72/74	TENSILE : 73/74
ELONGATION: 29/31	ELONGATION : 31/31
RED. OF AREA: 52/53	RED. OF AREA : 50/51
FLATTENING:	HYDROSTATIC:
REVERSE FLATTEN:	PNEUMATIC:
FLARE TEST:	HARDNESS:
BEND TEST:	EDDY CURRENT:
ANNEAL: ANNEALED 24MINS @1550F AC	ULTRASONIC:

REMARKS:

THIS MATERIAL DID NOT COME IN CONTACT WITH MERCURY OR DEVICES CONTAINING MERCURY AT TRICOR METALS DIVISION. WE CERTIFY THAT THE CHEMICAL ANALYSIS AND PHYSICAL TEST RESULTS APPLYING ON THE ABOVE ORDER NUMBER ARE CORRECT AND TRUE TO THE BEST OF OUR KNOWLEDGE AND BELIEF.

AUTHORIZED SIGNATURE. Amy Din

To Page No.

Witnessed & Understood by me, | Date 7/13/05 | Invented by | Date
Recorded by He

From Page No.

TIMET

Titanium Metals Corporation *Approved Certificate*

100 Titanium Way, Toronto, OH 43984
Telephone (740) 537-5694, Fax (740) 537-5759

CERTIFICATE ID	*CUSTOMER*	*PURCHASE ORDER*
CN2775-4A	TRICOR INDUSTRIAL, INC.	029616-00
HEAT NUMBER	*GRADE*	*PRODUCT DESCRIPTION*
CN2775	TIMETAL®50A .15Pd	.500" PLATE

SPECIFICATIONS

ASME SB 265_01 GR 7; ASTM B 265_02 GR 7

DELIVERY CONDITION

Annealed

CHEMICAL ANALYSIS

(Weight Percent)

	C	Fe	N	O	Pd
CN2775-TOP	0.010	0.08	0.007	0.137	0.15
CN2775-BOT	0.010	0.07	0.006	0.139	0.15

	H2 (ppm)	LOCATION	METHOD
CN2775-4-J5302-1-1	3	PLATE	FUSION
CN2775-4-J5302-2-1	2	PLATE	FUSION

Yttrium less than 10 ppm.
Residual elements each less than 0.10% maximum, 0.40% maximum total.
Balance titanium.

MECHANICAL PROPERTIES

Mill Annealed 24 Minutes @ 1550F AC
Room Temperature Tensile Results (YS @ .2% Offset)

	TENSILE DIR	TS KSI	YS KSI	4D, % EL	RA, %
CN2775-4-J5302-1-1	L	74	41	29	52
CN2775-4-J5302-1-1	T	74	56	31	51
CN2775-4-J5302-2-1	L	72	42	31	53
CN2775-4-J5302-2-1	T	73	56	31	50

COMPLIANCE STATEMENTS

1. Surface free from contamination and product conforms to the other technical requirements of the referenced specifications.
2. Material has received a .010" minimum pickle.
3. Material melted using EB process.
4. Material and certificate in compliance with 50049-3.1.B as in EN 10204 3.1.B.
5. TIMET-Toronto has established a quality management system that is in compliance with ISO 9001 & Q9001 - 2000 & AS 9100 Rev. A (2001), Certificate #1033, through American Quality Assessors, registration effective 8-Apr-03.
6. Flat Products Material Concession SP-1118 (grindout) conditionally accepted and applies.

ANSI-RAB ACCREDITED
REGISTERED ISO 9001:2000 & AS9100

This test report shall not be reproduced except in full, without the written approval of TIMET.
The intentional recording of false, fictitious, or fraudulent statements or entries on the certificate may be punished as a felony under federal law.

Nadcap NDT & LAB

First in Titanium Worldwide

To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by He	

From Page No.

Procurement plan for Titanium Grade-7

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES QUALITY ASSURANCE PROCEDURE	Proc. QAP–016 Revision 8 Chg 0 Page 8 of 9

ATTACHMENT 1

CNWRA PROCUREMENT PLAN

The following information is required when purchasing quality affecting items, services, or materials from a supplier not listed on the SwRI Approved Suppliers List.

Item or Activity to Be Procured	Action or Tests Required to Assure Quality
☐ Laboratory Analysis	☐ Provide blind samples with known compositions to the non-ASL supplier to provide confidence in reported results (Preferred approach) ☐ Provide duplicate samples to the non-ASL supplier to provide confidence in reported results ☐ Other (describe)
☒ Metals, Chemical Standards or other samples	☒ Perform confirmatory analysis with an ASL supplier in accordance with QAP–018
☐ Special Processes	☐ (describe)
☐ Other (explain)	☐ (describe)

Proposed Supplier: Tricor Metals

Reason for not using an ASL supplier or for not placing this supplier on the ASL:

☒ No ASL supplier is capable of providing the required items/services.
☐ Desired supplier does not have a quality program.
☐ Other:

Acceptance Criteria:
Perform confirmatory analysis with an ASL supplier

Procurement Plan Initiated By: Xihua He Date: 7/5/2005

Approved: [signature] Date: 7/5/2005
Director of CNWRA Quality Assurance

Results of Receipt Inspection: ☒ Accept ☐ Reject NCR Number:

Reference Documentation Location: Notebook No. 729, Pg# 67

Performed By: [signature] Date: 8/25/05

CNWRA FORM QAP-18 (05/2004)

To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by He	8/25/05

TIMET
Titanium Metals Corporation
100 Titanium Way, Toronto, OH 43984
Telephone (740) 537-5694, Fax (740) 537-5759

Approved Certificate

CERTIFICATE ID	CUSTOMER	PURCHASE ORDER
CN2775-4A	TRICOR INDUSTRIAL, INC.	029616-00
HEAT NUMBER	**GRADE**	**PRODUCT DESCRIPTION**
CN2775	TIMETAL®50A .15Pd	.500" PLATE

SPECIFICATIONS
ASME SB 265_01 GR 7; ASTM B 265_02 GR 7

Results are from TIMET Quality Control records on file
Cert Master used: PLATE01
Sales Order # : 110029

Date : 05-NOV-2003
Time : 16:36

Carolyn R. Thompson 101
Authorized Signature

This is the second page of the report on p. 4

PCS/LBS/FT: 125 Lbs
DESCRIPTION: TI-7 Plate
.300" x 12" x 12"
CUSTOMER: Southwest Research Institute
P.O. # 544476 ORDER # 198825
DATE: 7/18/05
SIGNATURE: [signature]

ANSI-RAB ACCREDITED
REGISTERED ISO 9001:2000 & AS9100

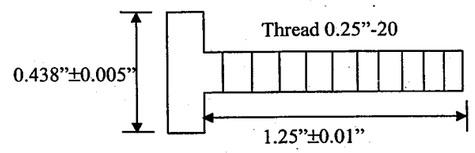
This test report shall not be reproduced except in full, without the written approval of TIMET.
The intentional recording of false, fictitious, or fraudulent statements or entries on the certificate may be punished as a felony under federal law.

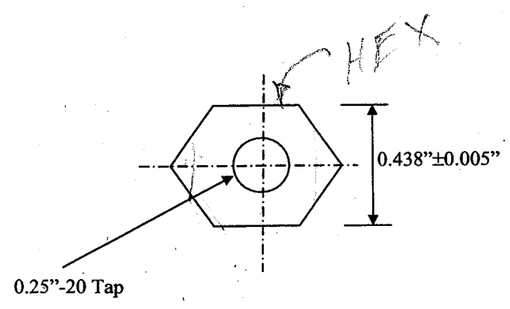
Nadcap
NDT & LAB

From Page No.

Xihua He CNWRA-SwRI Phone: 210-522-5194 Fax: 210-522-6081 e-mail: xhe@swri.org	CNWRA drawing # 20.06002.01.322.010	To be completed at time of order Material: Titanium Grade-7 Heat: CN2775 Specimen orientation: ~~Normal to rolling direction~~ Other: X.H 8/3/05

Bolts and nuts for multiple crevice assembly





LOCATION CC31 MS
EQUIPMENT Calipers Dwg 1-18-06 Tables 00276 Dwg 11-19-07
J.C. # 81704
Procedure: 105-wd-821
Project #
TOTAL PCS. INSPECTED
TOTAL PCS. ACCEPTED
TOTAL PCS. REJECTED
"NR #" IF REJECTS
INSPECTOR
DATE AUG - 3 2005

7/18/05
Initiated by: X. He Date

7/18/05
Reviewed by: V. Jain Date

7/19/05
QA approval: B. Brient Date

To Page No.

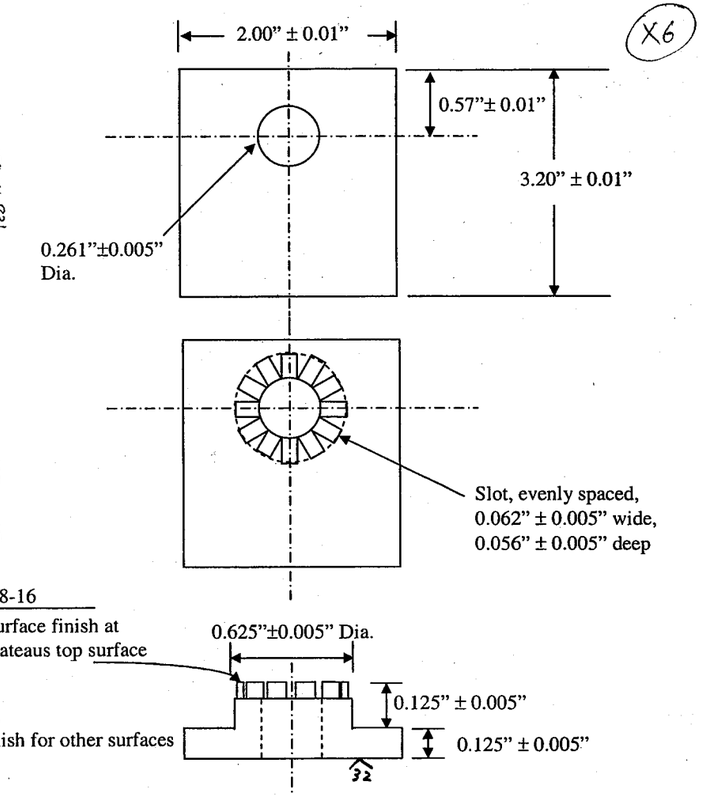
Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/3/05

From Page No.

Xihua He CNWRA-SwRI Phone: 210-522-5194 Fax: 210-522-6081 e-mail: xhe@swri.org	CNWRA drawing # 20.06002.01.322.011	To be completed at time of order Material: Titanium Grade-7 Heat: CN2775 Specimen orientation: ~~Normal to rolling direction~~ Other: X.H 8/31/05

Large surface area serrated crevice washer with 24 plateaus

X6



Procedure: 105-wd-821
Project #
TOTAL PCS. INSPECTED
TOTAL PCS. ACCEPTED
TOTAL PCS. REJECTED
"NR #" IF REJECTS
INSPECTOR
DATE AUG - 3 2005
LOCATION CC31 MS
EQUIPMENT CMM Dwg 1-18-06
J.C. # 81704

7/20/05
Initiated by: X. He Date

Reviewed by: V. Jain Date

7/20/05
QA approval: B. Brient Date

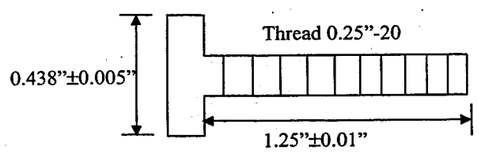
To Page No.

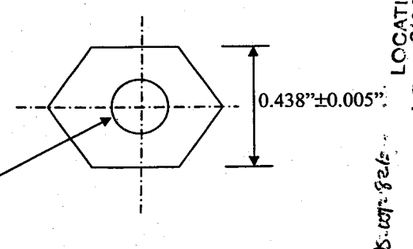
Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/3/05

From Page No.

Xihua He CNWRA-SwRI Phone: 210-522-5194 Fax: 210-522-6081 e-mail: xhe@swri.org	CNWRA drawing # 20.06002.01.322.010	To be completed at time of order Material: Alloy 22 Heat: 2277-3-3266 Specimen orientation: Other:

Bolts and nuts for multiple crevice assembly





X6

LOCATION CC31 MS
J.C. # 8809
EQUIPMENT Cal 80-5081 due 9-13-05 Thd Gage 002176 due 11-19-07
TOTAL PCS. INSPECTED 6
TOTAL PCS. ACCEPTED 6
TOTAL PCS. REJECTED 0
"NR #" IF REJECTS NA
INSPECTOR
DATE AUG 16 2005
Procedure HS-CM-826
Project #

He 7/18/05
Initiated by: X. He Date

7/18/05
Reviewed by: V. Jain Date

7/19/05
QA approval: B. Brient Date

To Page No.

Witnessed & Understood by me,	Date X.H 8/16/05 7/20/05 8/16/05	Invented by	Date
		Recorded by He	

From Page No.

7/20/05

To Page No.

Witnessed & Understood by me,	Date 7/20/05	Invented by	Date
		Recorded by He	

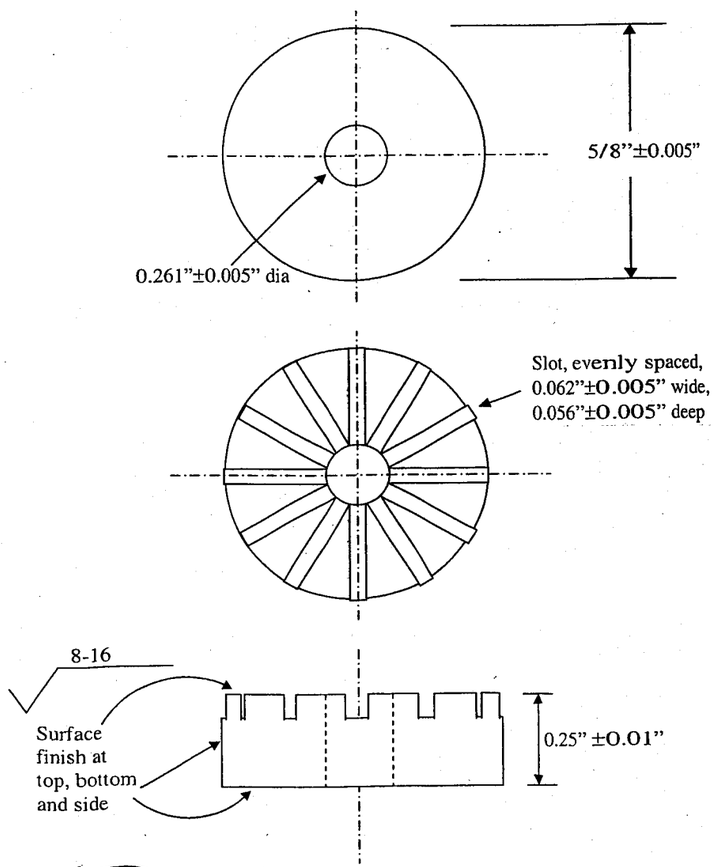
From Page No.

Xihua He
CNWRA-SwRI
Phone: 210-522-5194
Fax: 210-522-6081
e-mail: xhe@swri.org

SwRI drawing #
20.06002.01.322.006

Heat: 2277-3-3266
Specimen orientation: Normal to rolling direction

Serrated Alloy 22 crevice washer with 24 plateaus



7/5/05
Initiated by: X. He Date

7/5/05
Reviewed by: V. Jain Date

7/5/05
QA approval: B. Brient Date

To Page No.

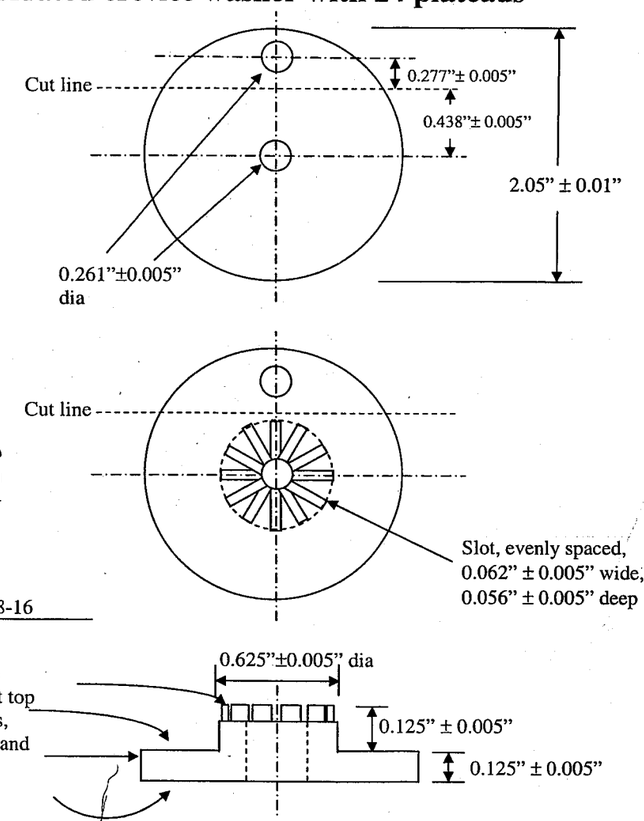
Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by 7/20/05	

From Page No.

Xihua He CNWRA-SwRI Phone: 210-522-5194 Fax: 210-522-6081 e-mail: xhe@swri.org	CNWRA drawing # 20.06002.01.322.008.A (first revision of CNWRA drawing # 20.06002.01.322.008)	To be completed at time of order Material: Alloy 22 Heat: 2277-3-3266 Specimen orientation: Other:

Serrated crevice washer with 24 plateaus

Procedure: TDS-WI-821
Project #
TOTAL PCS. INSPECTED
TOTAL PCS. ACCEPTED
TOTAL PCS. REJECTED
"NR #" IF REJECTS
INSPECTOR
J.C. #
LOCATION Ce 31
EQUIPMENT
DATE JUL 26 2005



7/28/05
Initiated by: X. He Date

7/29/05
Reviewed by: V. Jain Date

7/29/05
QA approval: B. Brient Date

JUL 26 2005

To Page No.

Witnessed & Understood by me,	Date 7/29/05	Invented by	Date
		Recorded by	

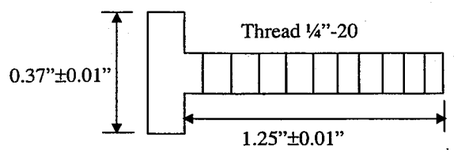
Xihua He
CNWRA-SwRI
Phone: 210-522-5194
Fax: 210-522-6081
e-mail: xhe@swri.org

SwRI drawing #
20.06002.01.322.007

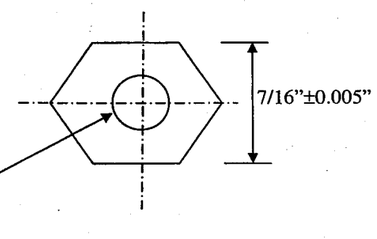
Material Alloy 22
Heat # 2277-3-3266

X3

Bolt for multiple crevice assembly



Nut for multiple crevice assembly



LOCATION 0C31 MS
EQUIPMENT
J.C. #
Procedure Dos-WI-821
Project #
TOTAL P.S. INSPECTED 1 Each
TOTAL P.S. ACCEPTED 1 Each
TOTAL P.S. REJECTED 0
NR # OF REJECTS NA
DATE JUL 26 2005
INSPECTOR

7/5/05
Initiated by: X. He Date

SwRI QA JUL 26 2005

7/5/2005
Reviewed by: V. Jain Date

7/5/05
QA approval: B. Brient Date

Requisition: 05027848
Requisitioner: He, Xihua
Req Organization: 1.20.01.50
Phone: (210) 522-5194

SOUTHWEST RESEARCH INSTITUTE

Suggested Supplier: Texas Toolmakers
City/State: San Antonio/Texas
Contact: Mike Ridgway
Phone: 210-494-3651 Fax: 210-494-6139

Page 1 of 2
Date Printed: 07/18/2005
Date Created: 07/05/2005
Requisition Date: 07/07/2005

Special Instructions: Machine specimens using wire EDM to conserve material and position specimens, particulary in welded Alloy 22 plate. The quote is attached and the drawings are attached.

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
1	Flat crevice specimens from Alloy 22 Deliver To: Xihua He/Building 57 Account: 704-000 Organization: 1.20 Project: 06002.01.322 Allocation Pct: 100.00	EA	7/19/2005	20.00	135.00	2,700.00
2	Flat crevice specimens from 316L stainless steel Deliver To: Xihua He/Building 57 Account: 704-000 Organization: 1.20 Project: 06002.01.322 Allocation Pct: 100.00	EA	7/19/2005	10.00	135.00	1,350.00
3	Flat crevice specimens from welded Alloy 22 Deliver To: Xihua He/Building 57 Account: 704-000 Organization: 1.20 Project: 06002.01.322 Allocation Pct: 100.00	EA	7/19/2005	10.00	135.00	1,350.00
					Total Estimated Cost:	$5,400.00

Government Project?: YES Property Type: G1 Is Govt. Property being sent to supplier?: NO

Quality Assurance?: YES ASL Required: YES

Approvals: Requestor: Xihua He 7/6/2005 3:03:01 PM Department/Division Management: Vijay Jain 7/6/2005 10:22:25 AM
Sitakanta Mohanty 7/6/2005 6:24:39 PM Quality Assurance: Robert D Brient 7/6/2005 8:27:47 AM

Submitted By: Shirlee Garcia 7/7/2005 10:13:34 AM

Your organization will provide goods or services to the Center for Nuclear Waste Regulatory Analyses (CNWRA) in accordance w ith the requirements of your quality system or that of the CNWRA Quality Assurance Manual. Any special technical or QA proc edures required in the performance of your staff members' work will be provided. Special CNWRA requirements apply to scient ific and engineering software and must be followed. Your organization's product will be accepted based on an evaluation by

Requisition: 05027848
Requisitioner: He, Xihua
Req Organization: 1.20.01.50
Phone: (210) 522-5194

SOUTHWEST RESEARCH INSTITUTE

Suggested Supplier: Texas Toolmakers
City/State: San Antonio/Texas
Contact: Mike Ridgway
Phone: 210-494-3651 Fax: 210-494-6139

Page 2 of 2
Date Printed: 07/18/2005
Date Created: 07/05/2005
Requisition Date: 07/07/2005

Line # | Item / Description | U/M | Need By Date | Requested Qty | Est Unit Cost | Estimated Costs

the CNWRA Principal Investigator or technical staff member and will be returned for rework at Seller's expense if the prod uct does not meet CNWRA requirements. If scientific notebooks are utilized, they are subject to periodic review and must be returned at the conclusion of work to the CNWRA QA Records Room, or invoice remittance will be withheld. Additionally, ther e shall be "right of access" to your facility to confirm effective implementation of the quality requirements with the possi bility of audits, source inspections, or surveillances. Any special documentation requirements shall be specified in the pu rchase order and will be supplied to the CNWRA with the product. The Seller shall notify CNWRA QA of any nonconformance to t he requirements of this purchase order; further work shall not be done unless directed by CNWRA QA. If there are any QA-rel ated questions, please call the CNWRA Director of QA at (210) 522-5537.

SUPPLIER SHALL FURNISH DIMENSIONAL INSPECTION DATA VERIFYING COMPLIANCE WITH THE REQUIREMENTS OF THE FABRICATION DRAWINGS.

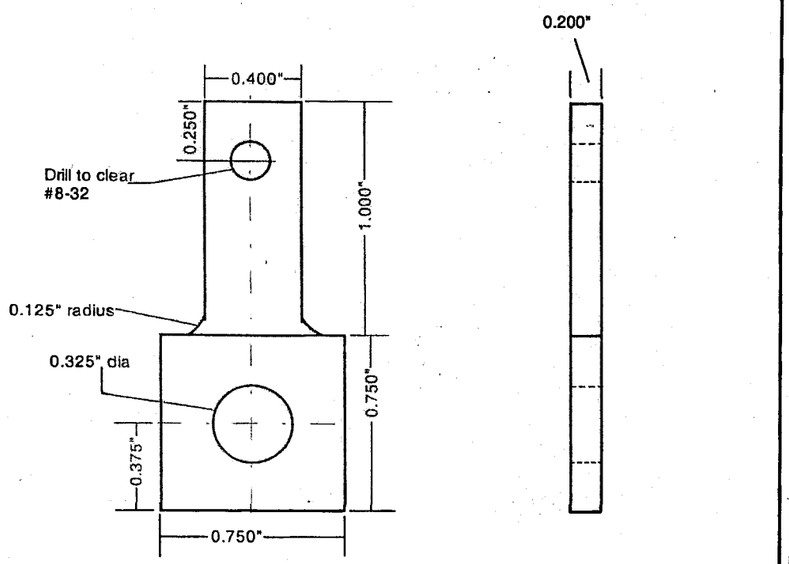
Project No._____
Book No._____ TITLE _____

From Page No.____

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

CNWRA Drawing 20-06002-01-322-002
Dimensional tolerances +/- 0.005"

To be completed at time of order:
Material: Alloy 22
Heat: 2277-3-3266
Specimen Orientation: Normal to rolling direction
Other:



Darrell S. Dunn 3/11/05
Initiated by. D. Dunn Date

3/11/05
Reviewed by V. Jain Date

Mark R. Ehrnstrom 3/4/05
QA Approval B. Brient for Date

To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

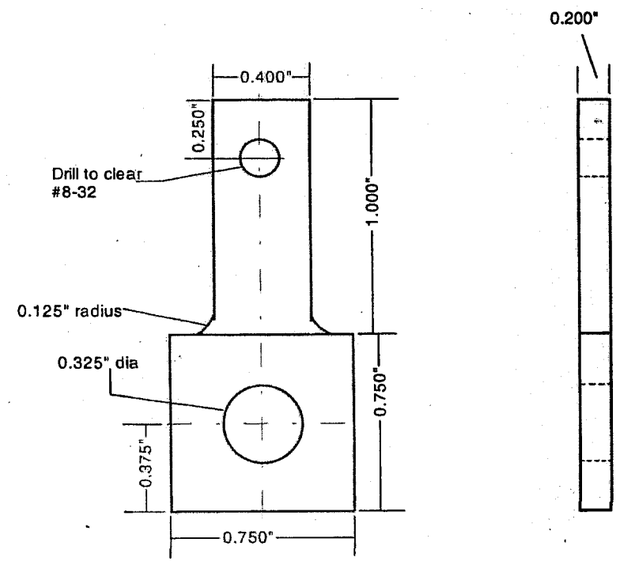
TITLE _____ Project No._____
Book No._____

From Page No.____

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

CNWRA Drawing 20-06002-01-322-002
Dimensional tolerances +/- 0.005"

To be completed at time of order:
Material: 316L Stainless Steel
Heat: P80746
Specimen Orientation: Normal to rolling direction
Other:



Darrell S. Dunn 3/11/05
Initiated by. D. Dunn Date

3/11/05
Reviewed by V. Jain Date

Mark R. Ehrnstrom 3/4/05
QA Approval B. Brient for Date

To Page No._____

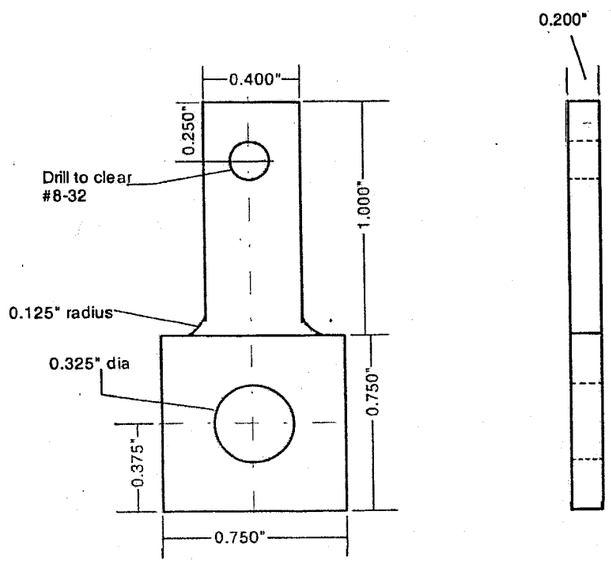
Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

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

CNWRA Drawing 20-06002-01-322-002
Dimensional tolerances +/- 0.005".

