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032

TASK 3 - Thermal Stability
IWPE Project.

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Pages 1 **through** 160 **of this Scientific Notebook were reviewed for compliance with QAP-001 in response to Corrective Action Request 94-02. Corrections and clarifications were made as appropriate. In some cases, the date