To be completed at time of order:
Material: Alloy 22 Welded
Heat: 2277-3-3292 and WN813
Specimen Orientation: as shown in drawings
Other:



Darrell S. Dunn 3/11/05
Initiated by. D. Dunn Date

Vijay Jain 3/11/05
Reviewed by V. Jain Date

Mark R. Ehrnstrom 3/11/05
QA Approval B. Brient for Date

To Page No.____

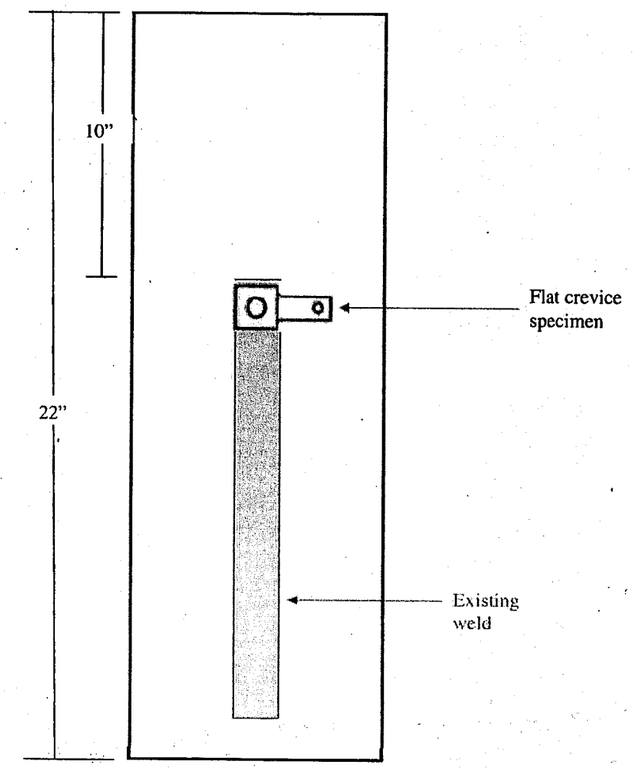
Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

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

CNWRA Drawing 20-06002-01-322-003
Dimensional tolerances: No applicable
Drawing for information only

To be completed at time of order:
Material: Alloy 22 Welded
Heat: 2277-3-3292 and WN813
Specimen Orientation: as shown



Darrell S. Dunn 3/11/05
Initiated by. D. Dunn Date

Vijay Jain 3/11/05
Reviewed by V. Jain Date

Mark R. Ehrnstrom 3/11/05
for QA Approval B. Brient Date

To Page No.____

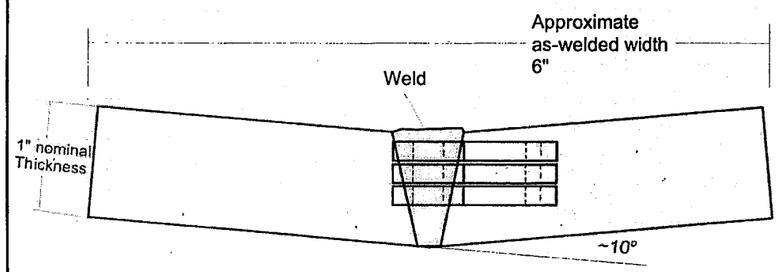
Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

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

CNWRA Drawing 20-06002-01-322-004
Dimensional tolerances: Not applicable
Drawing for information only

To be completed at time of order:
Material: Alloy 22 Welded
Heat: 2277-3-3292 and WN813
Specimen Orientation: as shown



1. Machine flat crevice specimens from welded plate
2. The 0.750" x 0.750" dimension of the crevice specimen to be centered in the weld
3. Three specimens from top layers of weld
4. Retain weld metal from machining

Darrell S. Dunn 3/11/05
Initiated by. D. Dunn Date

Vijay Jain 3/11/05
Reviewed by V. Jain Date

for Mark R. Ehrstrom 3/11/05
QA Approval B. Brient Date

To Page No.____

Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

07/05/2005 14:16 2104020369 TEXAS TOOLMAKERS INC PAGE 01

TEXAS TOOLMAKERS, INC.
11411 EAST COKER LOOP
SAN ANTONIO, TX 78216-2810

Phone: 210-494-3651
Fax: 210-494-6139

Page 1

CUSTOMER QUOTE/WORK ORDER

Quote Number: **Q2061**

Customer: **1111**
SOUTHWEST RESEARCH INSTITUTE
6220 CULEBRA ROAD
SAN ANTONIO, TX 78228

Quote Date: **7/5/2005**
Quote Good Until: **10/5/2005**
Terms: **0.5%/10 days,Net 30**
FOB: **TTI**

Contact: **XIHUA HE**
Cust. Phone: **522-5194**
Cust. Fax: **522-6081**

Assigned Job #:

ITEM	PART NUMBER	REV	DESCRIPTION	QUANTITY	UNIT PRICE	TOTAL
1.00	20-06002-01-322-002		CREVICE CORROSION SPECIMEN (316L)	10.00	135.00	$1,350.00
2.00	20-06002-01-322-002		CREVICE CORROSION SPECIMEN (C-22)	10.00	135.00	$1,350.00

Work Instructions:
DELIVERY: 3-4 WEEKS ARO

Quality Requirements: None As Noted Below
Material /Process Certification: Yes No Certificate of Compliance: Yes No Source Inspection: Yes No
Documented Dimensional Inspection: Yes No IF YES: 1) Specified Dimensions Only 2) Sampling 3) 100%
Authorized TTI Representative: Mike Ridgway Date: 7-5-05
Customer Acceptance: Title: Date:
Customer Comments:

Note: Price(s) may be affected if scope of work/inspection is deviated from that quoted.

For TTI Use Only
Reviewed by: Date: P.O. provided at time of review: ____Yes ____No

TTI Form QF-030101 Rev 2

To Page No.____

Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

11411 East Coker Loop
San Antonio, Texas 78216
Phone: (210) 494-3651
Fax: (210) 494-6139
www.texastoolmakers.com

TEXAS TOOL MAKERS INC

A8306

ISO 9001:2000

CERTIFICATE OF CONFORMANCE

TO: Southwest Research Institute
6220 Culebra Road
San Antonio, Tx. 78238-5166

CUSTOMER P.O. 544455G

TTI JOB #: 37071

DESCRIPTION 11 EA. P/N 20-06002-01-322-002 CREVICE CORROSION SPECIMEN (316L)

WE CERTIFY THAT THE ITEM(S) ON THE ABOVE REFERENCED PURCHASE ORDER HAVE BEEN PROCESSED AND/OR MANUFACTURED IN ACCORDANCE WITH:

Drawings

RECORDS ARE ON FILE AT THIS FACILITY, WHICH VERIFY OUR PROCESS CONTROLS, AND AVAILABLE FOR REVIEW UPON REQUEST. TEST RESULTS ARE AS FOLLOWS:

Accepted

TEXAS TOOLMAKERS,

BY : (Steve Espinoza)

TITLE: Q.C. Inspector

DATE : 7/19/05

To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by 7/20/05	

From Page No.____

11411 East Coker Loop
San Antonio, Texas 78216
Phone: (210) 494-3651
Fax: (210) 494-6139
www.texastoolmakers.com

TEXAS TOOL MAKERS INC

A8306

ISO 9001:2000

CERTIFICATE OF CONFORMANCE

TO: Southwest Research Institute
6220 Culebra Road
San Antonio, Tx. 78238-5166

CUSTOMER P.O. 544455G

TTI JOB #: 37071

DESCRIPTION 10 EA. P/N 20-06002-01-322-002 CREVICE CORROSION SPECIMEN (C-22)

WE CERTIFY THAT THE ITEM(S) ON THE ABOVE REFERENCED PURCHASE ORDER HAVE BEEN PROCESSED AND/OR MANUFACTURED IN ACCORDANCE WITH:

Drawings

RECORDS ARE ON FILE AT THIS FACILITY, WHICH VERIFY OUR PROCESS CONTROLS, AND AVAILABLE FOR REVIEW UPON REQUEST. TEST RESULTS ARE AS FOLLOWS:

Accepted

TEXAS TOOLMAKERS,

BY : Casey Ridgway (Casey Ridgway)

TITLE: Q.A. Manager

DATE : 7/20/05

To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date
	7/20/05	Recorded by	

From Page No.____

11411 East Coker Loop
San Antonio, Texas 78216
Phone: (210) 494-3651
Fax: (210) 494-6139
www.texastoolmakers.com

TEXAS TOOL MAKERS INC.

A8306

ISO 9001:2000

CERTIFICATE OF CONFORMANCE

TO: Southwest Research Institute
6220 Culebra Road
San Antonio, Tx. 78238-5166

CUSTOMER P.O. 544455G

TTI JOB #: 37071/3

DESCRIPTION 10 EA.; P/N 20-06002-01-322-002 Crevice Corrosion Specimen C-22

WE CERTIFY THAT THE ITEM(S) ON THE ABOVE REFERENCED PURCHASE ORDER HAVE BEEN PROCESSED AND/OR MANUFACTURED IN ACCORDANCE WITH:

Drawing

RECORDS ARE ON FILE AT THIS FACILITY, WHICH VERIFY OUR PROCESS CONTROLS, AND AVAILABLE FOR REVIEW UPON REQUEST. TEST RESULTS ARE AS FOLLOWS:

Accepted

TEXAS TOOLMAKERS,

BY : Casey Ridgway (Casey Ridgway)
TITLE: Q.A. Manager
DATE : 7/25/05

To Page No._____

Witnessed & Understood by me,	Date 7/29/05	Invented by	Date
		Recorded by	

From Page No.____

THERMALLY AGED PROCEDURE

Quanity/Specimens = 5 C-22 HT 2277-3-329 WN813
Weld Specimens

OVEN= Lindberg model #51333 SN#909172

OVEN SETPOINT= 1130 °C

OVEN TEMPERATURE= 1136 °C

Measurement taken with FISHER MICROPROCESSOR THEMOMETER
SN#= 41523645 CAL= 6/7/05 DUE= 6/7/06

Thermocouple=
SN#= 330 Cal = 7/26/05 Due = 1/26/06

AMOUNT OF TIME = 20 min

DETAILS= Placed All 5 Specimens Into oven for 20 min @ Temp Set Point then Water Quenched

To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date 8/2/05
		Recorded by	

Project No._____
Book No._____ TITLE_____

From Page No.

POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L HT# P80746 w/ C22 HT# 2277-3-3266 Crevice Washer + Bolts

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing #20.06002.01-322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In Oz. **SN:** 139072 **Cal:** 4/11/05 **Due:** 10/11/05

Initial Weight: 22.02235 g **Final Weight:** 21.96113 g **Model:** Sartorius Genius **Cal:** 5/11/05 **SN:** 12809099 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.58 g NaCl Lot# 045904
+ DI to 2000 mls

Test ID:
316SSBA2200

Reagents measured with **Model:** OHAUS **Cal:** 7/12/05 **SN:** 2883 **Due:** 1/12/06

Initial pH: 6.71 **Final pH:** 7.23 **Model:** Orion EA 940 **Cal:** 7/25/05 **pH Probe:** #13-620-296 **SN:** 2330 **Due:** 7/25/06 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **Cal:** 4/1/05 **SN:** F98-393 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.995% N_2

Ecorr: ~351 mv **Ept:** +257 mv > Zero Air Readings **Model:** Keithley 614 **Cal:** 5/27/05 **SN:** 0704936 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 00148500

DATA FILE: 316LOCAIR, 316LOCN2, 316LOCN2b, 316LOCN2C, 316LBA22, 316LBA22b, 316LBA22c, 316LBA22d, 316Lscanup, 316LscanH, 316LscanD

Number of Crevice Corrosion Sites: 24/24 (24 max.)

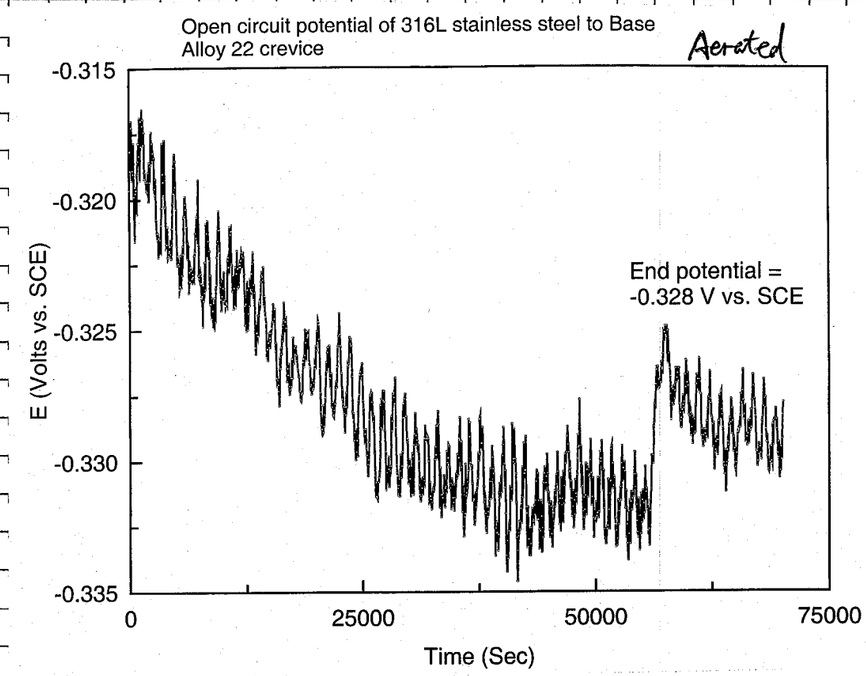
Crevice Corrosion on 24/24 feet of Crevice Washer
Pitting on outer Edge Surfaces of Specimen - Milo
Surface staining on All Sides

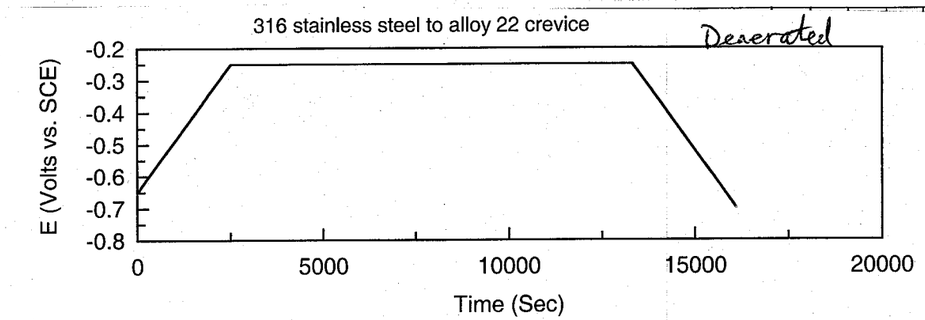
Crevice Washers OK

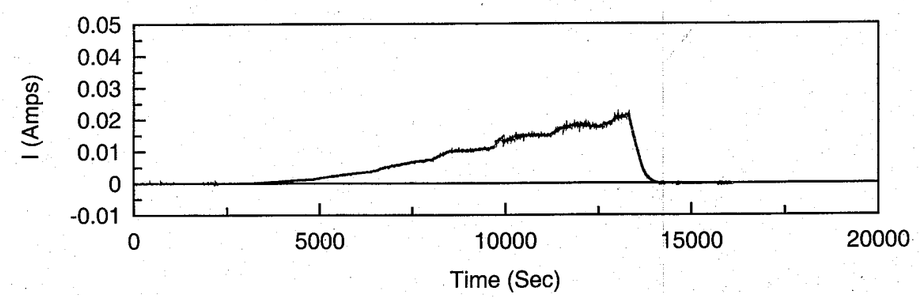
Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/25/05

TITLE_____ Project No._____
Book No._____

From Page No.







To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date
	7/25/05	Recorded by	

From Page N

POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT#2277-3-3292 filler WN813 w/C-22 HT#2277-3-3266 Crevice Washers And Bolts
SA 1125°C 20 min See NB#712 Pg# 62

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In.-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 22.6744g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 22.6713g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.55g NaCl Lot# 045904
+ DI water to 2000mls

Test ID:
WA22SABA2200

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 7.67 **Model:** Orion EA 940 **SN:** 2330
Final pH: 5.76 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/22/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC w/zero Air then 99.999% N_2

Ecorr: -197 mv } Taken
Ept: +242 mv } Zero Air **Model:** Keithley 614 **SN:** 0704936
Cal: 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 00153550

DATA FILE: ~~W C22~~ X.H 7/25/05 WASACC22OC air, WASACC22BAOC N2, wasac22SAP
wasac22SH, wasac22SD

Number of Crevice Corrosion Sites: 1 /24 (24 max.)

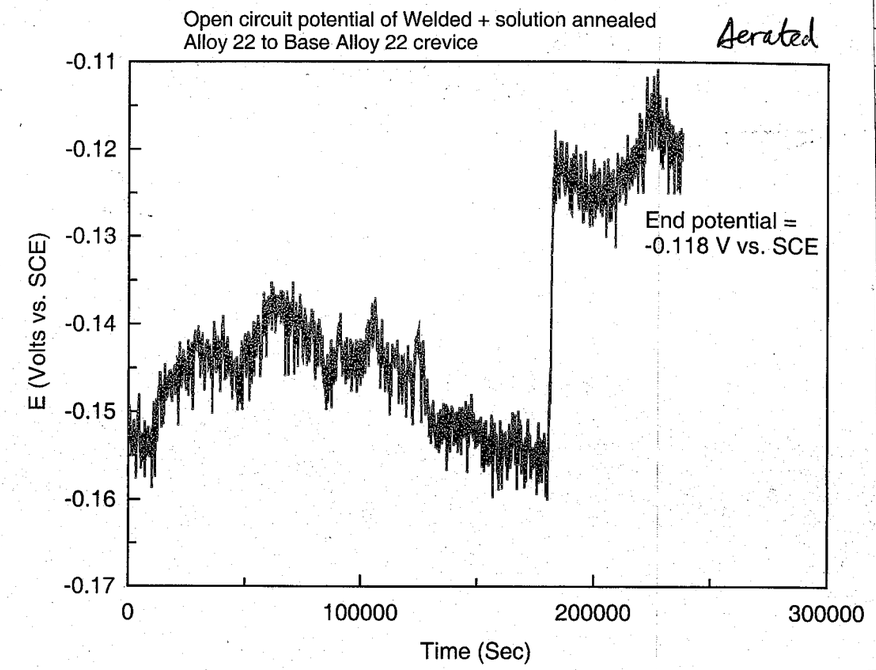
Crevice Corrosion on 1/24 feet of Crevice Washer
Crevice washers OK. Mild Surface staining

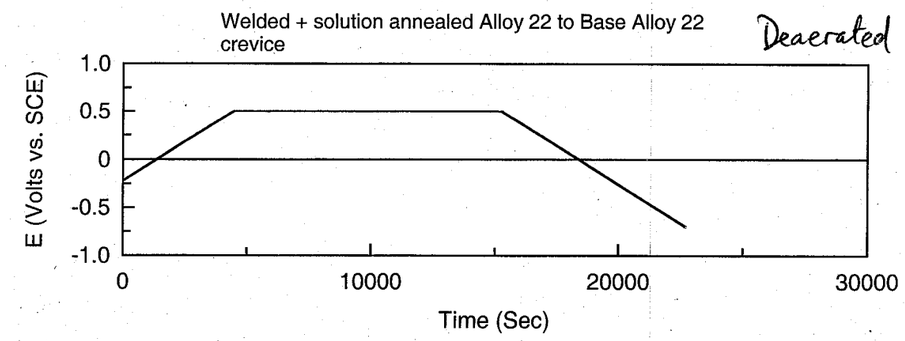
* Note: Specimen Not Repolished

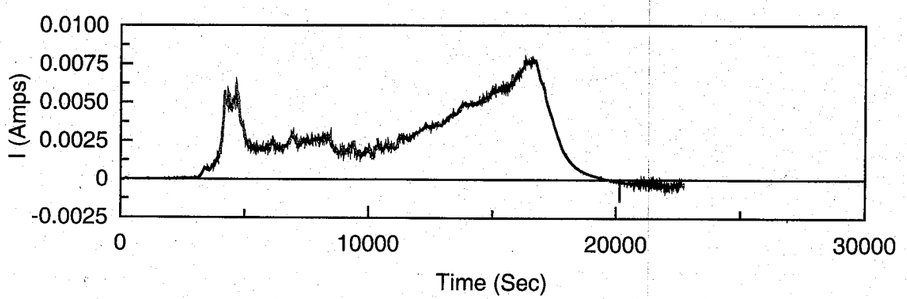
To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	7/25/05

From Page No.







To Page No.

Witnessed & Understood by me,	Date	Invented by	Date
	7/25/05	Recorded by	

From Page

POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L MT # P80746 Stainless steel w/C-22 HT 2277-3-3266 Crevice Washers + Bolt/Nut

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002, Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 — **Model# &Torque:** 50 In-Oz — **SN:** 139072 — **Cal:** 4/11/05 — **Due:** 10/11/05

Initial Weight: 21.93368g — **Final Weight:** 21.59342 — **Model:** Sartorius Genius — **SN:** 12809099 — **Cal:** 5/11/05 — **Due:** 11/11/05

Solution: 4.0 M NaCl; 467.53g NaCl Lot# 045904 + DI to 2000 ml

Test ID: 316SSBA220 1a

Reagents measured with — **Model:** OHAUS — **SN:** 2883 — **Cal:** 7/12/05 — **Due:** 1/12/05

Initial pH: 7.78 — **Final pH:** 8.29 — **Model:** Orion EA 940 — **SN:** 2330 — **Cal:** 7/25/05 — **Due:** 7/25/06 — **pH Probe:** #13-620-296 — **SN:** 4065196

Test Temperature: 95°C — **Measured with Hg Thermometer** — **SN:** F98-393 — **Cal:** 4/1/05 — **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 — **SN:** 3329075

Gas: OC w/zero Air then 99.999% N_2 for Repassivation measurement

Ecorr: -92 mV vs. SCE — **Ept:** 179.6 mV vs. SCE — **Model:** Keithley 614 — **SN:** 0704936 — **Cal:** 5/27/05 — **Due:** 5/26/06

Potentiostat: Solartron 1287 — **SN:** 0 0148500

DATA FILE: 316LOC AIR_a, 316LOC N2_a, 316LSU-a, 316LSU-b, 316LSH_a, 316LSU-c, 316LSH-b, 316LSU-d, 316LSH-c, 316LSU-e, 316LSH-d, 316LSU-f, 316LSH-e, 316LSU-g, 316LSH-f, 316LSD_a

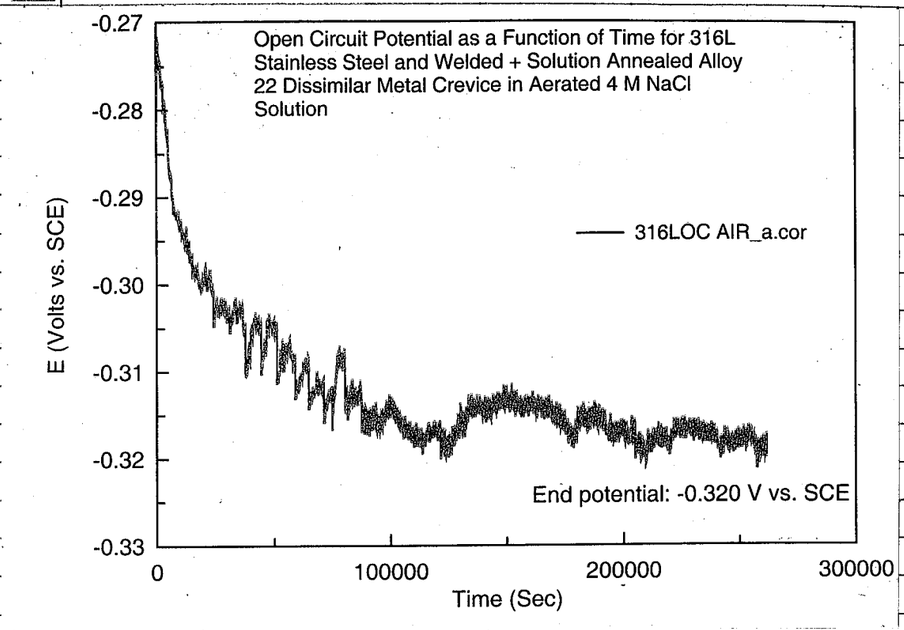
Number of Crevice Corrosion Sites: 21/24 (24 max.) X.H 10/5/05

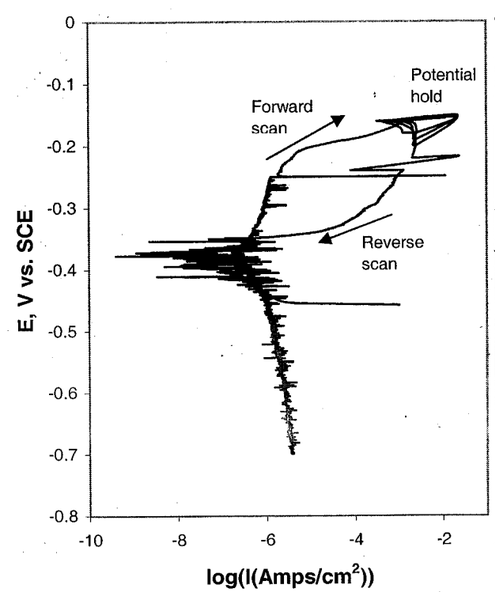
Crevice Corrosion on 21/24 feet of C-22 washer/cathode
No Corrosion on Crevice Washers or Bolt - Pitting on outside Edges of Specimen with Staining.

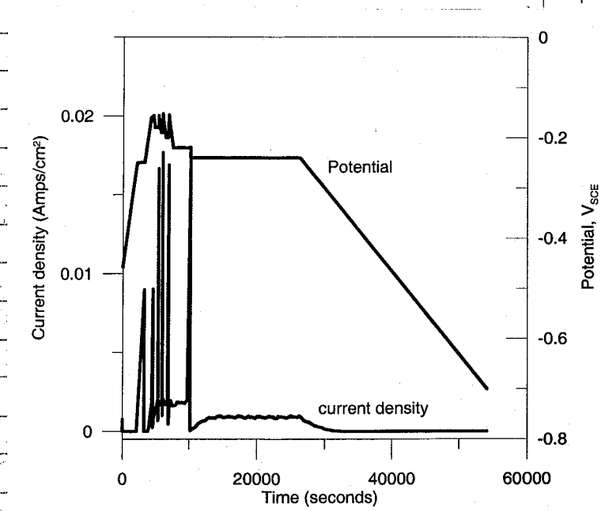
To Page No._____

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	7/29/05

From Page No.







Cross-over potential: -349 mV SCE

316L stainless steel (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, bolt wrapped with Teflon tape
Anode to cathode area ratio: ~1/3, Torque: 50 in-oz,
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: -240 mV_{SCE}, for 5 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculating current density:
$i < 10^{-5}$ A/cm² at -340 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -345 mV_{SCE};
$i < 10^{-6}$ A/cm² at -347 mV_{SCE}
Using crevice specimen area for calculating current density:
$i < 10^{-5}$ A/cm² at -345 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -348 mV_{SCE};
$i < 10^{-6}$ A/cm² at -354 mV_{SCE}

Witnessed & Understood by me,	Date	Recorded by	8/2/05

From Page No.

POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT #2277-3-3292 filler WN813 w/c-22 HT #2277-3-3266 crevice washers & Bolts, nuts
SA 1125°C 20min See NB# 712 pg# 62

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. XIH 10/4/05

Bolt wrapped with Teflon XIH 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-Oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 22.46416 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 22.45928 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.54 NaCl Lot # 045904
+ DI water to 2000mL

Test ID ~~WA22~~ WA2288A2201a
XIH 8/16/05

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 6.40 **Model:** Orion EA 940 **SN:** 2330
Final pH: 6.73 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/22/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC Zero Air then 99.999% N_2 for E Repassivation Measurement
Ecorr: -181 mV vs SCE (N_2) **Model:** Keithley 614 **SN:** 0704936
Ept: 223.5 mV vs. SCE (N_2) **Cal:** 5/27/05 **Due:** 5/26/06
Potentiostat: Solartron 1287 **SN:** 06153550

DATA FILE: C22 /WASAC22OCair, WASAC22BAOCN2, WASAC22SWP_a
WASAC22SH-a, WASAC22sd_a

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen - Just gold tint staning
Crevice Bolt And Nut on outside of Crevice washer Bolt
And Nut have Corrosion. But No Corrosion on facial
Surface of C-22 Crevice washers

Note: Will Repolish Specimen for further Testing

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	7/29/05

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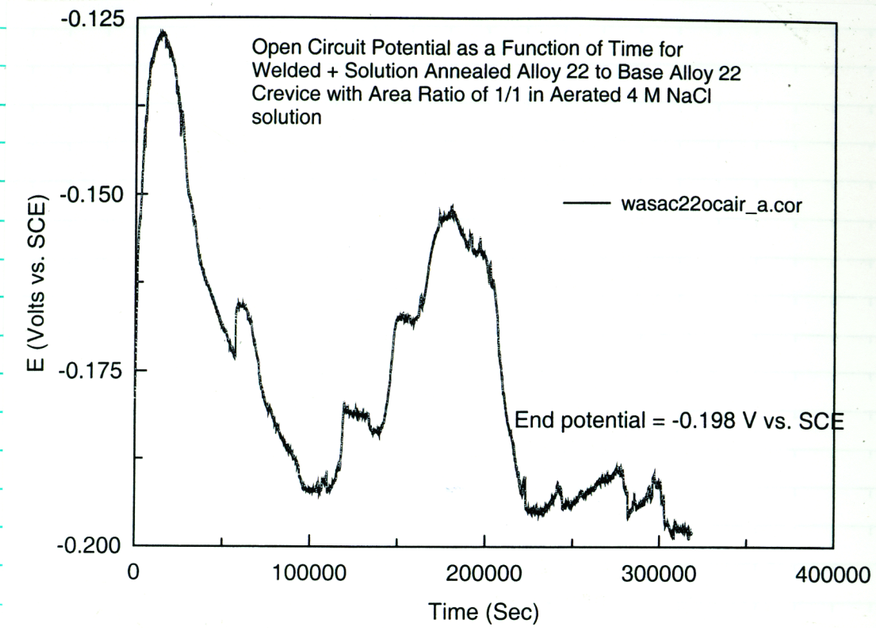

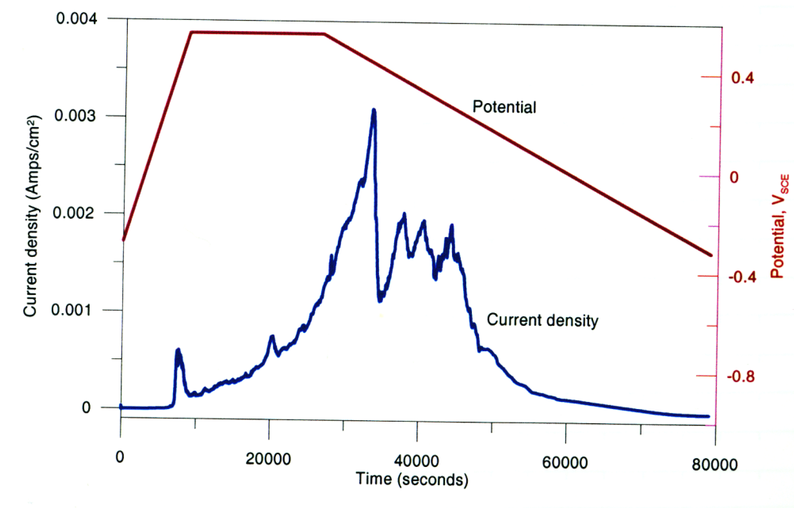

Welded + solution annealed Alloy 22 (Anode) with Base Alloy 22 (Cathode) metal to metal crevice
Base Alloy 22 bolt and nut, bolt wrapped with Teflon tape
Anode to cathode area ratio: ~1/3; Torque: 50 in-oz; N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV_{SCE} for 5 hours; Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at -224 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -249 mV_{SCE}; $i < 10^{-6}$ A/cm² at -252 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 Ht 2277-3-3292 filler WN 813 SA 1125°C 20min Sec NB 712 Ag #62 w/c-22 Ht # 2277-3-3266 Crevice washer & isolts & nuts

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torqued to 50 in-oz.or 75 in lbs.~~ - C22 Crevice Cathode Lg Bolt wrapped with Teflon 20.06002.01.322.002. x.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072 **Cal:** 4/11/05 **Due:** 10/11/05

Initial Weight: 22.63143g **Model:** Sartorius-Genius **SN:** 12809099
Final Weight: 22.62865g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.6g NaCl Lot# 045504
+ DI water to 2000 mls

Test ID: WA22SABA2202a

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 6.34 **Model:** Orion, EA 940 **SN:** 2330
Final pH: 6.84 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065156

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-273
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

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

Gas: UC Zero Air than 99.999% N_2

Ecorr: -189 mV$_{SCE}$ 3N_2 **Model:** Keithley 614 **SN:** 0704936
Ept: +363 mV$_{SCE}$ **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: C-22SAC22COL, C22SAC22COCN2, C22SAC22CSU, C22SAC22CSh, C22SAC22CSul, C22SAC22CSol

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen - Gold tint staining
Crevice Corrosion on Bolt, Nut And outside of Crevice washer. But No Corrosion on C-22 Crevice Washer face

* Note: will Repolish specimen for further Testing

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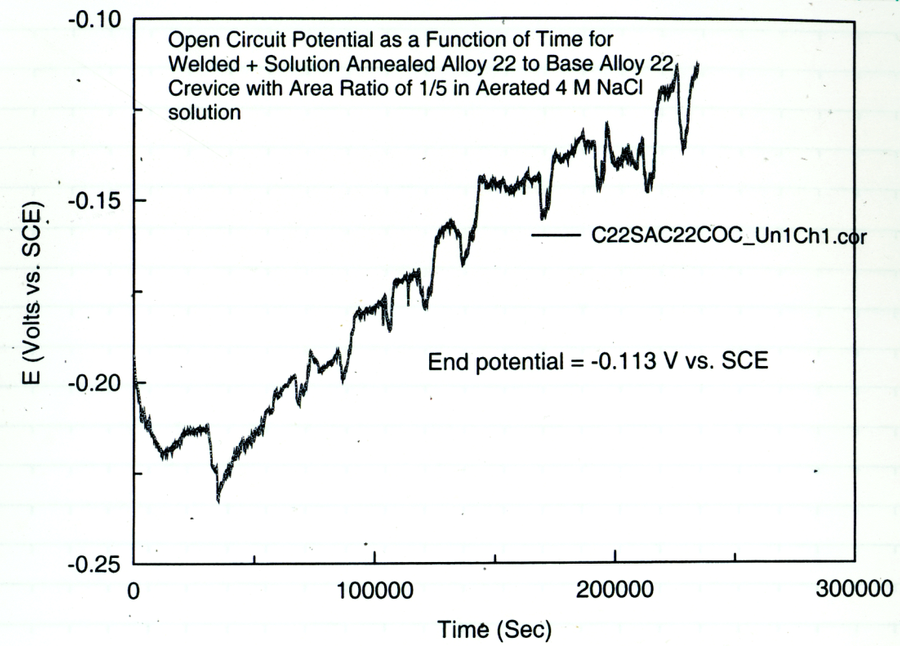

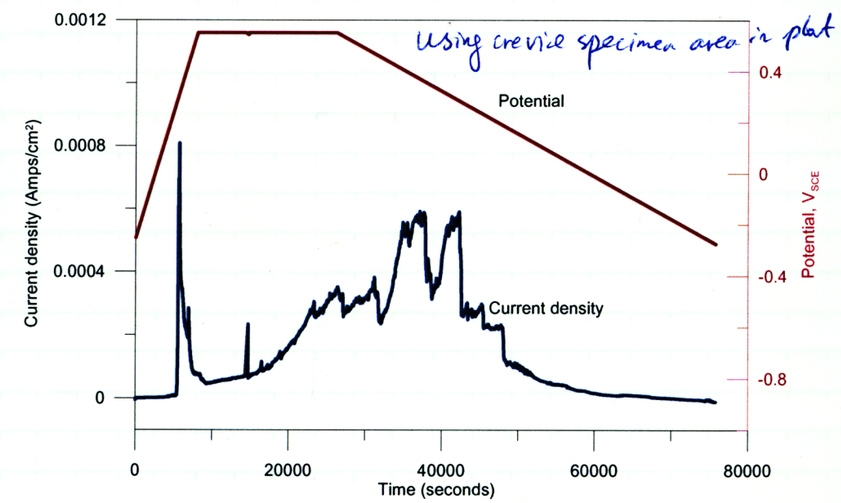

Welded + solution annealed Alloy 22 (Anode) with Base Alloy 22 (Cathode) metal to metal crevice
Base Alloy 22 bolt and nut, bolt wrapped with Teflon tape
Anode to cathode area ratio: ~1/5; Torque: 50 in-oz; N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV$_{SCE}$ for 5 hours; Reverse scan rate: 0.0167 mV/s
$i < 10^{-5}$ A/cm² at -88.4 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at -154 mV$_{SCE}$; $i < 10^{-6}$ A/cm² at -168 mV$_{SCE}$

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT 2277-3-3266 Base Alloy w/C-22 HT 2277-3-3266 Hardware area ratio: 1/3

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. KH 10/4/05 KH 10/4/05

Torque Screwdriver: Pauto 6104 **Model# &Torque:** 50 In-Oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.85259 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.84918 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.66g NaCl Lot# 045944
+ DI water To 2000mls

Test ID: BA22BA220/a

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/05

Initial pH: 5.95 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.83 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** F98.393
Cal: 4/1/05 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: -266mv OC -285mv N_2 **Model:** Keithley 614 **SN:** 0704936
Ept: +168mv +75mv **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 001485000

DATA FILE: C-22BAAIR_a, C22BAOCN2_a, C22BASU, C22BASH, C22BASD.

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen or Hardware
Gold tint Staining on All Surfaces of Specimen And Crevice washer Hardware

Note: will polish specimen for further testing.

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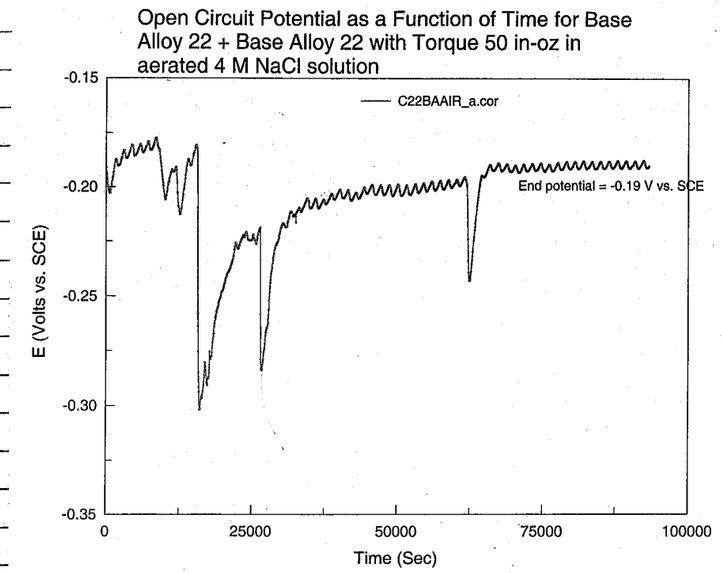
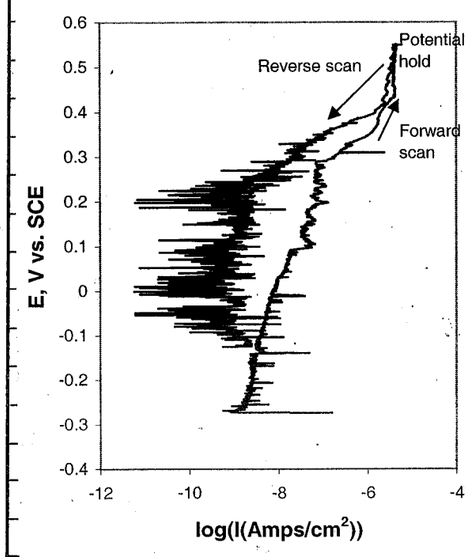
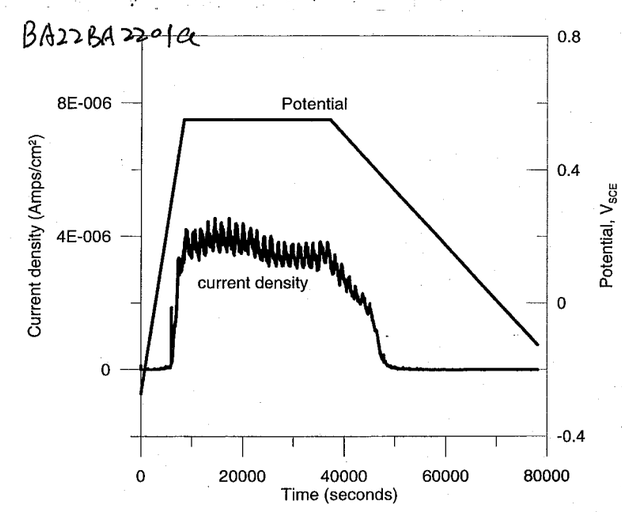




No cross-over point

BA22BA220/a



Base Alloy 22 (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, no Teflon tape wrapped
Anode to cathode area ratio: ~~1/4~~, Torque: 50 in-oz,
N_2 deaerated, 95 °C, 4 M NaCl solution 1/3 KH 8/12/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE}, for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculatin current density:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 452 mV_{SCE};
$i < 10^{-6}$ A/cm² at 395 mV_{SCE}
Using crevice specimen area for calculatin current density:
$i < 10^{-5}$ A/cm² at 368 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 336 mV_{SCE};
$i < 10^{-6}$ A/cm² at 315 mV_{SCE}

Witnessed & Understood by me,	Date	Invented by	Date
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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3266 w/C-22 HT# 2277-3-3266 Hardware 1/3 area ratio

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 70.056002.01.702002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ Torque to 50 in-oz.or 75 in lbs. XH 10/4/05

Torque Screwdriver: Teve Craft **Model# &Torque:** 75 In-lbs **Cal:** 7/22/05 **SN:** 694000691 **Due:** 7/21/06 XH 10/4/05

Initial Weight: 23.73807g **Final Weight:** 23.73076g **Model:** Sartorius Genius **Cal:** 5/11/05 **SN:** 12809099 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.56g NaCl Lot # 045904
+ DI water To 2000 mL

Test ID: BA22BA2202a

Reagents measured with **Model:** OHAUS **Cal:** 7/12/05 **SN:** 2883 **Due:** 1/12/06

Initial pH: 6.29 **Final pH:** 8.02 **Model:** Orion, EA 940 **Cal:** 7/25/05 **pH Probe:** #13-620-296 **SN:** 2330 **Due:** 7/25/06 **SN:** 4065196

Test Temperature: 95°c **Measured with Hg Thermometer** **Cal:** 6/22/05 **SN:** E98-191 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC Zero Air then 99.999% N_2 for E Repassivation

Ecorr: −0.277 V_{SCE} } N_2 **Ept:** 86 mV/SCE **Model:** Keithley 614 **Cal:** 5/27/05 **SN:** 0704936 **Due:** 5/26/05

Potentiostat: Solartron 1480 **SN:** ~~00133550~~ 00238265 2ND 11/2/05

DATA FILE: C-22BAOC, C22BAN2, C22BASU, C22BASH, C22BASU6, C22BAS HUnICH, C22BASD

Number of Crevice Corrosion Sites: 1 /24 (24 max.)

Crevice Corrosion on 1/24 feet of C-22 Crevice Washer Also Crevice Washer Has Corrosion on Same Location As Specimen. Also outside of Crevice Bolt Nut Has Location of Corrosion And mild Corrosion on threading of Bolt Gold tint staining on All Surfaces

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/3/05

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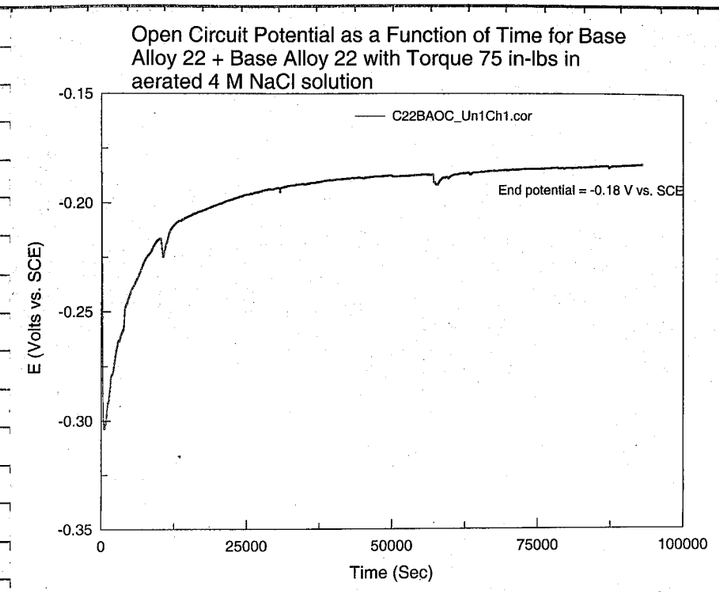

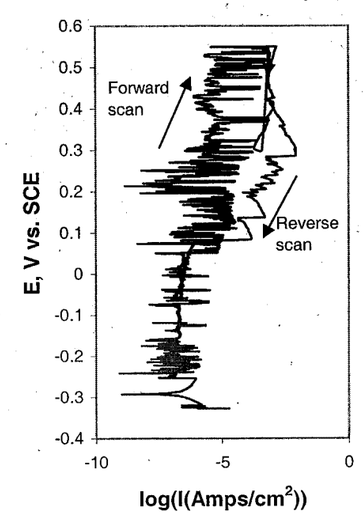

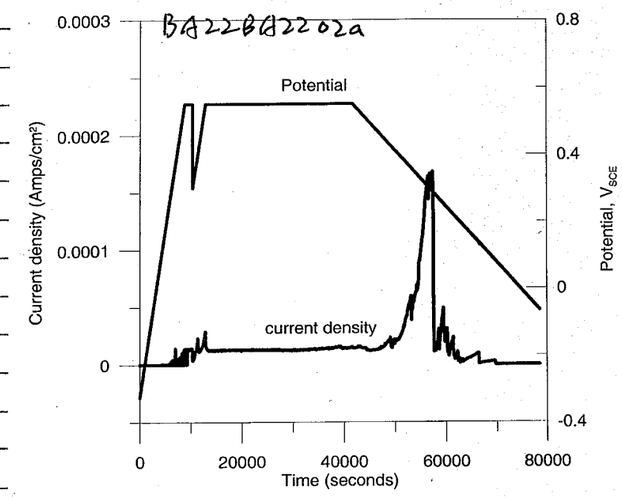

Base Alloy 22 (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, no Teflon tape wrapped
Anode to cathode area ratio: ~~1/1~~, Torque: 75 in-lbs, 1/3 area ratio XH 8/12/05
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE}, for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculating current density:
$i < 10^{-5}$ A/cm² at 220 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 137 mV_{SCE};
$i < 10^{-6}$ A/cm² at 137 mV_{SCE}
Using crevice specimen area for calculating current density:
$i < 10^{-5}$ A/cm² at 101 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 82.1 mV_{SCE};
$i < 10^{-6}$ A/cm² at 82.1 mV_{SCE}

Cross-over potential: 465 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L HT#P80746 w/C-22 2277-3-3266 Hardware 1/3 area ratio

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266 Hardware Torque to~~ 50 in-oz.or 75 in lbs, torque. X.H 10/4/05 X.H 10/4/05 #06002-01.372.002 X.H 10/4/05

Torque Screwdriver: Tave Craft **Model# &Torque:** 75 In-lbs **Cal:** 7/22/05 **SN:** 694000691 **Due:** 7/21/06

Initial Weight: 22.66403g **Final Weight:** 21.7001g **Model:** Sartorius Genius **Cal:** 5/11/05 **SN:** 12809099 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.5g NaCl lot #051510
+ DI water to 2000 mls

Test ID: 316SSBA2202a

Reagents measured with **Model:** OHAUS **Cal:** 7/12/05 **SN:** 2883 **Due:** 1/12/05

Initial pH: 5.47 **Final pH:** 5.65 **Model:** Orion EA 940 **Cal:** 7/25/05 **SN:** 2330 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **Cal:** 4/1/05 **SN:** F98-393 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: -0.337 V_{SCE} (N_2) **Ept:** 212 V_{SCE} **Model:** Keithley 614 **Cal:** 5/27/05 **SN:** 0704936 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 001485000

DATA FILE: C22BA316SSAIR_a, 316C22BAOCN2, C22BA316SS75U, C22BA316SS75H, C22BA316SS75Ub, C22BA316SS75Hb, C22BA316SS75D

Number of Crevice Corrosion Sites: 24/24 (24 max.)

Crevice Corrosion on 24/24 feet of C-22 Crevice Washer
C-22 Crevice Washer & Hardware No Sign of Corrosion
Gold tint staining on All Surfaces Including Hardware
Also 316L Specimen Had Large Pitting Areas Along Bottom Edge of Specimen

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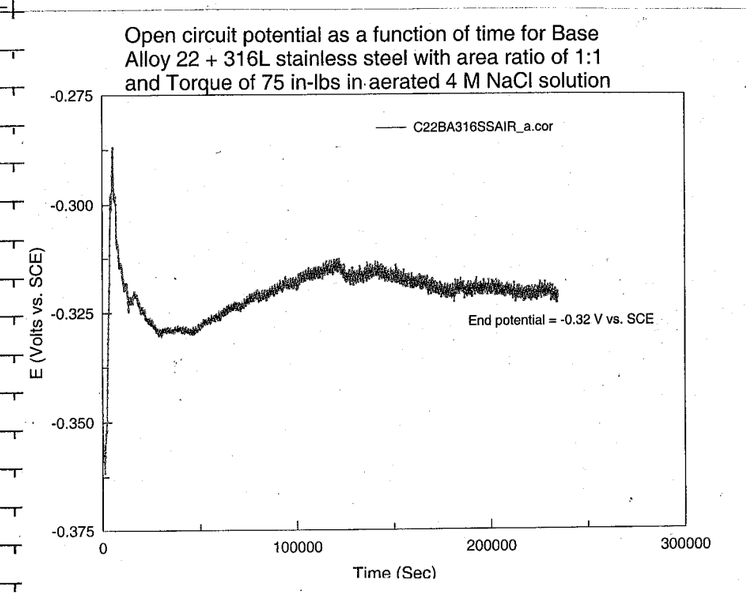
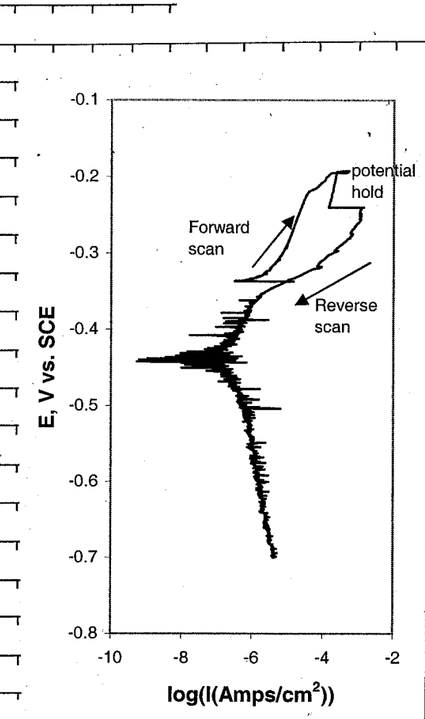
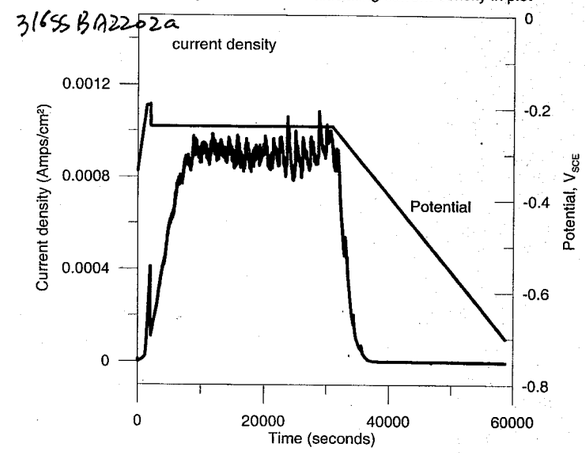




Cross-over potential = -337 mV$_{SCE}$

Entire crevice assembly area used for caluclating current density in plot

316SSBA2202a



316 Stainless steel (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, no Teflon tape wrapped
Anode to cathode area ratio: ~~1/1~~, Torque: 75 in-lbs
N_2 deaerated, 95 °C, 4 M NaCl solution 1/3 X.H 8/12/05
Forward scan rate: 0.1 mV/s, Potential hold: -240 mV$_{SCE}$ for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for calculating current density
$i < 10^{-5}$ A/cm² at -334 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at -349 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at -362 mV$_{SCE}$
Using crevice specimen area as surface area for calculating current density
$i < 10^{-5}$ A/cm² at -348 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at -386 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at -392 mV$_{SCE}$

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT # 2277-3-3266 w/ Ti 7 Hardware See Pg #6 - #7

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing: Area ratio #20.06022.01. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. 1/18 322.002 X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In-lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/06

Initial Weight: 23.63031 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.62920 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.54 g NaCl Lot # 051510
+ DI water To 2000 ml

Test ID: BA22Ti70/a

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.39 **Model:** Orion, EA 940 **SN:** 2330
Final pH: 7.67 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95 °C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/22/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: UC zero Air then 99.999% N_2 for E Repassivation

Ecorr: -0.211 V_{SCE} **Model:** Keithley 614 **SN:** 0704926
Ept: 88 mV_{SCE} **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** ~~00153550~~ 00238265 BHP 11/9/05

DATA FILE: Ti7C22BAOC (OCP measurement in air), Ti7C22BAN2 (OCP in N_2) Ti7C22BASU, Ti7C22BASH, Ti7C22BASD (Erepass measurement in N_2)

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on Specimen - Specimen shows slight scratching on surface for Torque Procedure of Ti 7 crevice washer plates - Slight staining on All Surfaces

Note: will polish specimen for further testing.

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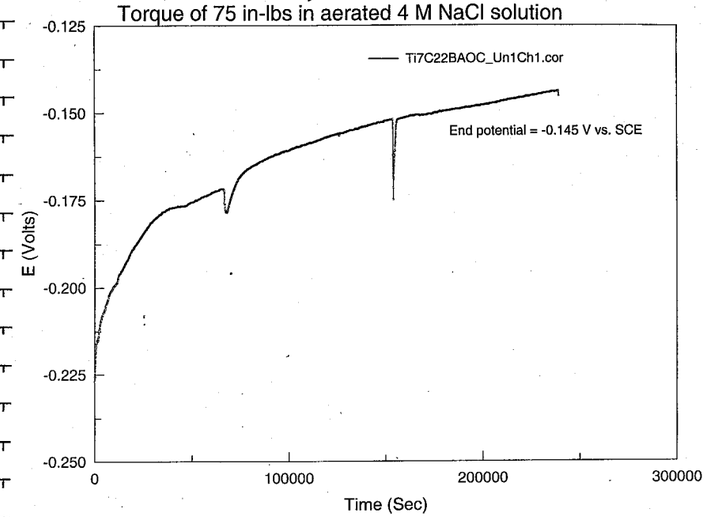
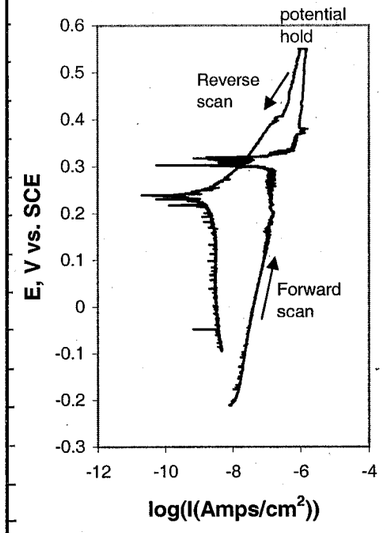
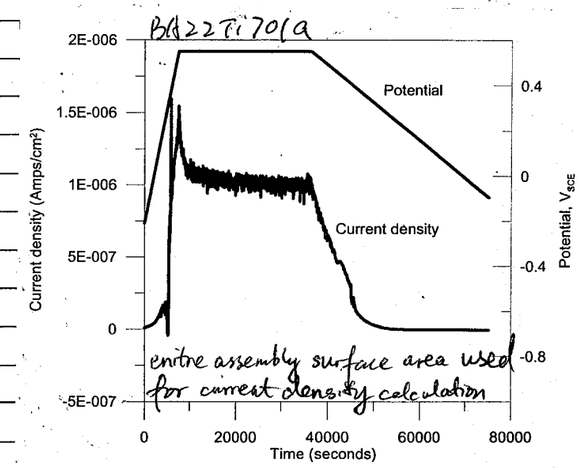
Open circuit potential as a function of time for titanium Grade-7 + Base Alloy 22 with area ratio of 10:1 and Torque of 75 in-lbs in aerated 4 M NaCl solution





Cross-over potential: 318 mV



Base Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~1/10; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution 18 X.H 8/16/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 5 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 550 mV_{SCE};
$i < 10^{-6}$ A/cm² at 550 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 475 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 382 mV_{SCE};
$i < 10^{-6}$ A/cm² at 351 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 2277-3-3266 Thermally Aged See Pg #23 w/ C-22 2277-3-3266 Hardware Pg #11 X.H 8/16/05 Welded X.H 8/16/05

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing* area ratio 1/10 X.H 8/16/05
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/14/05

Torque Screwdriver: True Craft	**Model# &Torque:** 75 In-lbs **Cal:** 7/22/05	**SN:** 694000691 **Due:** 7/21/06
Initial Weight: 23.6255 g **Final Weight:** 23.6190 g	**Model:** Sartorius Genius **Cal:** 5/11/05	**SN:** 12809099 **Due:** 11/11/05
Solution:	4.0 m NaCl 467.63 g NaCl Lot#051510 + DI water to 2000 mls	
Test ID: WA22SA&BA22203a		
Reagents measured with	**Model:** OHAUS **Cal:** 7/12/05	**SN:** 2883 **Due:** 1/12/05
Initial pH: 5.29 **Final pH:** 6.86	**Model:** Orion EA 940 **Cal:** 7/25/05 **pH Probe:** #13-620-296	**SN:** 2330 **Due:** 7/25/06 **SN:** 4065196
Test Temperature: 95°C	**Measured with Hg Thermometer** **Cal:** 4/1/05	**SN:** F98-353 **Due:** 9/30/05
Counter Electrode: Platinum Flag		
Reference Electrode: Fisher 13-620-52		**SN:** 3329075
Gas: OC w/zero Air then 99.995% N_2 for E Repassivation		
Ecorr: -0.276 V_{SCE} (N_2) **Ept:** 80 mV_{SCE} (N_2)	**Model:** Keithley 614 **Cal:** 5/27/05	**SN:** 0204936 **Due:** 5/26/06
Potentiostat: Solartron 1287		**SN:** 0 01485000

DATA FILE: C22SAC22CathAIR-a, C22SAC22CathN2, C22SAC22CathSU, C22SAC22CathH, C22SAC22CathSD

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on Specimen or Hardware (Bolt & Nut)
Cathode Has Dark Gold tint staining on All Surfaces
All Hardware ~~All so~~ Also Has Same Staining

Note: Will polish specimen for further testing

*Drawing number: 20.06002.01.322.002

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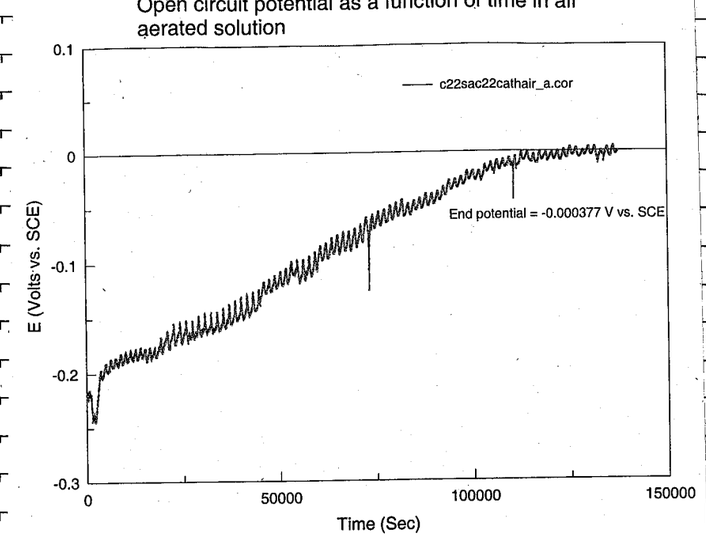

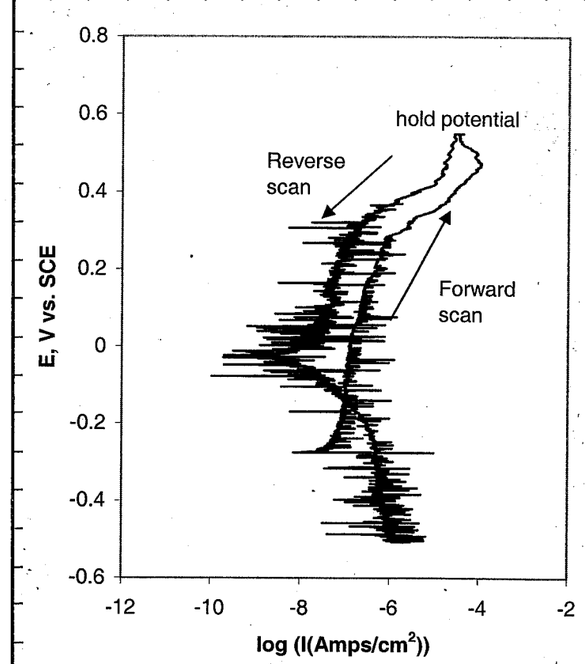

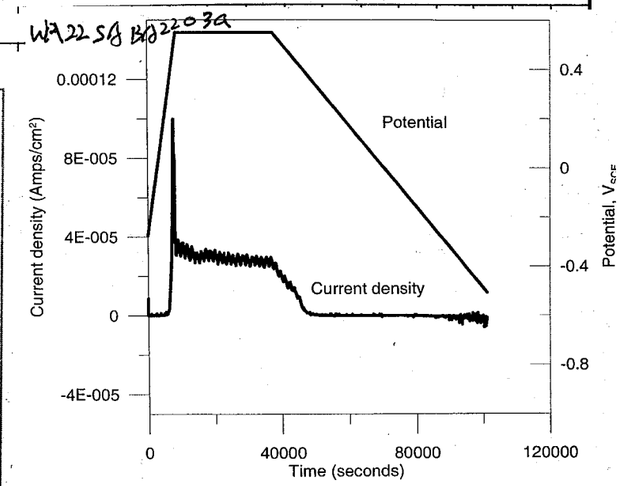

Note. No crevice corrosion, no cross-over

Welded + solution annealed Alloy 22 (Anode)
with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut to X.H 8/16/05
Anode to cathode area ratio: ~1/5; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV_{SCE} for 5 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for current density,
$i < 10^{-5}$ A/cm² at 432 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 390 mV_{SCE};
$i < 10^{-6}$ A/cm² at 370 mV_{SCE}
Using crevice specimen area as surface area for current density,
$i < 10^{-5}$ A/cm² at 370 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 322 mV_{SCE};
$i < 10^{-6}$ A/cm² at 276 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3266 Thermally Aged Sec pg #23 w/ C-22 2277-3-3266 Hardware pg #10
WN813 - Welded

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.
X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/01

Initial Weight: 23.50991g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.50633g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.6 lg NaCl Lot# 051510
+ DI to 2000 mls.

Test ID: WA22SAB2204a

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.11 **Model:** Orion EA 940 **SN:** 2330
Final pH: 8.08 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/27/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC zero Air then 99.999% N_2 for E Repassivation
Ecorr: −0.265 V_{SCE} (N_2 deaerated) **Model:** Keithley 614 **SN:** 6704936
Ept: +220 mV_{SCE} (N_2 deaerated) **Cal:** 5/27/05 **Due:** 5/26/05
Potentiostat: Solartron 1480 **SN:** ~~0015550~~ 0238265 AKO 8/11/05

DATA FILE: C22SAAirOC_Un1Ch1 (in aerated solution), C22SAN2-Un1Ch1 (N_2 deaeration), C22SASE-Un1Ch1, C22SASH-Un1Ch1, C22SASD-Un1Ch1

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

There is corrosion between Alloy 22 washer and Alloy 22 nut.
No corrosion between Alloy 22 cathode and crevice specimen.

Note: Will polish specimen for further testing

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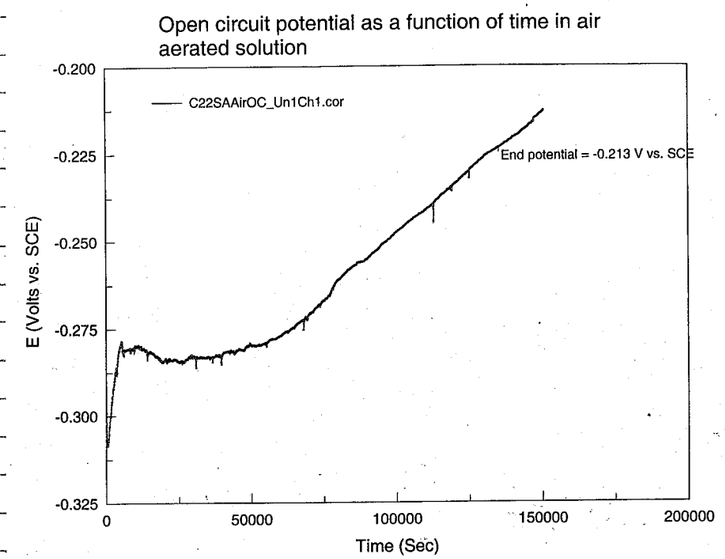
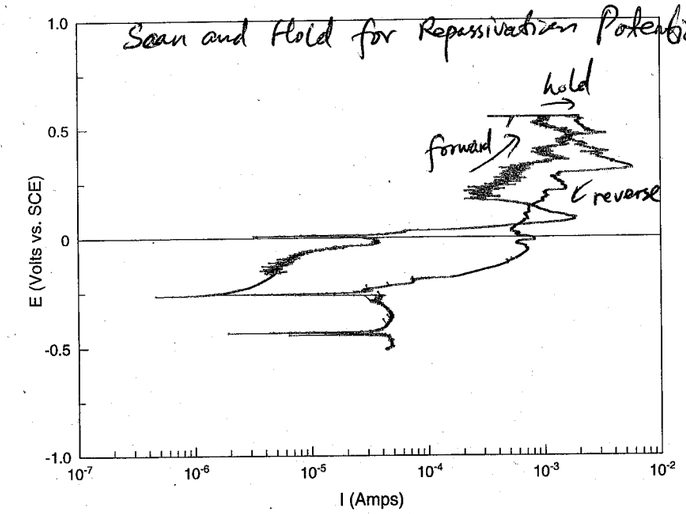
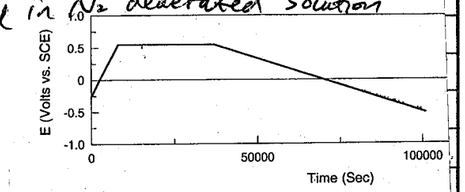
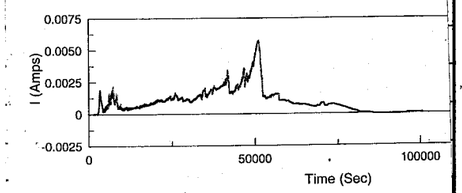


Scan and Hold for Repassivation Potential in N_2 deaerated solution







The cross over potential is 460 mV

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No. : C-22 HT#2277-3-3266 Base Alloy w/ Ti 7 CN2775 Crevice Washer + Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing# 1/3 area ratio
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.
X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.85716g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.84438g **Cal:** 5/11/05 **Due:** 11/11/05

Solution:
4.0 m NaCl
467.59g NaCl *051510 Lot
+ DI To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/05

Initial pH: 5.32 **Model:** Orion EA 940 **SN:** 2330
Final pH: 8.10 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296. **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** F98.393
Cal: 4/1/05 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.995% N_2 for E Repassivation

Ecorr: -164 mv **Model:** Keithley 614 **SN:** 0704936
Ept: +232 mv **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 0614850D0

DATA FILE: BA22Ti7ALR-a, BA22Ti7N2, BA22Ti7GU, BA22Ti7SH, BA22Ti7GD

Number of Crevice Corrosion Sites: 5/24 (24 max.)

Crevice Corrosion on 5/24 Location on Surface of Specimen. Ti 7 Hardware No Corrosion on Any Surface of Washers or Nut And Bolt. Slight gold tint Staining on Surface of Specimen And Hardware

* Drawing # 20.06002.01.322.002.

Test ID BA22T.702a

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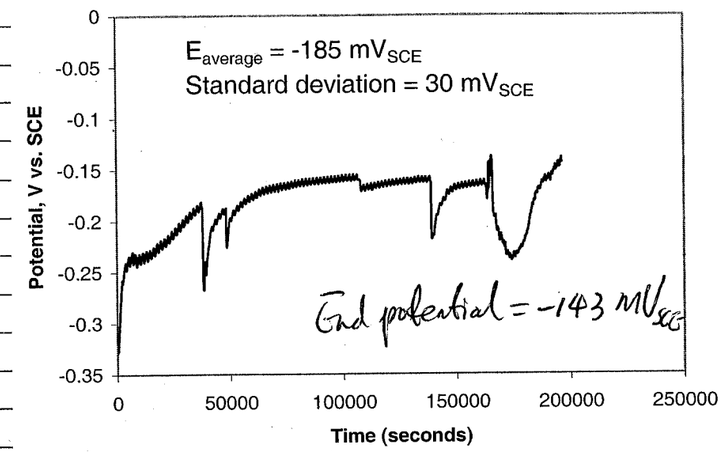

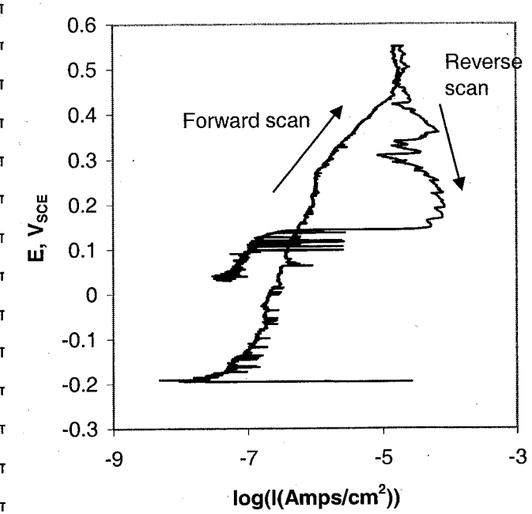

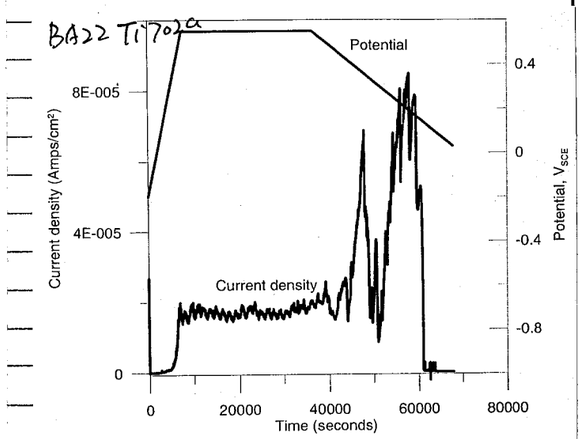

Base Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/1,~~ Torque: 50 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution 1/3 X.H 8/22/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 144 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 143 mV_{SCE};
$i < 10^{-6}$ A/cm² at 143 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 144 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 143 mV_{SCE};
$i < 10^{-6}$ A/cm² at 140 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3266 Base Alloy w/ Ti 7 HT# CN2775 Crevice Washers + Hardware 1/3 area ratio

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/01

Initial Weight: 23.95877g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.93813g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.62g Lot# 051510
+ DI water To 2000mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.47 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.74 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/27/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC w/zero Gas then 99.999% N_2 for E Repassivation

Ecorr: -176 mV_{SCE} **Model:** Keithley 614 **SN:** 0704936
Ept: 125 mV_{SCE} **Cal:** 5/27/05 **Due:** 5/26/05

Potentiostat: Solartron 1480 **SN:** ~~00153550~~ 00238265 8/18/05

DATA FILE: Ti7BA22AirOC, Ti7BA22-75 N2, Ti7BA22-75SU, Ti7BA22-75SH, Ti7BA22-75SD

Number of Crevice Corrosion Sites: 11 /24 (24 max.)

Crevice Corrosion on 11/24 Location on Surface of Specimen - Ti 7 Hardware No Corrosion on Any Surface of Crevice Washers or Nut & Bolt - Slight gold tint Staining on All Surfaces of Specimen And Hardware

* Drawing # 20.06002.01.322.002.

Test ID BA22 Ti 703a

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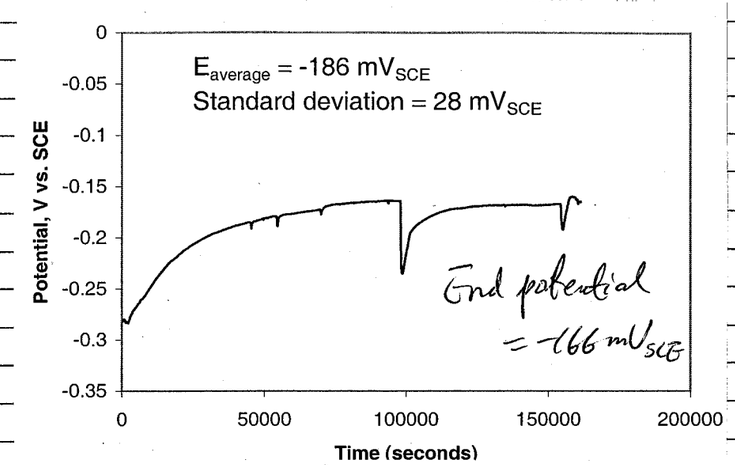

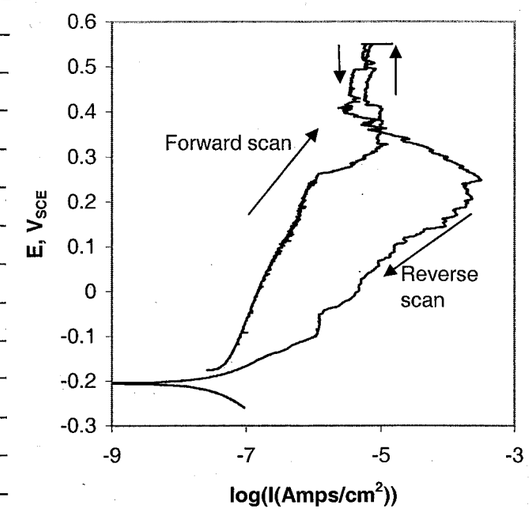

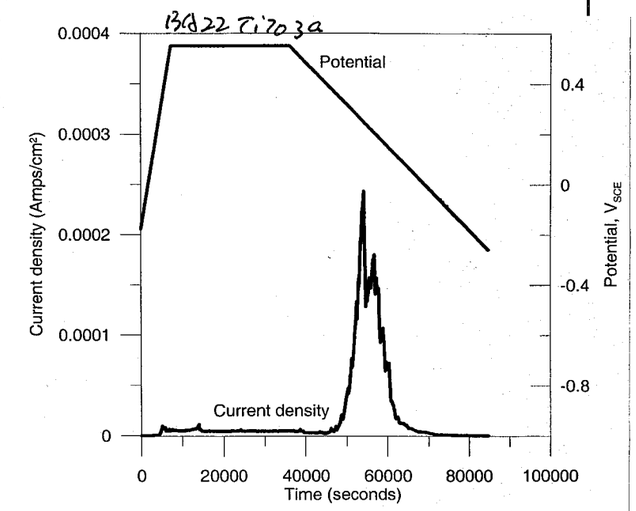

Base Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/4~~; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution 1/3 XH 8/22/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 75.7 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -27.9 mV_{SCE};
$i < 10^{-6}$ A/cm² at -50.1 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at -22.2 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -115 mV_{SCE};
$i < 10^{-6}$ A/cm² at -136 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT 2277-3-3292 CW813 w/ Ti 7 CW2775 Crevice Washers + Hardware 1/3
Welded · Solution Annealed See pg #23

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # X0-06002.9.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.
X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Tave Craft **Model# &Torque:** 75 In-lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/01

Initial Weight: 22.60509g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 22.57362g **Cal:** 5/11/05 **Due:** 11/11/05

Solution:
4 M NaCl
467.55g NaCl Lot# 051510
+DI water To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.34 **Model:** Orion, EA 940 **SN:** 2330
Final pH: 7.31 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 406 5196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** F98-393
Cal: 4/1/05 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −199 mV_{SCE} } in N_2 **Model:** Keithley 614 **SN:** 0704936
Ept: 252 mV_{SCE} } **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 001485000

DATA FILE: WA22SATi701a/ WA22SATi7A2R75, WA22SATi7N2, WA22SATi75D, WA22SATi75U, WA22SATi75H.

Number of Crevice Corrosion Sites: 12/24 (24 max.)
Crevice Corrosion on 12/24 feet of Crevice washer - No Sign of Corrosion on Ti 7 Crevice washers or Nut & Bolt. gold tint staining on C-22 Specimen - Dull Blue tint staining on All Ti 7 Hardware

Test #0 WA22SATi701a

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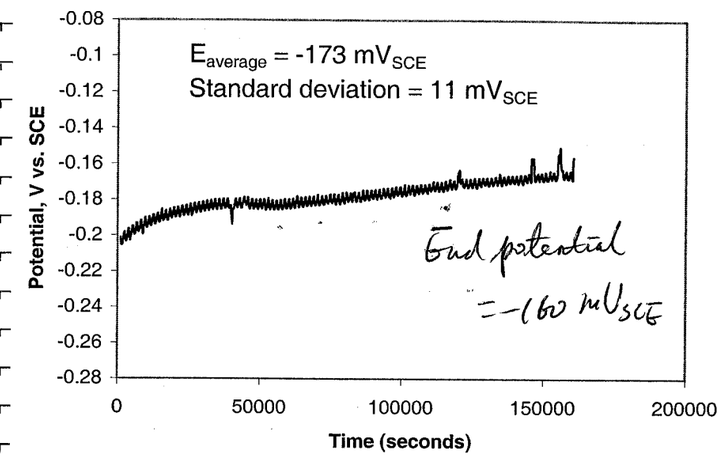

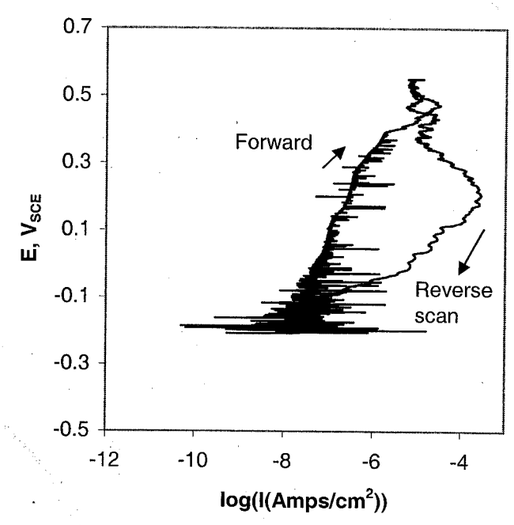

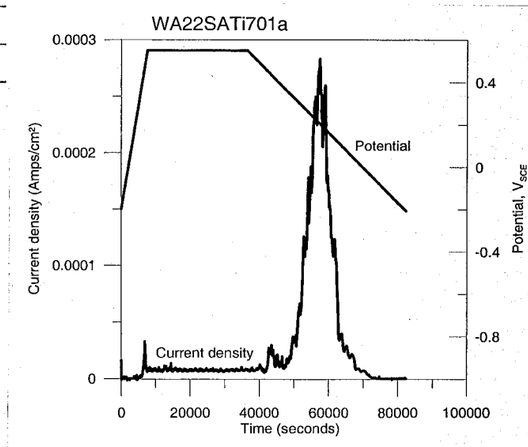

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/1~~, Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution 1/3 X.H 8/30/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 33.6 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -38.5 mV_{SCE};
$i < 10^{-6}$ A/cm² at -46.0 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at -36.3 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -62.2 mV_{SCE};
$i < 10^{-6}$ A/cm² at -74.3 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT#2277-3-3292 w/N893 Welded - Solution Annealed See pg #23 w/Ti 7 Crevice Washers ~~CN2776~~ #30 8/22/05 And Hardware 1/3 HT#CN2775

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing.* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. K.H 10/4/05 K.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 135072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.56713 **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.56417 **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.54g NaCl Lot #051510
+ DI water To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/05

Initial pH: 5.27 **Model:** Orion EA 940 **SN:** 2330
Final pH: 6.31 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** E98-191
Cal: 6/27/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028031

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −190 mV_{SCE} **Model:** Keithley 614 **SN:** 0704936
Ept: 126 mV_{SCE} **Cal:** 5/27/05 **Due:** 5/26/05
Potentiostat: Solartron 1480 **SN:** ~~00153550~~ 00238265 BKS 8/22/05

DATA FILE: WA22SATi750, WA22SATi750N2, WA22SATi750OC, WA22SATi750SH, WA22SATi750SD

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on C-22 Specimen + Ti 7 Nut-Bolt And Crevice washers show No Sign of Corrosion - But All Surfaces Have Staining C-22 gold tint staining Ti 7 Hardware Dull Blue tint staining on All Surfaces

Note: will polish specimen for further testing.

* Drawing # 20.06002.01.322.002.

Test ID WA22SATi702a

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/22/05

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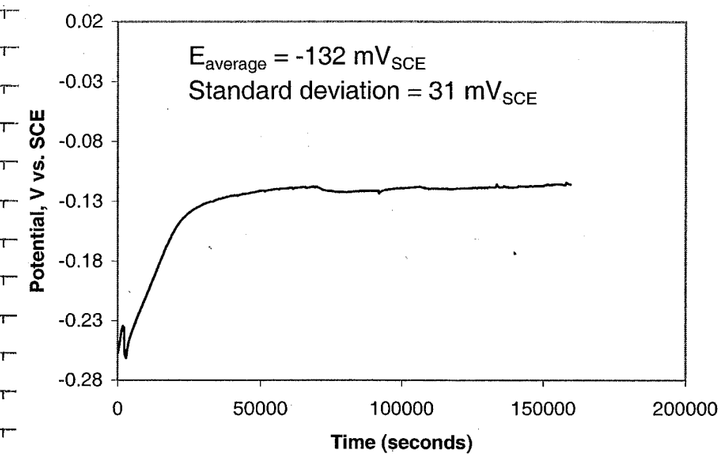

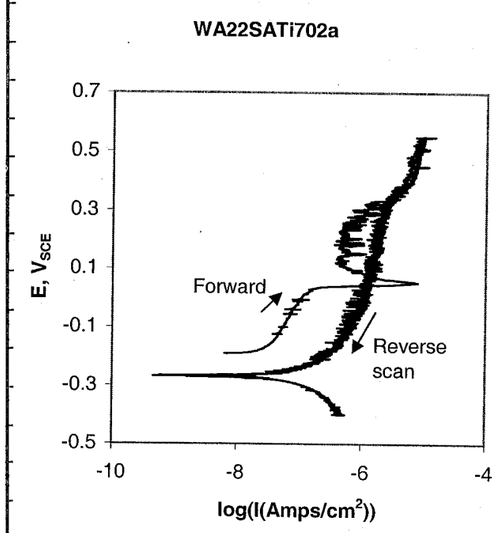

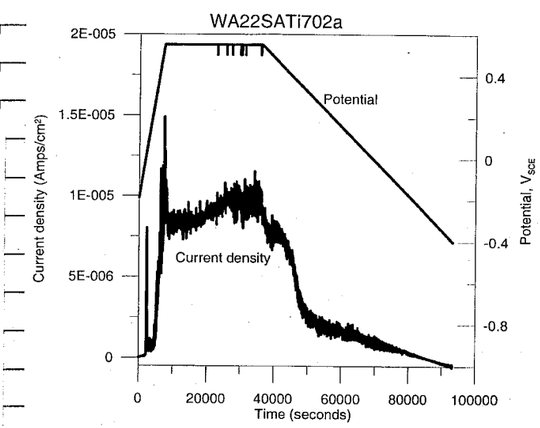

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/4~~ Torque: 50 in-oz; 1/3 K.H 8/30/05
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 316 mV_{SCE};
$i < 10^{-6}$ A/cm² at 46.9 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 302 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -128 mV_{SCE};
$i < 10^{-6}$ A/cm² at -187 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3292 WA 893 welded - Solution Annealed - See Pg #23 w/ T.7 CN2775 1/8 cath. w/Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002-01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3260~~ Hardware Torque to 50 in-oz.or 75 in lbs.
KM 10/4/05 K.M 10/4/05

Torque Screwdriver: Pwto 6104 **Model# &Torque:** 70 In-OZ **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 22.44034 **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 22.43724 **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.62g NaCl Lot #051510
+ DI To 2000mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/05

Initial pH: 5.49 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.52 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:**

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** C96-816
Cal: 6/22/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 0251439

Gas: 02 w/zero Air then 99.999% N2 for E Repassivation
Ecorr: −146 mV SCE **Model:** Keithley 614 **SN:** 0555368
Ept: 93 mV SCE **Cal:** 4/1/05 **Due:** 9/30/05
Potentiostat: Solartron 1287 **SN:** 00153550

DATA FILE: WASAC22Ti70CA2R-a, WASAC22Ti7N2, WASAC22Ti7SU, WASAC22Ti7SH, WASAC22Ti7SD

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on C-22 - No Corrosion on T.7 Cath on Nut & Bolt. C-22 Has gold tint staining on All Surfaces T.7 Hardware And Cathode Have Mild Surface staining

* Note: Specimen Repolished for further Testing

Test ID WA22SATi703a

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Witnessed & Understood by me,	Date	Invented by	Date
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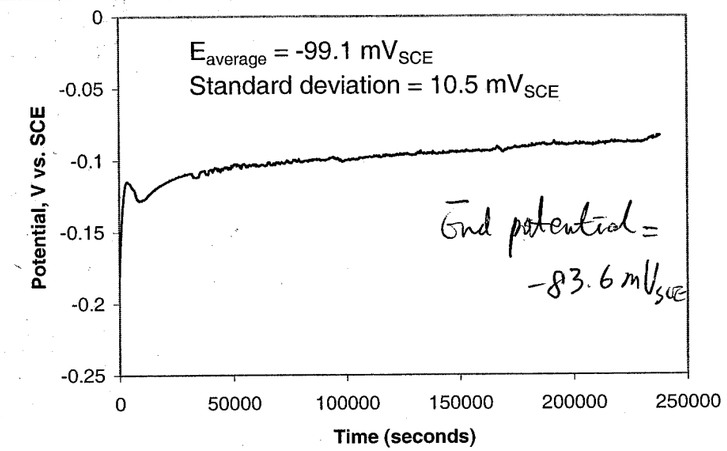
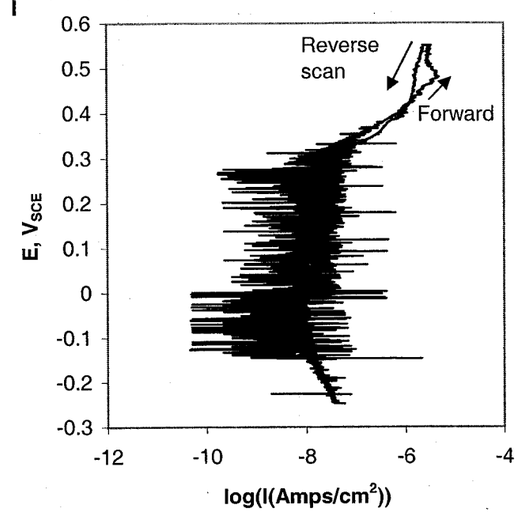
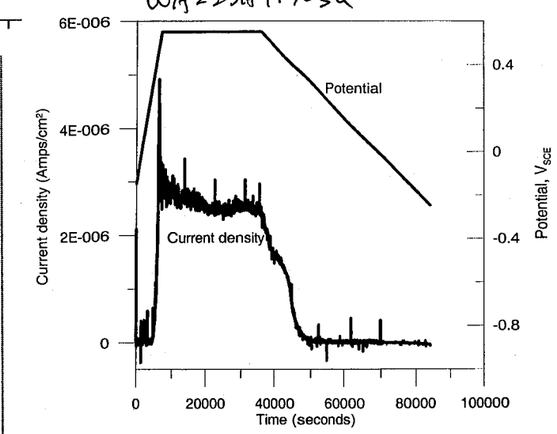




WA22SATi703a



Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~1/~~10~~; Torque: 70 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution KM 8/30/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 520 mV_{SCE};
$i < 10^{-6}$ A/cm² at 401 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 392 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 351 mV_{SCE};
$i < 10^{-6}$ A/cm² at 338 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT#2277-3-3292 WA813 w/T:7 CW2775 1/8
welded - solution annealed - seeps #23

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing #20.06022.0.320.002 w/Hardware
Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.
XH 10/4/05 XH 10/4/05

Torque Screwdriver: Tave Craft **Model# &Torque:** 75 In lbs. **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/01

Initial Weight: 22.82433g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 22.81742g **Cal:** 5/11/05 **Due:** 11/11/05

Solution:
4.0 M NaCl
467.55g NaCl lot #051510
+ DI water To 2000mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.63 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.76 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

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

Counter Electrode: Platinum Flag

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

Gas: oc w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −291.2 mV_{SCE} } N_2 **Model:** Keithley 614 **SN:** 0704936
Ept: 95 mV_{SCE} **Cal:** 5/27/05 **Due:** ~~5/26/05~~ 06 5/26/06 BKO 5/6/05

Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: WA22SATi775-UnlCh2, WA22SATi775N2, WA22SATi775SU, WA22SATi775SH, WA22SATi775SD

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on Surface of C-22 Specimen
No Corrosion on T:7 Cathode on Nut & Bolt
Gold tint staining on All surfaces of Specimen
Dull tint staining on All T:7 Hardware

Note: Will polish specimen for further testing.

Test ID WA22SATi704a

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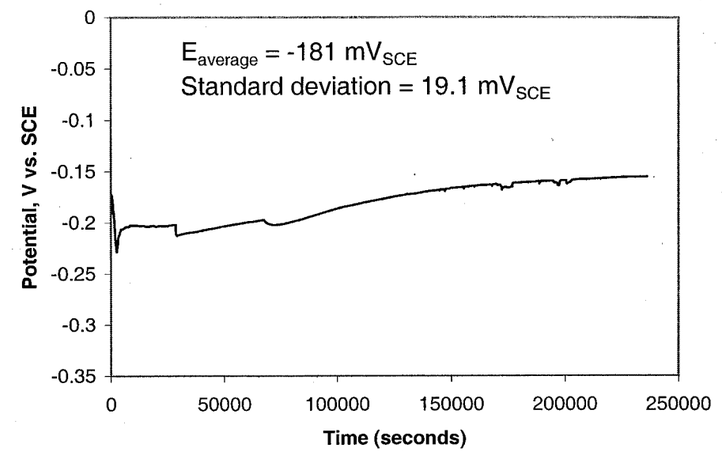

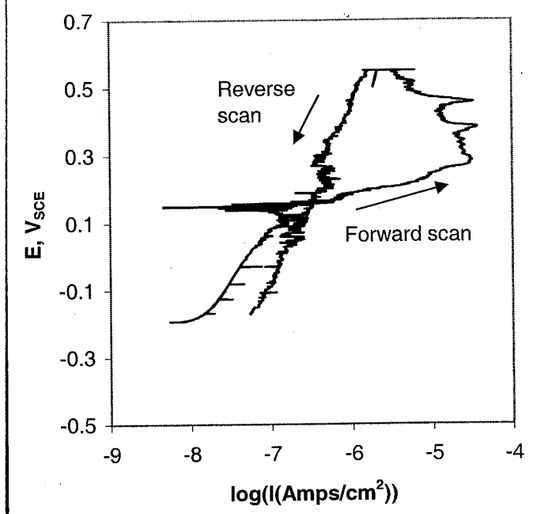

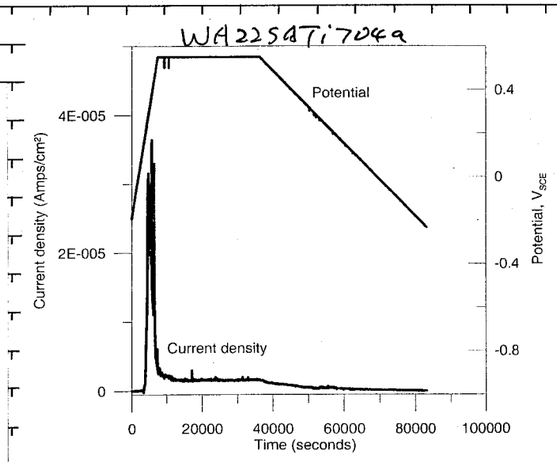

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/10~~; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution 1/8 X.H 8/29/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 550 mV_{SCE};
$i < 10^{-6}$ A/cm² at 464 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 331 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -73.3 mV_{SCE};
$i < 10^{-6}$ A/cm² at -171 mV_{SCE}

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Witnessed & Understood by me, Date 8/29/05 | Invented by | Date | Recorded by

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THERMALLY AGED PROCEDURE

Quanity/Specimens = 6 C-22 welds HT# 2277-3-3292
filler WN813

OVEN= Lindberg model #51333 SN# 909172

OVEN SETPOINT= 1132°C

OVEN TEMPERATURE= 1134.4°C

Measurement taken with FISHER MICROPROCESSOR THEMOMETER
SN#= 41523645 CAL= 6/7/05 DUE= 6/7/06

Thermocouple=
SN#= 330 Cal = 7/26/05 Due = 1/26/06

AMOUNT OF TIME = 20 min

DETAILS= Placed All 6 Specimens Into
oven for 20 min @ Temp
set point then water Quenches

8/29/05

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OCP TEST

Objective: to monitor open circuit potential

Specimen: Ti 7 Cylinder HT# 34115

Specimen Preparation: Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone

Test ID: Ti 70CPAIR01a

Initial Wt: 6.58725g

Final Wt: 6.58915g

Model: Sartorius Genius **SN:** 12809099

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

Solution: 4.0 M NaCl
467.54g NaCl Lot# 051510
+ DI To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.76
Adusted pH: None
Final pH: 6.29

Model: orion **SN:** 2330
Cal: 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **SN:** Fisher Thermometer H 00-387
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

Reference Electrode: 13-620-52 **SN:** ~~0199568~~ 8/22/05
0199568

Gas: Zero Air

DATA/TEST ID: T.7 OC
Ecorr: -313 mv Ept +134 mv Keithley 614 SN# 0704936
Cal 5/27/05 Due ~~5/26/06~~ 9/6/05 5/26/06

Specimen Examination:
No Corrosion or Pitting on Specimen
mlo Dull tint surface staining

* Specimen polished for further testing

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		Recorded by	8/22/05

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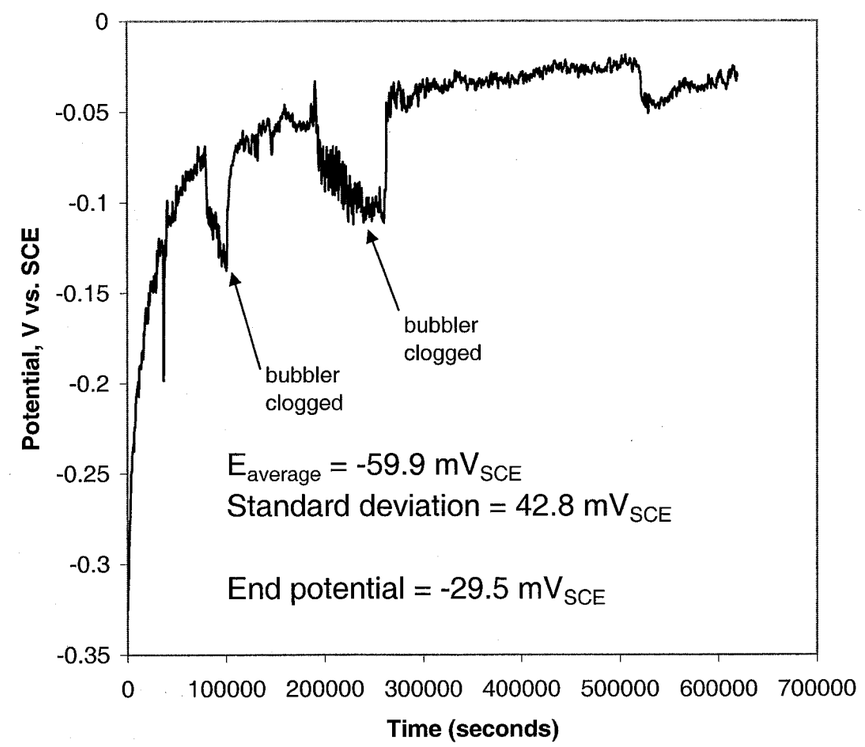

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		Recorded by	8/31/05

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT # 2277-3-3266 Base Alloy w/T:7 CN2775 1/8 crath Nut & Bolt

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06202.01.372.0002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.M 10/4/05 X.M 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 70 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.63523g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.63316g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.55g NaCl
+ DI water to 2000 mls

Test ID: BA22Ti704a

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 6.14 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.27 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** F98-393
Cal: 4/1/05 **Due:** 9/30/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: -0.291 V_{SCE} } N_2 **Model:** Keithley 614 **SN:** 0704976
Ept: 0.125 V_{SCE} **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1287 **SN:** 001485000

DATA FILE: BA22Ti7A2R70, BA22Ti7-70N2, BA22Ti7-70SU, BA22Ti7-70SH, BA22Ti7-70SD

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on C-22 specimen. Dull tint staining on All surfaces. No Corrosion on Ti 7 1/10 Crath with Crevice Bolts on Hardware Dull tint staining on All surfaces of Ti 7

* Specimen will be polished for further testing.

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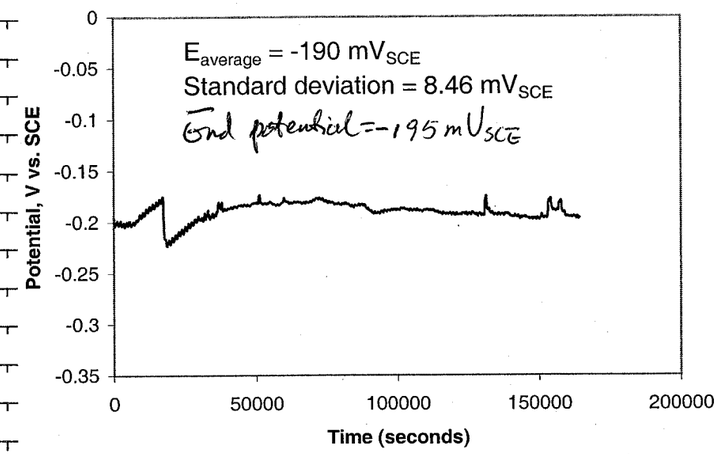

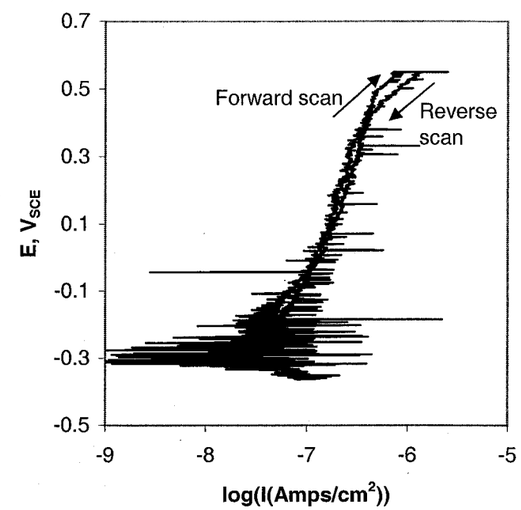

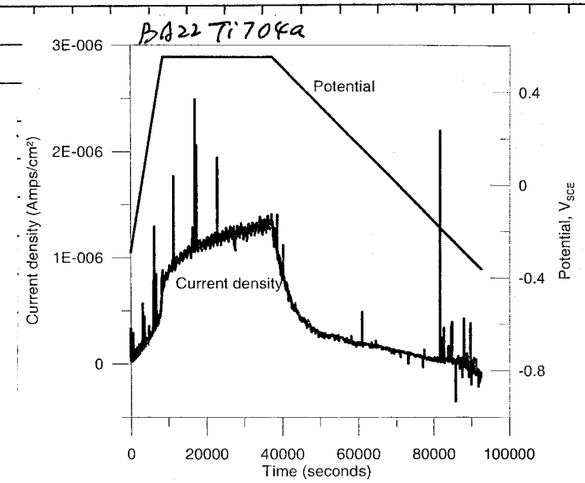

Base Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~1/10, Torque: 70 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution X.M 8/29/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 550 mV_{SCE};
$i < 10^{-6}$ A/cm² at 520 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 445 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -37.1 mV_{SCE};
$i < 10^{-6}$ A/cm² at -107 mV_{SCE}

Cross-over potential: 394 mV_{SCE}

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Confirmatory Analyses for Titanium Grade-7
(Continued from Page 4)

Requisition: 05029595
Requisitioner: He, Xihua
Req Organization: 1.20.01.50
Phone: (210) 522-5194

SOUTHWEST RESEARCH INSTITUTE

Suggested Supplier: Staveley Services Materials Testing
City/State: Santa Fe Springs/CA
Contact: Connie Casillas
Phone: 1-800-266-1721 Fax: 1-562-944-8389

Page 1 of 2
Date Printed: 08/25/2005
Date Created: 07/21/2005
Requisition Date: 07/22/2005

Special Instructions: Please notify Xihua He x5194 when P.O. number is used so sample can be sent.

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs
1	Chemical analyses of Titanium Grade-7	EA	8/5/2005	1.00	246.00	246.00

Deliver To: Xihua He/Bldg.57
Account: 753-104 Organization: 1.20 Project: OHD20.131 Allocation Pct: 100.00
Total Estimated Cost: $246.00

Quality Assurance?: YES ASL Required: YES

To Be Used For: Confirmatory analyses

Approvals: Requestor: Xihua He 7/22/2005 9:07:02 AM Department/Division Management: Vijay Jain 7/22/2005 9:44:25 AM
Patrick C Mackin 7/22/2005 10:00:04 AM Quality Assurance: Robert D Brient 7/22/2005 8:35:53 AM

Submitted By: Paul Maldonado 7/22/2005 10:48:30 AM

Your organization will provide goods or services to the Center for Nuclear Waste Regulatory Analyses (CNWRA) in accordance with the requirements of your quality system or that of the CNWRA Quality Assurance Manual. Any special technical or QA procedures required in the performance of your staff members' work will be provided. Special CNWRA requirements apply to scientific and engineering software and must be followed. Your organization's product will be accepted based on an evaluation by the CNWRA Principal Investigator or technical staff member and will be returned for rework at Seller's expense if the product does not meet CNWRA requirements. If scientific notebooks are utilized, they are subject to periodic review and must be returned at the conclusion of work to the CNWRA QA Records Room, or invoice remittance will be withheld. Additionally, there shall be "right of access" to your facility to confirm effective implementation of the quality requirements with the possibility of audits, source inspections, or surveillances. Any special documentation requirements shall be specified in the purchase order and will be supplied to the CNWRA with the product. The Seller shall notify CNWRA QA of any nonconformance to the requirements of this purchase order; further work shall not be done unless directed by CNWRA QA. If there are any QA-rel

Requisition: 05029595
Requisitioner: He, Xihua
Req Organization: 1.20.01.50
Phone: (210) 522-5194

SOUTHWEST RESEARCH INSTITUTE

Suggested Supplier: Staveley Services Materials Testing
City/State: Santa Fe Springs/CA
Contact: Connie Casillas
Phone: 1-800-266-1721 Fax: 1-562-944-8389

Date Printed: 08/25/2005
Date Created: 07/21/2005
Requisition Date: 07/22/2005

Line #	Item / Description	U/M	Need By Date	Requested Qty	Est Unit Cost	Estimated Costs

ated questions, please call the CNWRA Director of QA at (210) 522-5537.

CERTIFIED INSPECTION/TEST DATA IS REQUIRED WITH SHIPMENT OF PARTS, MATERIALS, AND FOR SERVICES.

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Copy of ASTM B265-05 Providing Chemical Requirements for R52400.

Information potentially subject to copyright protection was redacted from this location. The redacted material was from the above mentioned information; ASTM manual, Table 2: Chemical Requirements

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by He Xihua	8/25/05

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Copy of Letter to Staveley Services for Confirmatory Analyses of Ti Grade-7 Heat # CN2775

Xihua He
Phone: (210) 522-5194
Fax: (210) 522-6081
E-mail: xhe@swri.org

Dear Connie Casillas,

I will send you the heat of Titanium Grade-7 (Heat # CN2775) submitted for chemical analyses. Per our previous phone conversation I need to have the specimen analyzed for the Ti, Pd, Fe, C, H, O, and N. According to the vendor, the material heats are within the chemical composition ranges specified in ASTM B265-02. The chemical composition of UNS R52400, specified in ASTM B265-02 is provided below.

C: 0.08 max
Fe: 0.30 max
H: 0.015 max
N: 0.03 max
O: 0.25 max
Pd: 0.12-0.25
Ti: balance

I have provided a copy of ASTM B265-02, a copy of the alloy composition provided by the vendor, and a copy of the mill test report.

The chemical analyses performed by Staveley Material Testing should provide the chemical composition of the alloy heat and should specify the heat number of the material. The analyses should conclusively determine if the heat submitted are within the specifications listed in ASTM B265-02. Any discrepancy between the chemical analyses performed by Staveley Material Testing and the specifications of ASTM B265-02 should be clearly identified.

Please call me if you have any questions. Thank you for your assistance.

Sincerely

Xihua He

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		Recorded by	8/25/05

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staveleyservices MATERIALS TESTING

STAVELEY SERVICES – MATERIALS TESTING
10005 Freeman Avenue, Santa Fe Springs, California 90670
Tel: (562) 946-1721 Fax: (562) 944-8389 www.staveleymt.com

Customer: CNWRA
Material: CP Titanium Grade 7
Specification: ASTM B265, Rev: 02
PO/SO: PO TO FOLLOW
P/N:
Lab No: 406142
Date: 08/11/05
Heat Number: CN2775
Other: Chem Sample

CERTIFICATION OF TEST

CHEMISTRY ELEMENT		MINIMUM REQ'S	MAXIMUM REQ'S	ACTUAL	COMMENTS
N2	Nitrogen		0.03	0.01	
C	Carbon		0.08	0.01	
H2	Hydrogen		0.015	0.001	
Fe	Iron		0.30	0.08	
O2	Oxygen		0.25	0.13	
OE	Other Elements Each		0.1	0.1	Less than
OET	Other Elements Total		0.4	0.4	Less than
Ti	Titanium	BAL		BAL	
Pd	Palladium	0.12	0.25	0.16	

Conforms to requirements.
Comment: METHOD: ICP, XRF, COMBUSTION

Respectfully Submitted
Mario Garcia
Q.A. Supervisor

Accredited Nadcap Materials Testing Laboratory

MTM PAGE: 1 of 1

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STAVELEY SERVICES - MATERIALS TESTING

The purchased titanium Grade-7 meets compositional specification requirements for UNS R52400 as specified per ASTM B265-05.

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	8/25/05

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OCP TEST

Objective: to monitor open circuit potential

Specimen: Ti 7 Cylinder HT # 34115

Specimen Preparation: Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone

Initial Wt: 6.58473g
Final Wt: 6.58282g
Model: Sartorius Genius **SN:** 12809099
Cal: 5/11/05 **Due:** 11/11/05
Solution: 4.0 m NaCl
NaCl Lot # 051510
+DI To 2000mls

Test ID: Ti70CPAIR01b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.49
Adusted pH: None
Final pH: 7.12
Model: orion **SN:** 2330
Cal: 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **SN:** Fisher Thermometer H00-387
Cal: 2/11/05 **Due:** 1/11/06
Counter Electrode: Platinum Flag
Reference Electrode: 13-620-52 **SN:** 0199568
Gas: Zero Air

DATA/TEST ID: T.7 OC
Econ = -76lmv Eot = +26lmv Keithley 614 sn# 0204936 cal 5/27/05 Due 5/26/05
Specimen Examination:

No Sign of Corrosion or Pitting on Surface of Specimen - Very mild Dull tint staining on Surface of Specimen

Note: Specimen will be polished for future testing.

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/1/05

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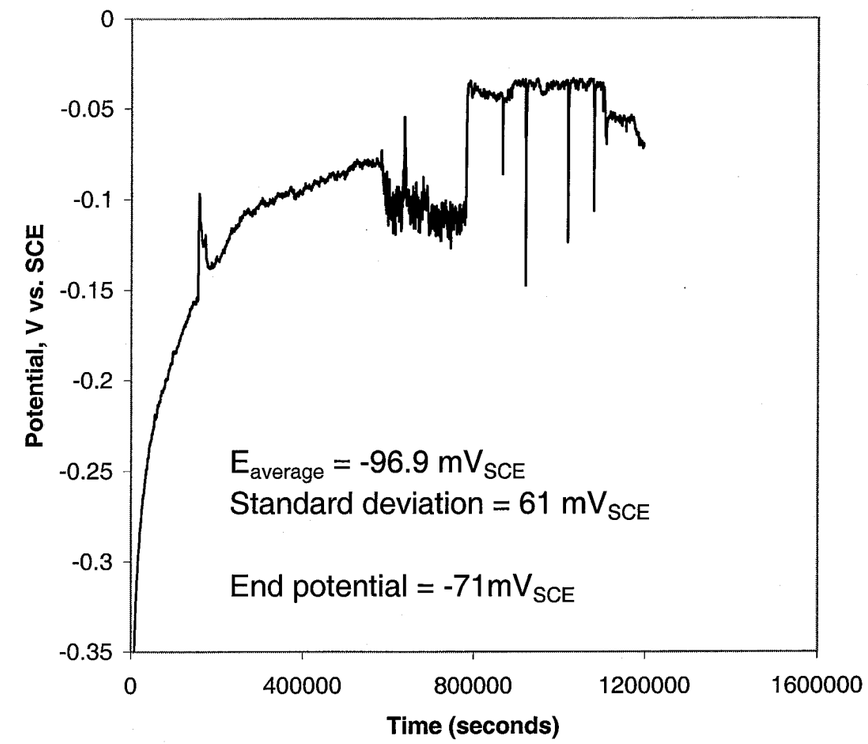

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/20/05

From Pag

POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3292 WA813 welded Solution Annealed See Pg# 5* - C-22 HT# 2277-3-3266 Crevice washer + Hardware

1/3 X.H 9/12/05

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing ~~#~~ 22.06002.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.

X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 Model# &Torque: 50 In Oz SN: 139 072
Cal: 4/11/05 Due: 10/11/05

Initial Weight: 23.44269g Model: Sartorius Genius SN: 12809099
Final Weight: 23.43596g Cal: 5/11/05 Due: 11/11/05

Solution: 4.0 M NaCl
467.55g NaCl #05150 Lot
+ DI water 2000 mls

Test ID: WA22SABA2201b

Reagents measured with Model: OHAUS SN: 2883
Cal: 7/12/05 Due: 1/12/06

Initial pH: 5.29 Model: Orion EA 940 SN: 2330
Final pH: 7.13 Cal: 7/25/05 Due: 7/25/06
pH Probe: #13-620-296 SN: 4065196

Test Temperature: 95°C Measured with Hg Thermometer SN: E 98-191
Cal: 6/22/05 Due: 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 SN: 4028031

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −122 mV$_{SCE}$ } in N_2 Model: Keithley 614 SN: 0704936
Ept: 105 mV$_{SCE}$ } deaerated Cal: 5/27/05 Due: 5/26/06

Potentiostat: Solartron 1480 SN: 0024005 3

DATA FILE: WASA22BA220CA2R-B4_UnICH4, WASA22BA220CN2-B4, WASA22BA22SU_B4, WASA22BA22SH_B4, WASA22BA22_B4_UnICH4

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen or C-22 Crevice Washers/Hardware - Gold Tint Staining on All Surfaces.

* Note: will Repolish for Further Testing

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

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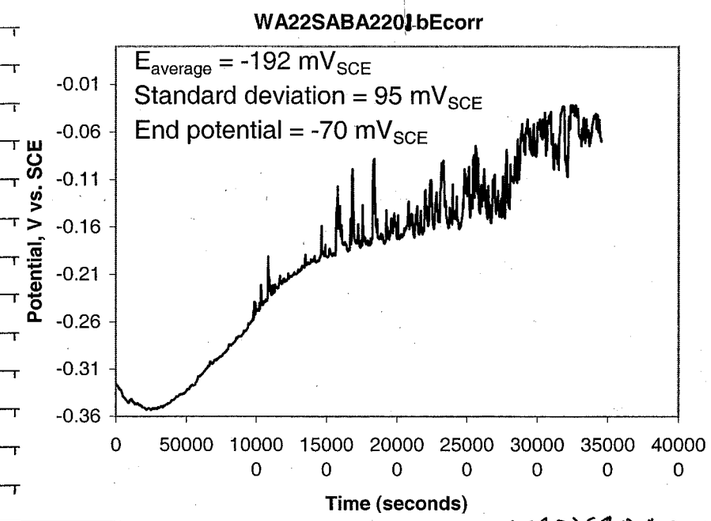

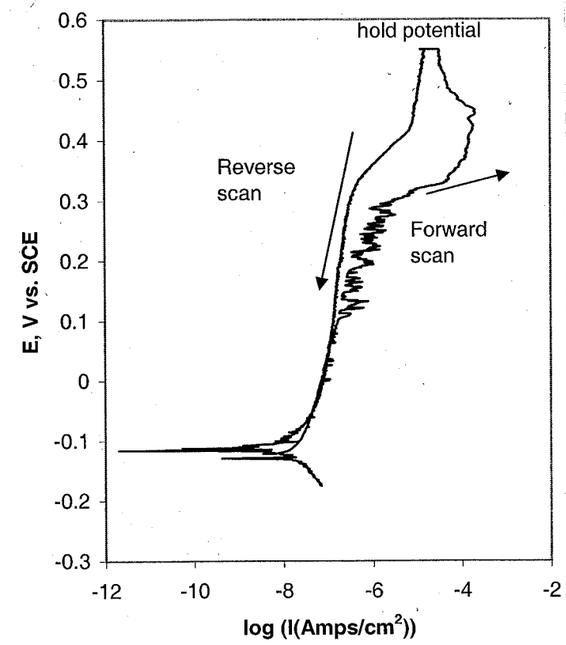

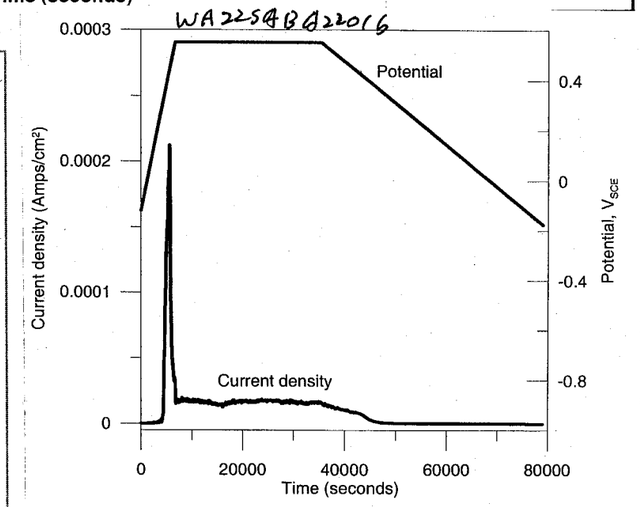

Welded + solution annealed Alloy 22 (Anode)
with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut 1/3 X.H 9/12/05
Anode to cathode area ratio: ~~1/4~~; Torque: 50 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV$_{SCE}$ for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for current density,
$i < 10^{-5}$ A/cm² at 464 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 380 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at 359 mV$_{SCE}$
Using crevice specimen area as surface area for current density,
$i < 10^{-5}$ A/cm² at 384 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 327 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at 253 mV$_{SCE}$

Witnessed & Understood by me,	Date	Invented by	Date
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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT#2277-3-3292 wn813 welded Solution Annealed See pg 58 - C-22 HT#2277-3-3266 Crevice washer & Hardware ** X.H 9/12/05 X 1/3

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing** X.H Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In lbs **SN:** 654000691
Cal: 7/22/05 **Due:** 7/22/06

Initial Weight: 23.54938 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.54996 g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 m NaCl
467.6 g NaCl Lot # 051510
+ DI water To 2000 mls

Test ID: WA22SABA2204b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.54 **Model:** Orion EA 940 **SN:** 2330
Final pH: 8.59 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** C 96-816
Cal: 6/22/05 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then E Repassivation w/ 99.999% N_2

Ecorr: −128 mV_{SCE} } in N_2 **Model:** Keithley 614 **SN:** 0704936
Ept: 56 mV_{SCE} } deaerate **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00 240053

DATA FILE: WASA22BA220CA2R-B5, WASA22BA220CN2, WASA22BA225U-B5, WASA22BA225H-B5, WASA22BA22-B5-UnlCh5

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on Specimen or C-22 Crevice washers or Hardware - Mild Gold tint staining on All Surfaces of Specimen And Hardware

** Drawing # 20.06002.01.322.002
* Note: Specimen will be Repolished for further Use

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		Recorded by	9/6/05

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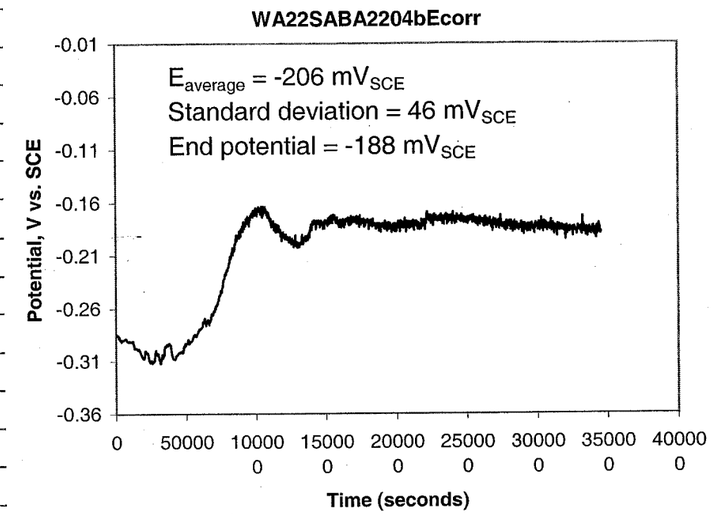

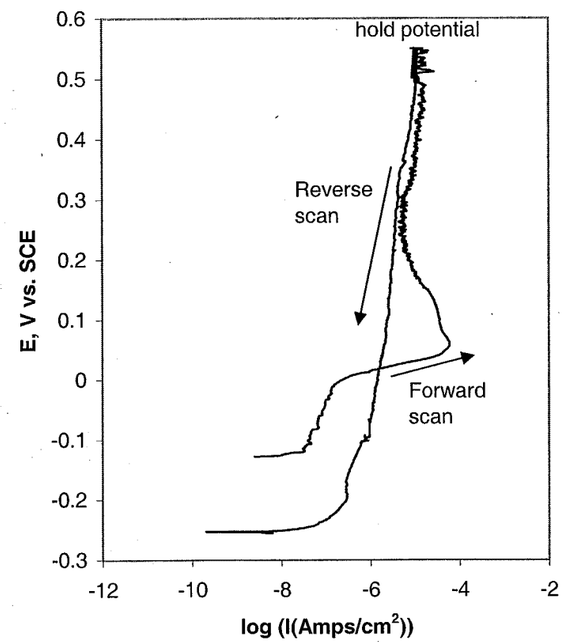

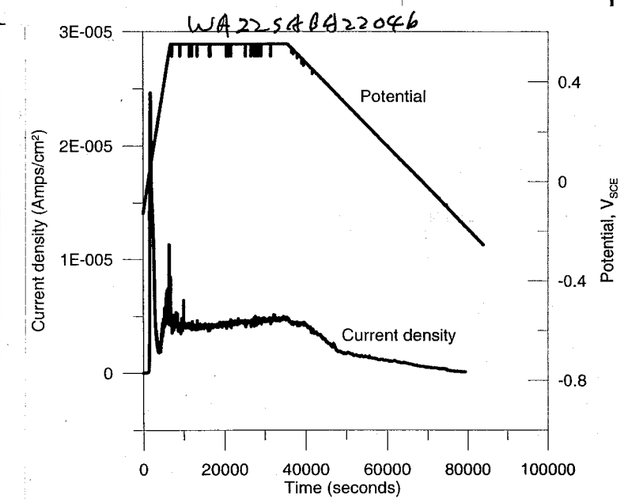

Welded + solution annealed Alloy 22 (Anode)
with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut 1/3 X.H 9/12/05
Anode to cathode area ratio: ~~1/4~~; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV_{SCE} for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for current density,
$i < 10^{-5}$ A/cm² at 469 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 56.5 mV_{SCE};
$i < 10^{-6}$ A/cm² at -65.8 mV_{SCE}
Using crevice specimen area as surface area for current density,
$i < 10^{-5}$ A/cm² at 98.5 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -127 mV_{SCE};
$i < 10^{-6}$ A/cm² at -208 mV_{SCE}

Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/12/05

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3292 Wn813 Solution Annealed welded See pg # 5r. C-22 HT # 2277-3-3266 ~~X~~ Crevice washer & Hardware * 1/10 K.H 9/15/05

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing.* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.52908g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.52508g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.73g NaCl Lot # 051510
+ DI water 2000mls

Test ID: WA22SABA2202b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.63 **Model:** Orion EA 940 **SN:** 2330
Final pH: 8.38 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** H 98-179
Cal: 5/6/05 **Due:** 5/5/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 925105

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −160 mV$_{SCE}$ } in N_2 deaerate **Model:** Keithley 614 **SN:** 0704936
Ept: 86 mV$_{SCE}$ **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00240053

DATA FILE: WASA22BA22BOCAIR-B6cor, WASA22BA22OCN2-B6_UnlCh6
WASA22BA22SH-B6, WASA22BA22SH-B6, WASA22BA22-B6_UnlCh6

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen or on C-22 Cathode w/crevice Washers And Hardware All ok gold tint staining on All Surfaces M.O.

Note: specimen will be polished for further testing.

* Drawing # 20.06002.01.322.002

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		Recorded by	9/6/05

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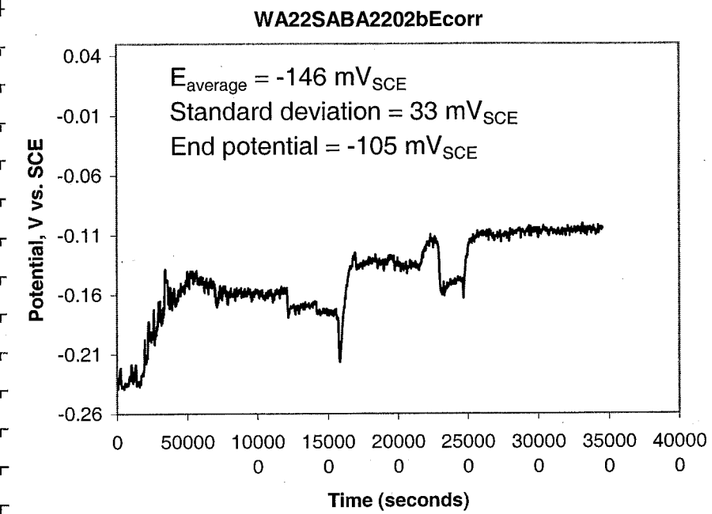

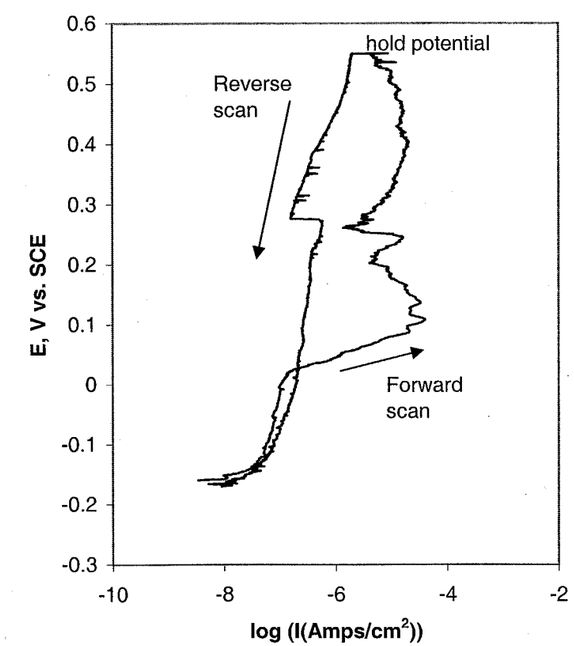

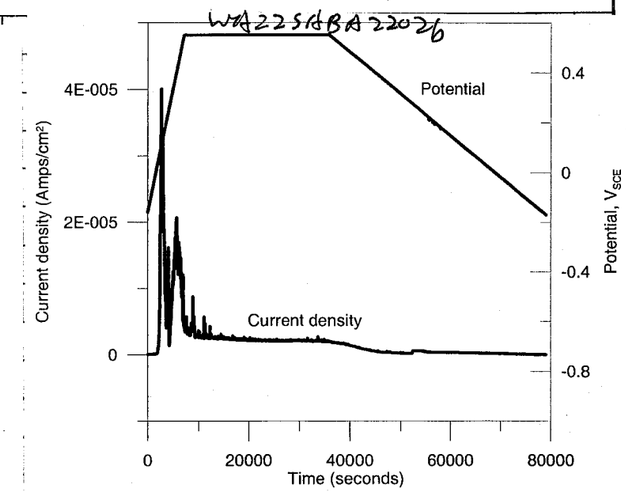

Welded + solution annealed Alloy 22 (Anode)
with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut 1/10 K.H 9/12/05
Anode to cathode area ratio: ~~4/5~~; Torque: 50 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV$_{SCE}$ for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for current density,
$i < 10^{-5}$ A/cm² at 550 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 550 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at 450 mV$_{SCE}$
Using crevice specimen area as surface area for current density,
$i < 10^{-5}$ A/cm² at 449 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 304 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at -82 mV$_{SCE}$

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT 2277-3-3292 WA813 welded solution Annealed See pg #58 C-22 HT 2277-3-3266 Cathode & Hardware 1/10

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing #30.06002.01 30.06002.02 X.H 9/15/05 Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Tech Craft **Model# &Torque:** 75 In-lbs **SN:** 694000691 **Cal:** 7/22/05 **Due:** 7/21/06

Initial Weight: 23.48742g **Final Weight:** 23.48184g **Model:** Sartorius Genius **Cal:** 5/11/05 **SN:** 12809099 **Due:** 11/11/05

Solution: 4 m NaCl
467.53g NaCl Lot#051510
+ DI water To 2000mls

Test ID WA22SABA2203b

Reagents measured with **Model:** OHAUS **Cal:** 7/12/05 **SN:** 2883 **Due:** 1/12/06

Initial pH: 5.59 **Final pH:** 4.46 **Model:** Orion EA 940 **Cal:** 7/25/05 **SN:** 2330 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **Cal:** 6/22/05 **SN:** C96-816 **Due:** 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: OC w/zero Air then E Repassivation w/99.995% N_2

Ecorr: ~~-143.8~~ mV$_{SCE}$ -258.7 X.H 10/4/05 } in N_2 **Model:** Keithley 614 **Cal:** 5/27/05 **SN:** 0704936 **Due:** 5/26/06

Ept: ~~-49.7~~ mV$_{SCE}$ 6.9 X.H 9/13/05

Potentiostat: Solartron 1480 **SN:** 00240053

DATA FILE: WASA22BA22BOCA2Rb_B6, WASA22BA22OCN2b-B6, WASA22BA22SUb-B6, WASA22BA22SHb_B6, WASA22BA22b-B6

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion 0/24 feet of C-22 1/5 cathode with Crevice washers - No Corrosion on C-22 (2277-3-3266) Nuts/Bolts - Gold tint staining on All Surfaces of Specimen And Cathode

Note, specimen will be polished for further testing.

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		Recorded by	9/9/05

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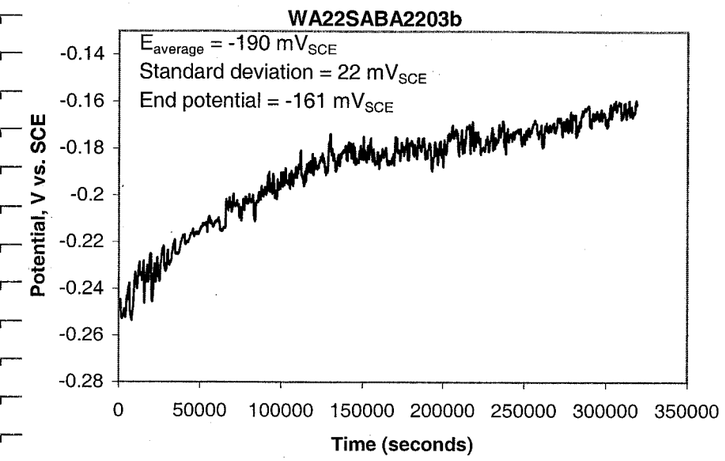

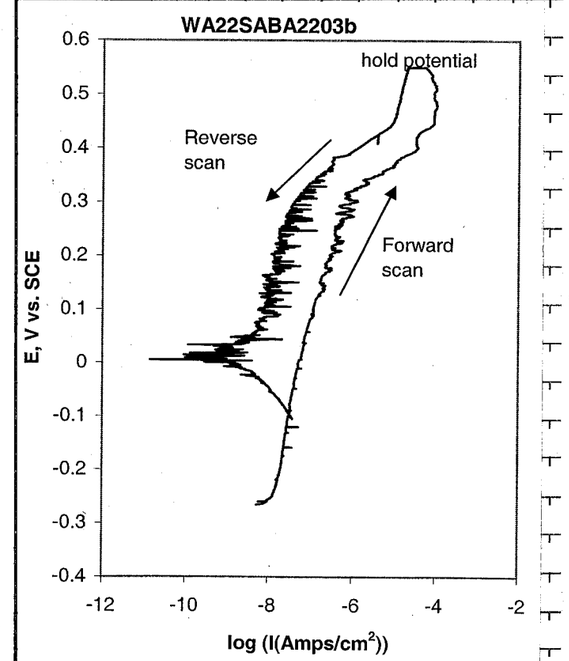

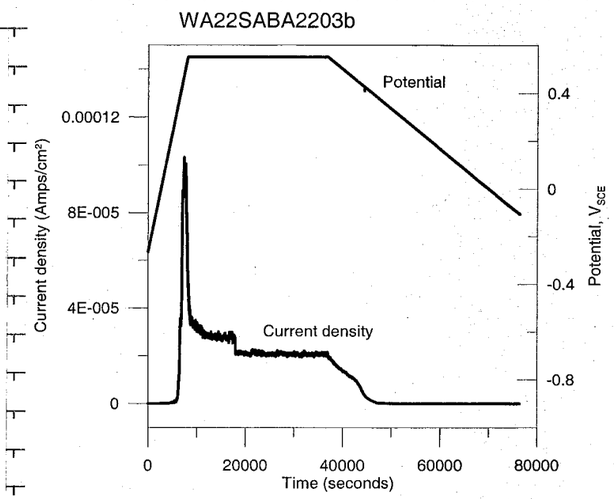

Welded + solution annealed Alloy 22 (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut 1/10 X.H 9/15/05
Anode to cathode area ratio: ~~1/5~~; Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s; Potential hold: 550 mV$_{SCE}$ for 5 hours;
Reverse scan rate: 0.0167 mV/s
Using entire assembly area as surface area for current density,
$i < 10^{-5}$ A/cm² at 456 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 410 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at 395 mV$_{SCE}$
Using crevice specimen area as surface area for current density,
$i < 10^{-5}$ A/cm² at 394 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm² at 354 mV$_{SCE}$;
$i < 10^{-6}$ A/cm² at 335 mV$_{SCE}$

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/15/05

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3292 WN813 w/ Ti-2 HT# CN2775 Welded Solution Annealed See pg #58 1/3 X.H 9/15/05 1/4 Crevice washers + Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 24.06002.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3280~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 Model# &Torque: 50 In-oz SN: 139072 Cal: 4/11/05 Due: 10/11/05

Initial Weight: 23.38448g Model: Sartorius Genius SN: 12809099
Final Weight: 23.37951g Cal: 5/11/05 Due: 11/11/05

Solution: 4.0 M NaCl 467.58g NaCl Lot#051510 + DI To 2000mls

Test ID: WA22SATi702b

Reagents measured with Model: OHAUS SN: 2883 Cal: 7/12/05 Due: 1/12/06

Initial pH: 6.65 Model: Orion EA 940 SN: 2330
Final pH: 7.30 Cal: 7/25/05 Due: 7/25/06
pH Probe: #13-620-296 SN: 4065196

Test Temperature: 95°C Measured with Hg Thermometer SN: E98-191 Cal: 6/22/05 Due: 12/22/05

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 SN: 4028031

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: −152.4 mVSCE } in N_2 Model: Keithley 614 SN: 0704936
Ept: −376.7 mVSCE Cal: 5/27/05 Due: 5/26/06

Potentiostat: solartron 1480 SN: 0824053

DATA FILE: WASA22Ti70CAIR-B4, WASA22Ti70CN2-B4, WASA22Ti75U-B4, WASA22Ti75H-B4, WASA22Ti75D-B4

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen 0/24 feet of Ti7 Crevice washers. Ti7 Crevice Surface No Corrosion or on Bolt/Nut - Slight gold tint staining on All Surfaces

Note: Specimen will be polished for future use.

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Witnessed & Understood by me,	Date	Invented by	Date
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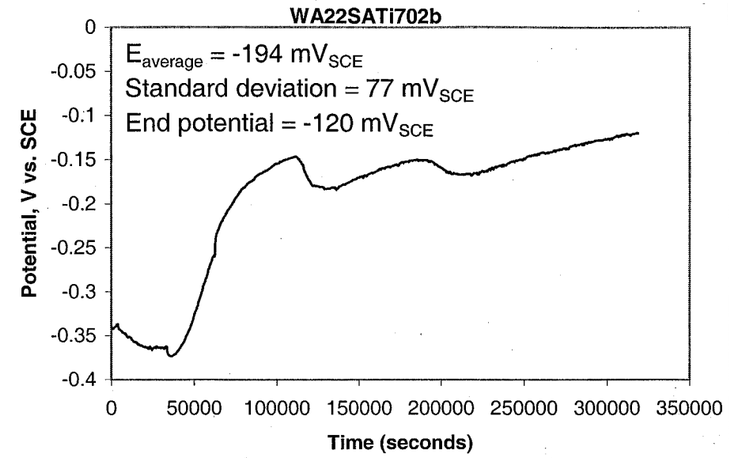

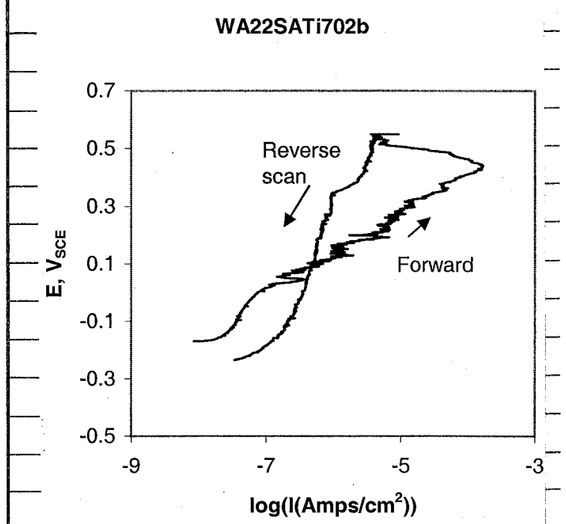

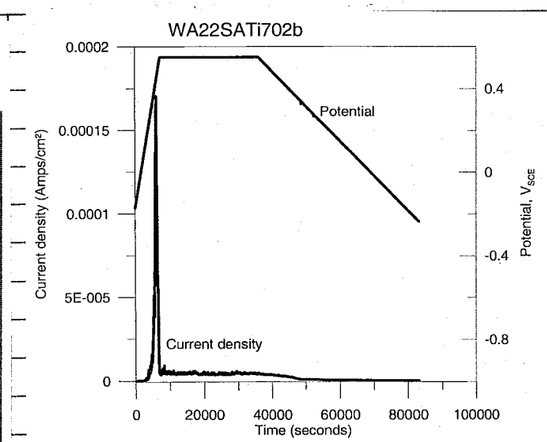

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/4~~ 1/3 X.H 9/15/05; Torque: 50 in-oz;
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 381 mV_{SCE};
$i < 10^{-6}$ A/cm² at 348 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 387 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 85 mV_{SCE};
$i < 10^{-6}$ A/cm² at -89.8 mV_{SCE}

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		Recorded by	9/15/05

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POTENTIAL SCAN AND HOLD

X.H 9/13/05

Objective: See page 1.

Alloy / Heat No.: C-22 HT #2277-3-3292 WN893 w/ Ti 7 HT CN2775 X 1/3 Crevice washers + HARDWARE
welded solution Annealed See Pg #58

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing #22.06002.01.322.002 Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.

X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/06

Initial Weight: 23.69657 **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.68985 **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.63g NaCl Lot # 051510
+ DI water to 2000 mls

Test ID: WA22SATi701b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.54 **Model:** Orion EA 940 **SN:** 2330
Final pH: 4.91 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** M98-179
Cal: 5/6/05 **Due:** 5/5/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 925105

Gas: O_2 w/zero Air then 99.998% N_2 for E Repassivation

Ecorr: -151.9 mV$_{SCE}$ } in N_2 **Model:** Keithley 614 **SN:** 0204936
Ept: -142.5 mV$_{SCE}$ } **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 0624005 3

DATA FILE: WASA22Ti70CAIR-BS, WASA22Ti70CN2-BS, WASA22Ti7SH-BS, WASA22Ti7SU-BS, WASA22Ti7SD-BS

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion 0/24 of Ti 7 Crevice washers.
No Corrosion on Any Ti 7 Hardware Nuts/Bolts or Crevice washers - Gold tint staining on All Surfaces of Specimens

Note: specimen will be polished for further use.

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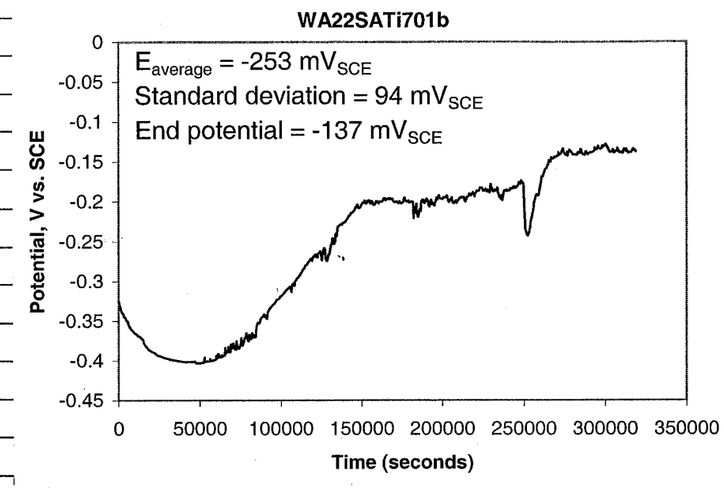

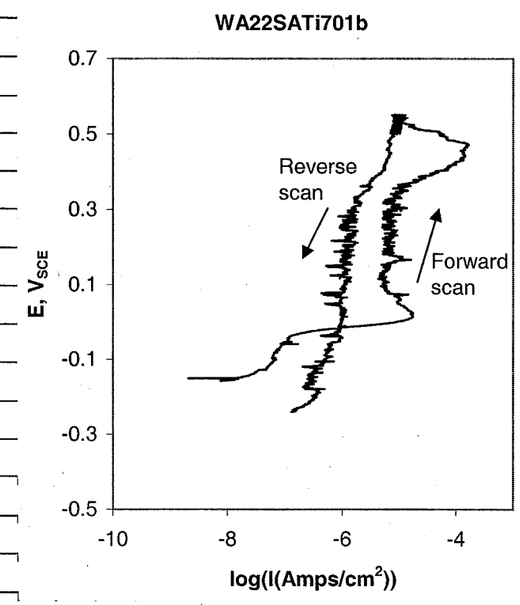

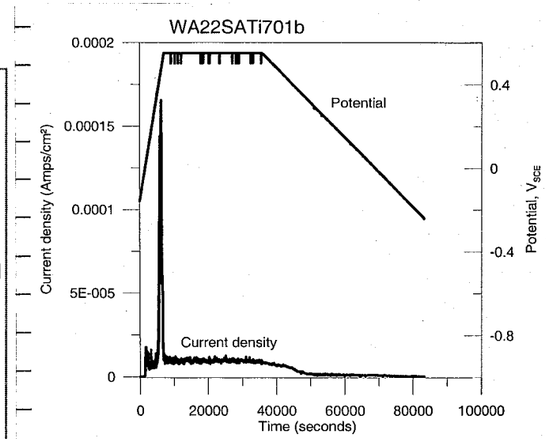

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/4~~; Torque: 75 in-lbs; 1/3 X.H 9/15/05
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV$_{SCE}$ for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm^2 at 550 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm^2 at 336 mV$_{SCE}$;
$i < 10^{-6}$ A/cm^2 at 283 mV$_{SCE}$
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm^2 at 341 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm^2 at -105 mV$_{SCE}$;
$i < 10^{-6}$ A/cm^2 at -118 mV$_{SCE}$

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT#2277-3-3292 WN813 welded Solution Annealed see pg #58 W/T.7 HT CN2775 1/8 Crevice washer Cathode + Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing.* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque to~~ 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 70 In-Oz **SN:** 139072 **Cal:** 4/11/05 **Due:** 10/11/05

Initial Weight: 23.40584 g **Final Weight:** 23.40302 g **Model:** Sartorius Genius **SN:** 12809099 **Cal:** 5/11/05 **Due:** 11/11/06

Solution: 4.0 M NaCl 467.54 g NaCl 051510 lot# + DI water to 2000 mL

Test ID: WA22SATi703b

Reagents measured with **Model:** OHAUS **SN:** 2883 **Cal:** 7/12/05 **Due:** 1/12/06

Initial pH: 8.03 **Final pH:** 7.43 **Model:** Orion EA 940 **SN:** 2330 **Cal:** 7/25/05 **Due:** 7/25/06 **pH Probe:** #13-620-296 **SN:** 4065716

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** H 98-170 **Cal:** 4/27/05 **Due:** 4/27/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3329075

Gas: DC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: ~~-252.7~~ -143.8 mV_{SCE} } in N_2 **Model:** Keithley 614 **SN:** 0704936

Ept: ~~-6.6~~ -19.7 mV_{SCE} **Cal:** 5/27/05 **Due:** 5/26/06

X.H 9/14/05

Potentiostat: solartron 1480 **SN:** 00240053

DATA FILE: WASA22Ti70CA2R_B7, WASA22Ti70CN2_B7, WASA22Ti7SD_B7, WASA22Ti7SH_B7, WASA22Ti7SU_B7

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion 0/24 feet of Ti7 1/10 cathode with Crevice washers. Also Ti7 Hardware Nut/Bolt No Corrosion. Gold tint staining on Specimen. Ti7 Hardware shows Dull tint staining

Note: Specimen will be polished for future use.

* Drawing # 20.06002.01.322.002

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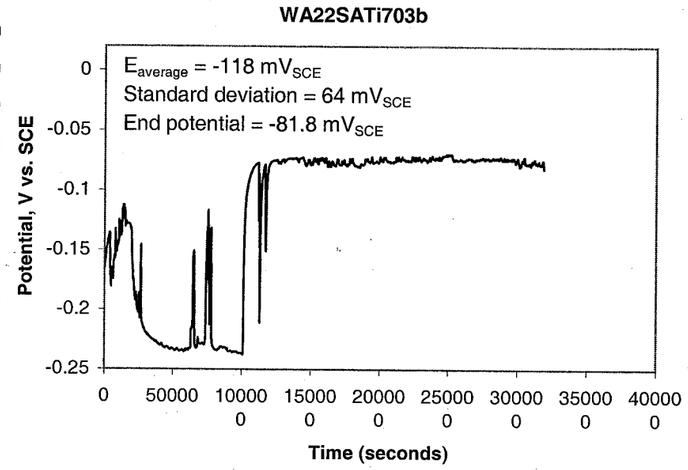

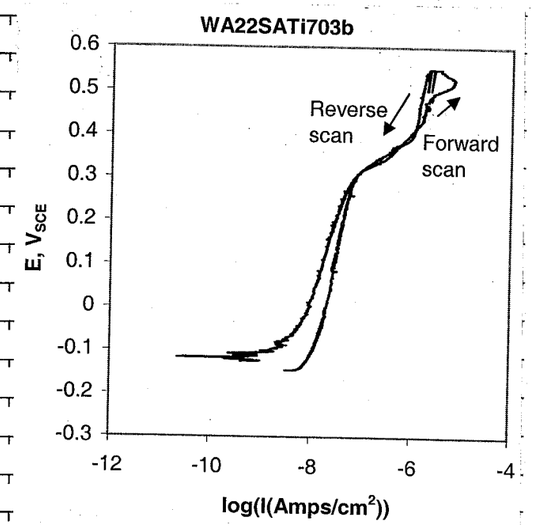

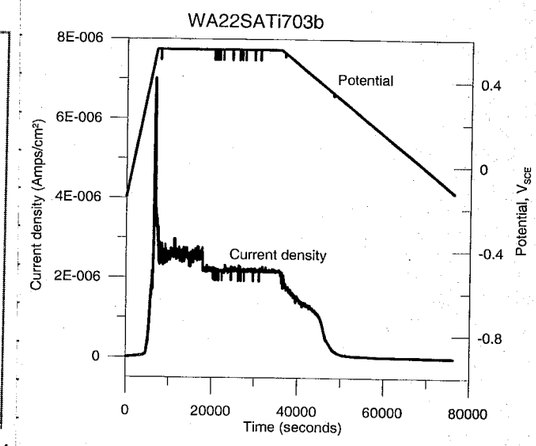

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/10~~; Torque: 70 in-oz; 1/18 X.H 9/15/05
N_2 deaerated, 95 °C, 4 M NaCl solution
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE} for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 543 mV_{SCE};
$i < 10^{-6}$ A/cm² at 395 mV_{SCE}
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm² at 374 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 320 mV_{SCE};
$i < 10^{-6}$ A/cm² at 277 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 HT# 2277-3-3292 WN803 w/Ti7 Cathode Crevice Washer 1/18 w/Loco Solution Annealed See Pg #58 And Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque to~~ 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Tree Craft **Model# &Torque:** 75 In lbs **SN:** 694000691
Cal: 7/22/05 **Due:** 7/21/06

Initial Weight: 23.48595g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.48598 **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4.0 M NaCl
467.67g NaCl cat#051510
+ DI water to 2000mls

Test ID. WA22SATi704b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 7.93 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.63 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** 183303
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 0251439

Gas: 0C w/zero then 99.999% N_2 E Repassivation

Ecorr: ~84 mV$_{SCE}$ 2 in **Model:** Keithley 614 **SN:** ~~0504996~~ 0704936 BW 9/6/05
Ept: 126.8 mV$_{SCE}$ 3 cm^2 **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00240053

DATA FILE: WASA22Ti70CA2R_B8, WASA22Ti70CN2, WASA22Ti75U_B8, WASA22Ti78D_B8, WASA22Ti78M_B8_UnlCh8

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion 0/24 feet of Ti7 1/10 cathode with Crevice ~~Washers~~ Washers AKA 9/14/05 · Ti7 Hardware Nut/Bolt No Corrosion - Gold tint Staining on All Surfaces of Specimen Ti7 cathode And Hardware Dull tint Staining on All surfaces

* Note Specimen Repolished for further Testing

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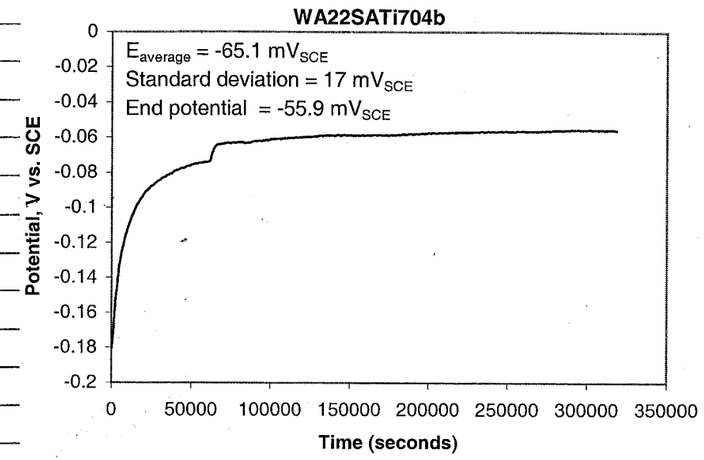

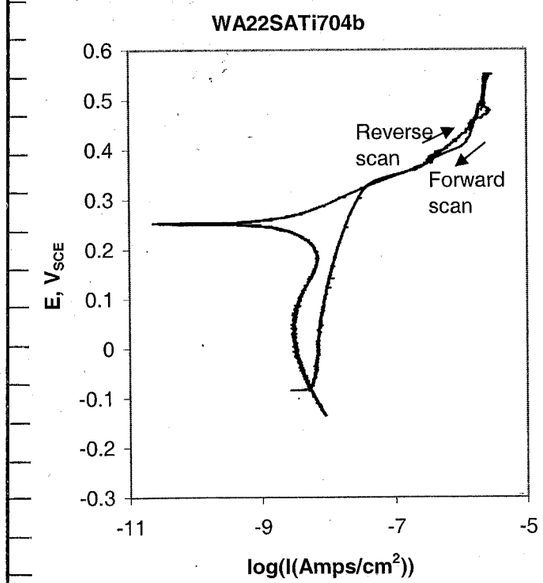

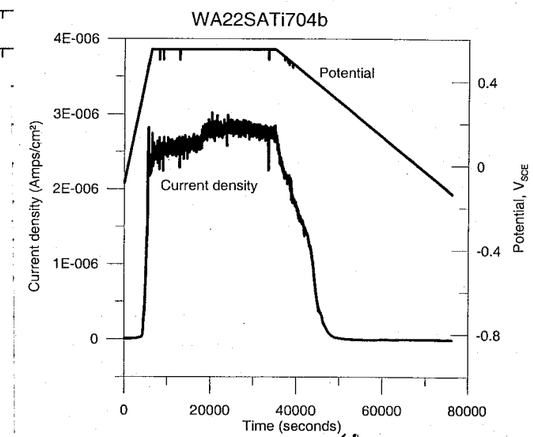

Welded+Solution Annealed Alloy 22 (Anode) to Ti Gr7 crevice, Ti7 bolt and nut
Anode to cathode area ratio: ~~1/18~~ 1/18, Torque: 75 in-lbs;
N_2 deaerated, 95 °C, 4 M NaCl solution X.H 9/15/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV$_{SCE}$ for 8 hours
Reverse scan rate: 0.0167 mV/s
Using entire assembly area for current density calculation:
$i < 10^{-5}$ A/cm^2 at 550 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm^2 at 494 mV$_{SCE}$;
$i < 10^{-6}$ A/cm^2 at 405 mV$_{SCE}$
Using crevice specimen area for current density calculation:
$i < 10^{-5}$ A/cm^2 at 390 mV$_{SCE}$; $i < 2*10^{-6}$ A/cm^2 at 347 mV$_{SCE}$;
$i < 10^{-6}$ A/cm^2 at 333 mV$_{SCE}$

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L HT# P80746 w/ Teflon Crevice washers And C276 Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.06002.01.322,002 Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs.
X.H 10/4/05 X.H 10/4/05

Torque Screwdriver: Pacto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 21.8282g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 21.8145g **Cal:** 5/11/05 **Due:** 11/11/06

Solution:

Test ID: 316SS TEFLON

0.5 M NaCl
58.48g NaCl Lot# 051510
+ DI To 2000 mls

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.87 **Model:** Orion EA 940 **SN:** 2330
Final pH: 6.37 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** C 96.377
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3300328

Gas: 99.999% N_2

Ecorr: -566 mv **Model:** Keithley 614 **SN:** 0704936
Ept: -101 mv **Cal:** 5/27/05 **Due:** 5/26/06
Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: CPP 316 PTFE

Number of Crevice Corrosion Sites: 24/24 (24 max.)

Crevice Corrosion on 24/24 feet of Crevice washer - Mild Gold tint Surface Staining on All Surfaces of Specimen

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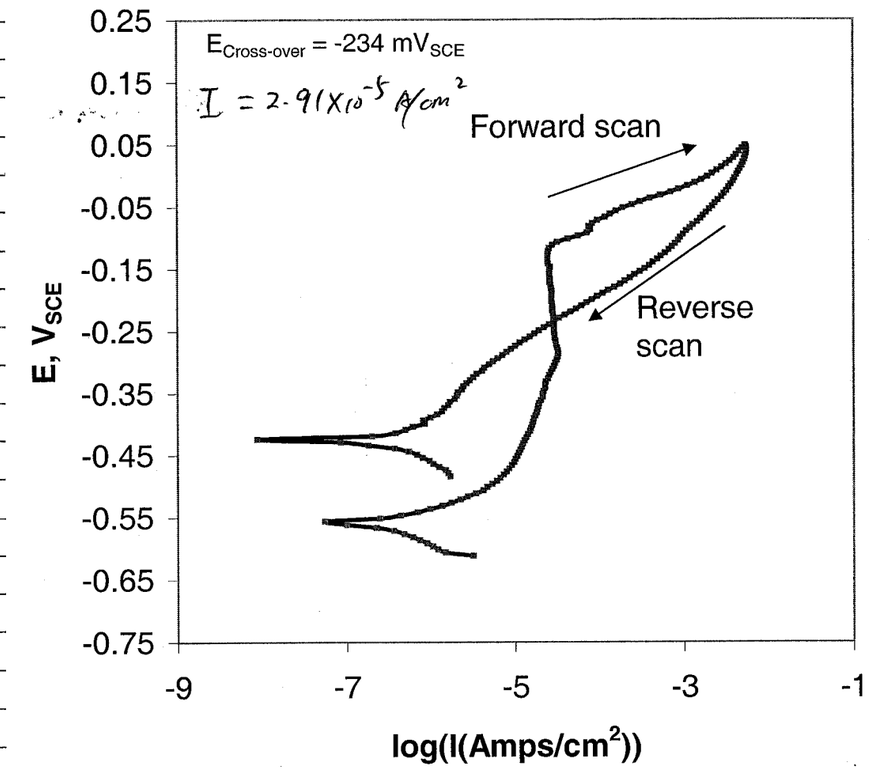

Specimen area = 11.6 cm^2

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L HT#P80746 w/C-22 ~~X~~ 1/3 Crevice Washer HT # 2277-3-3266 KM 9/13/05

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # 20.0602.01.322.002. Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using ~~C22 HT#2277-3-3266~~ Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. KM 10/4/05 KM 10/4/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 21.7650 g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 21.7285 g **Cal:** 5/11/05 **Due:** 11/11/06

Solution: 0.5 m NaCl
58.48 g NaCl Lot # 051510
+ DI water to 2000 mls

Test ID:
316SSBA22

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 5.14 **Model:** Orion EA 940 **SN:** 2330
Final pH: 6.20 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** 115858
Cal: 4/27/05 **Due:** 4/27/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028037

Gas: 99-99.9% N_2

Ecorr: -387 mv **Model:** Keithley 614 **SN:** 0704936
Ept: -79 mv **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: CPP 316 BA22

Number of Crevice Corrosion Sites: 24 /24 (24 max.)

Crevice Corrosion on 24/24 feet of Crevice Washer
Mild Gold tint staining on All surfaces of Specimen

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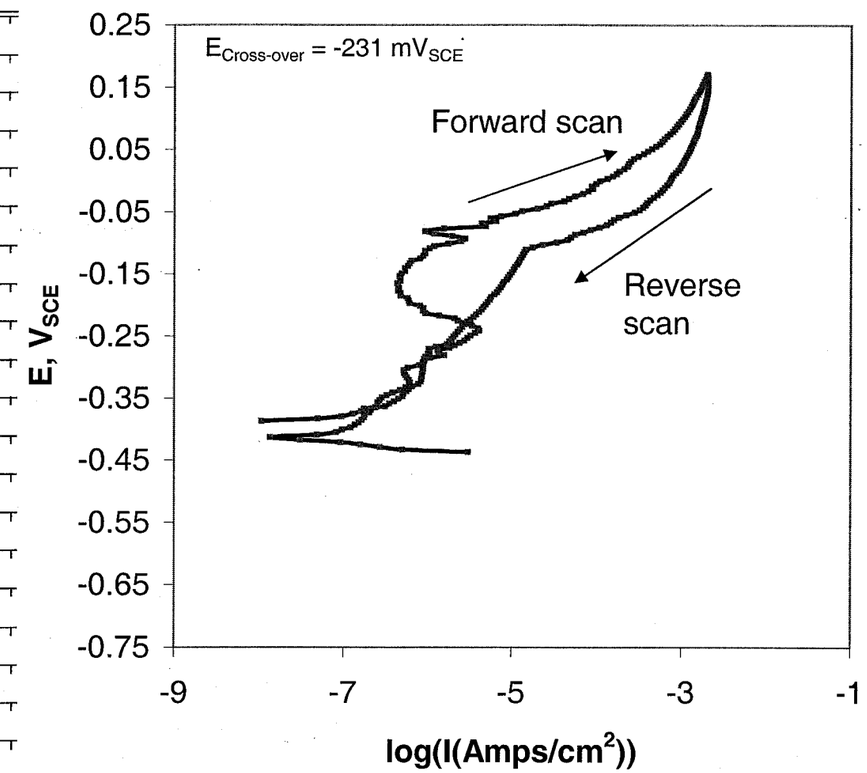

At E = -231 mV_{SCE}, current density = 2.79×10^{-6} A/cm^2 if entire crevice assembly area was used to calculate current density;
current density = 1.21×10^{-5} A/cm^2 if crevice specimen area was used to calculate current density.

Crevice specimen area = 11.6 cm^2
Entire crevice assembly area = 50.2 cm^2

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 Base Alloy HT#2277-3-3266 W/ C-22 2277-3-3266 Crevice Washer And Hardware X/X 1/3

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 10/4/05 X.H 9/23/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 23.0993g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.0975g **Cal:** 5/11/05 **Due:** 11/11/06

Solution: 4.0 M NaCl
467.53g NaCl Lot# 051510
+ DI water. To 2000mls

Test ID: ~~BA22SA/BA22016~~ X.H 9/21/05
BA22BA22016

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 6.35 **Model:** Orion EA 940 **SN:** 2330
Final pH: 6.97 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** C96.377
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 3300328

Gas: OC w/zero Air then 99.999% N_2 for E Repassivation

Ecorr: -235 mV **Model:** Keithley 614 **SN:** 0704936
Ept: +41 mV **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: BA22BA22250air-Ch1 Ch1, BA22BA22250N2, BA22BA22250SA, BA22BA22250SH, BA22BA22250SD-Ch1 Ch1

Number of Crevice Corrosion Sites: 0/24 (24 max.)

No Crevice Corrosion on C-22 Specimen
No Corrosion on C-22 Crevice washers or Nut/Bolt - Specimen Has gold tint Staining on All surfaces

Note: specimen will be polished for future use.

*Drawing # 20.06002.01.322.002.

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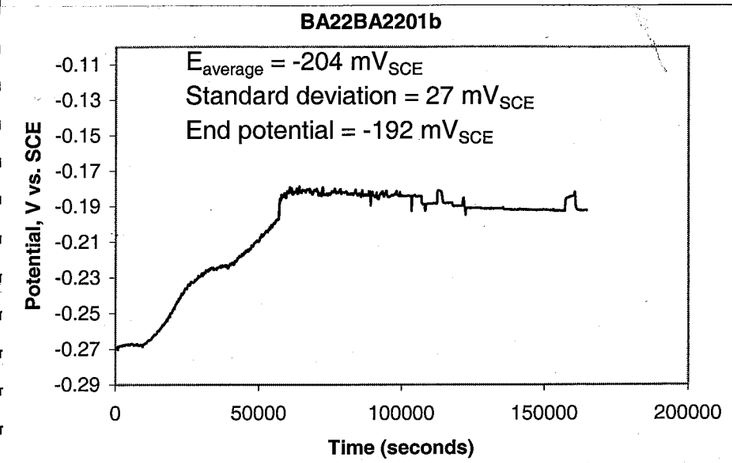

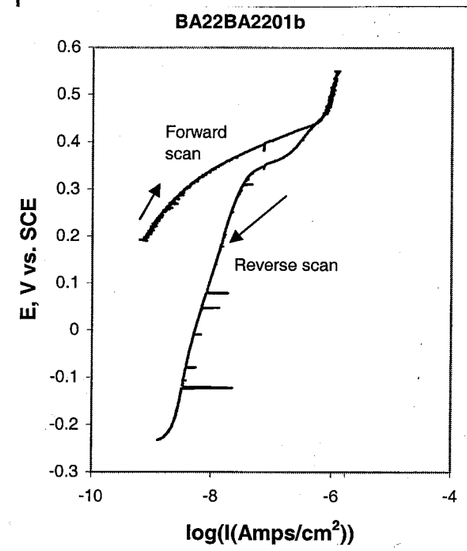

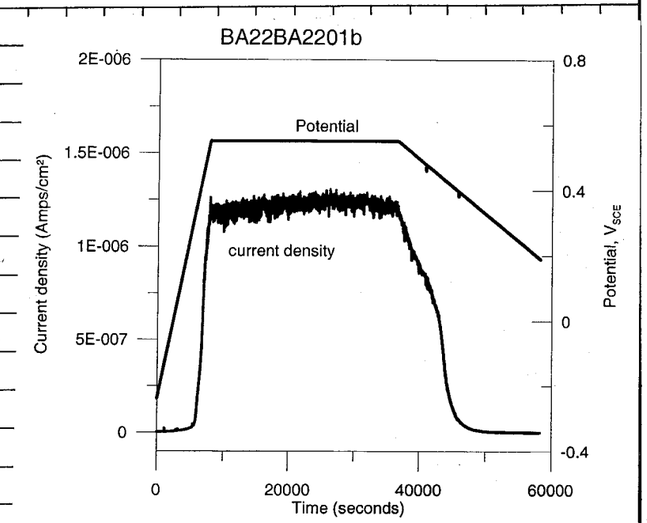

Base Alloy 22 (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, no Teflon tape wrapped
Anode to cathode area ratio: ~1/4, Torque: 50 in-oz,
N_2 deaerated, 95 °C, 4 M NaCl solution X.H 9/22/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE}, for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculatin current density:
$i < 10^{-5}$ A/cm² at 550 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 550 mV_{SCE};
$i < 10^{-6}$ A/cm² at 518 mV_{SCE}
Using crevice specimen area for calculatin current density:
$i < 10^{-5}$ A/cm² at 418 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 381 mV_{SCE};
$i < 10^{-6}$ A/cm² at 362 mV_{SCE}

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: C-22 Base Alloy HT#2277-3-3266 w/C-22 2277-3-3266 Crevice Washers And Hardware X.H 1/3

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing.* Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.H 9/22/05 X.H 10/4/05

Torque Screwdriver: True Craft **Model# &Torque:** 75 In-lbs **SN:** 69400069 1
Cal: 7/22/05 **Due:** 7/21/06

Initial Weight: 23.5908g **Model:** Sartorius Genius **SN:** 12809099
Final Weight: 23.5892 1/2g **Cal:** 5/11/05 **Due:** 11/11/05

Solution: 4 m NaCl
467.58g NaCl Lot#051510
+ DI water To 2000 mls

Test ID: BA22BA2202b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 6.14 **Model:** Orion EA 940 **SN:** 2330
Final pH: 7.34 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°C **Measured with Hg Thermometer** **SN:** 115858
Cal: 4/27/05 **Due:** 4/27/06

Counter Electrode: Platinum Flag

Reference Electrode: Fisher 13-620-52 **SN:** 4028037

Gas: OC with Zero Air then N_2 99.999% for E Repassivation

Ecorr: ~~-76 mv~~ -221 mV SCE X.H 9/24/05 **Model:** Keithley 614 **SN:** 0704936
Ept: + 219 mv **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00238265

DATA FILE: BA22BA2275air-Un1Ch2, BA22BA2275N2-Un1Ch2, BA22BA2275SU-Un1Ch2, BA22BA2275SH-Un1Ch2, BA22BA2275SD-Un1Ch2

Number of Crevice Corrosion Sites: 0 /24 (24 max.)

No Crevice Corrosion on Specimen - No Corrosion on Crevice former But Corrosion Noticed on Nut And Bolt outside of Nut - Gold tint staining on All Surfaces of Specimen

Note: Specimen will be polished for further use.

* Drawing # 20.06002.01.322.002. X.H 10/6/05

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/15/05

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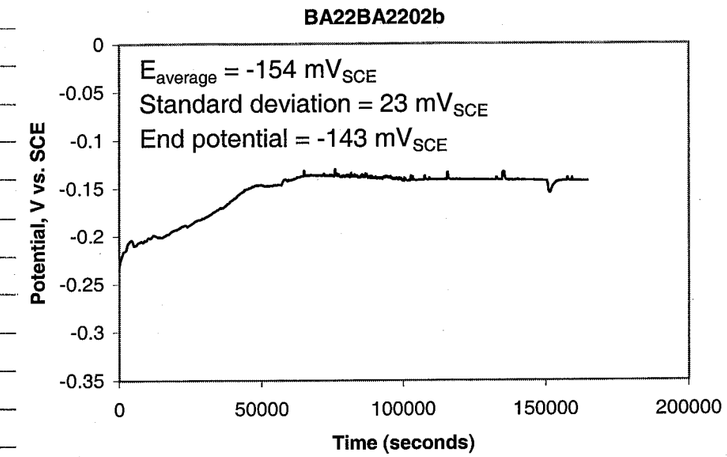

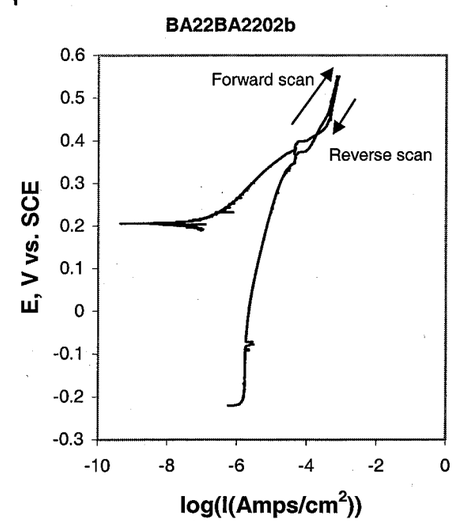

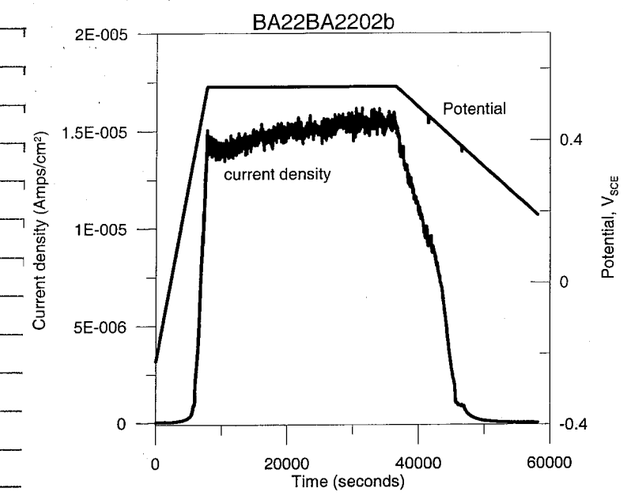

Cross-over potential = 415 mV_{SCE}

Base Alloy 22 (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, no Teflon tape wrapped
Anode to cathode area ratio: ~1/3, Torque: 75 in-lbs,
N_2 deaerated, 95 °C, 4 M NaCl solution X.H 9/22/05
Forward scan rate: 0.1 mV/s, Potential hold: 550 mV_{SCE}, for 8 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculating current density:
$i < 10^{-5}$ A/cm² at 480 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 401 mV_{SCE};
$i < 10^{-6}$ A/cm² at 394 mV_{SCE}
Using crevice specimen area for calculating current density:
$i < 10^{-5}$ A/cm² at 405 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at 367 mV_{SCE};
$i < 10^{-6}$ A/cm² at 349 mV_{SCE}

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		Recorded by	9/22/05

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POTENTIAL SCAN AND HOLD

Objective: See page 1.

Alloy / Heat No.: 316L HT# P80746 w/c-22 2277-3-3266 Crevice Washer + Hardware

Specimen Preparation: Specimen machined to dimensions specified in CNWRA Drawing # * 1/3 Specimen surfaces polished to 600 Grit finish using SiC paper. Specimen cleaned in acetone then X.M 9/22/05 crevice forming washers attached to specimen using C22 HT#2277-3-3266 Hardware ~~Torque~~ to 50 in-oz.or 75 in lbs. X.M 19/8/05

Torque Screwdriver: Proto 6104 **Model# &Torque:** 50 In-oz **SN:** 139072
Cal: 4/11/05 **Due:** 10/11/05

Initial Weight: 21.72124 **Model:** Sartorius Genius **SN:** 1280 9099
Final Weight: 21.73502 **Cal:** 5/11/05 **Due:** 11/11/06

Solution: 4.0 m NaCl
467.56g NaCl Lot# 051510
+ DI water to 2000mls

Test ID: 316SSBA2201b

Reagents measured with **Model:** OHAUS **SN:** 2883
Cal: 7/12/05 **Due:** 1/12/06

Initial pH: 7.97 **Model:** Orion EA 940 **SN:** 2330
Final pH: 9.22 **Cal:** 7/25/05 **Due:** 7/25/06
pH Probe: #13-620-296 **SN:** 4065196

Test Temperature: 95°c **Measured with Hg Thermometer** **SN:** 00-387
Cal: 7/11/05 **Due:** 1/11/06

Counter Electrode: Platinum Flag

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

Gas: oc with zero Air then 99.999% N_2 for E Repassivation

Ecorr: ~~-366~~ mV_{SCE} X.M 9/21/05 **Model:** Keithley 614 **SN:** 0704936
Ept: 330 68 mV_{SCE} **Cal:** 5/27/05 **Due:** 5/26/06

Potentiostat: Solartron 1480 **SN:** 00 240053

DATA FILE: 316LBA2201CB2R-B1-UnlCh2, 316LBA2201CN2-B1, 316LBA22SU-B1, 316LBA22SH-B1, 316LBA22SD-B1-UnlCh2

Number of Crevice Corrosion Sites: 18 /24 (24 max.)

Crevice Corrosion on 18/24 feet of 316L Specimen
C-22 Crevic Washer & Bolt/nut No Corrosion - Gold tint staining on All Surfaces

* Drawing # 20.06002.01.322.002.

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Witnessed & Understood by me,	Date	Invented by	Date
		Recorded by	9/15/05

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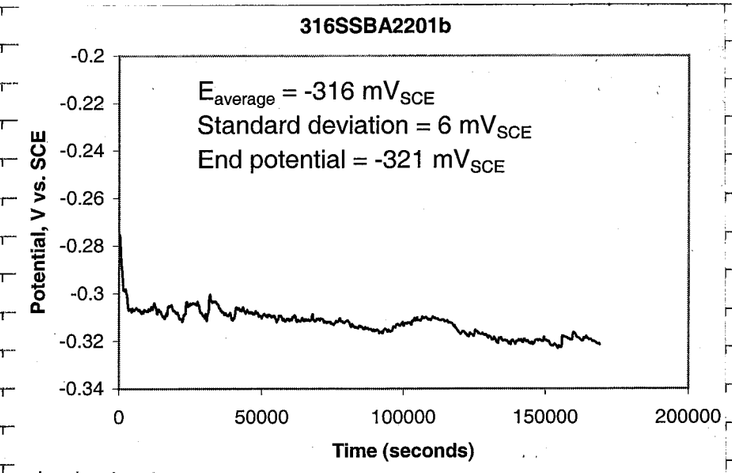

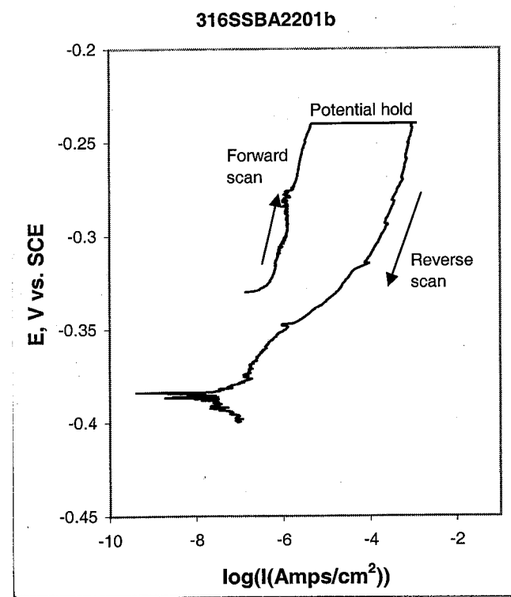

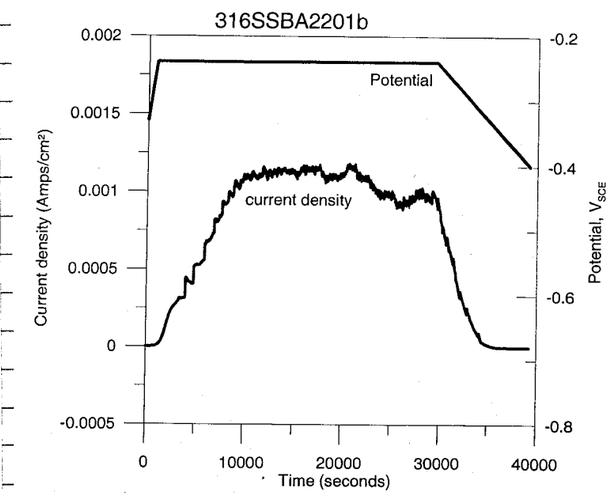

316L stainless steel (Anode) with Base Alloy 22 (Cathode) crevice
Base Alloy 22 bolt and nut, bolt wrapped with Teflon tape
Anode to cathode area ratio: ~1/43 Torque: 50 in-oz,
N_2 deaerated, 95 °C, 4 M NaCl solution X.M 9/22/05
Forward scan rate: 0.1 mV/s, Potential hold: -240 mV_{SCE}, for 5 hours;
Reverse scan rate: 0.0167 mV/s
Using crevice assembly area for calculating current density:
$i < 10^{-5}$ A/cm² at -334 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -346 mV_{SCE};
$i < 10^{-6}$ A/cm² at -347 mV_{SCE}
Using crevice specimen area for calculating current density:
$i < 10^{-5}$ A/cm² at -345 mV_{SCE}; $i < 2*10^{-6}$ A/cm² at -357 mV_{SCE};
$i < 10^{-6}$ A/cm² at -367 mV_{SCE}

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Witnessed & Understood by me,	Date	Invented by	Date
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Book No._____ TITLE_____

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Continued Testing

In Notebook #744

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

10/5/2005

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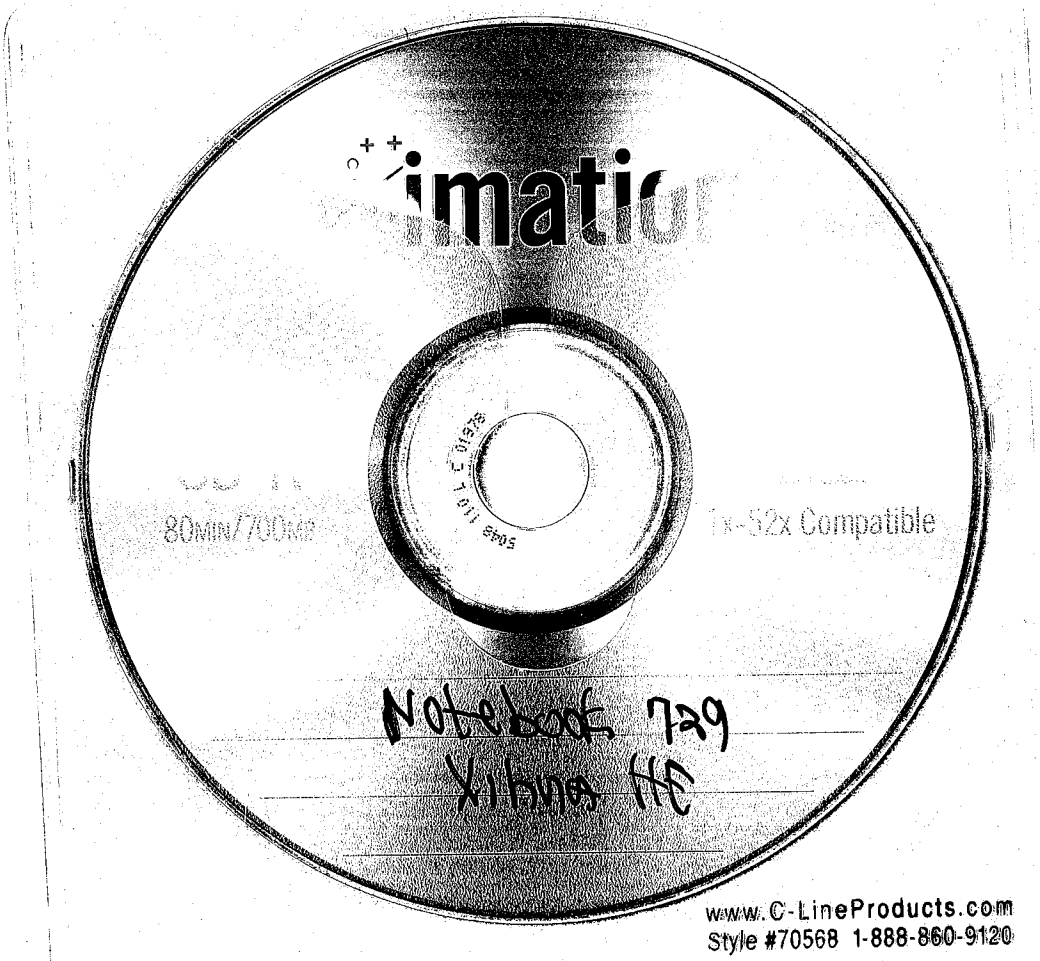
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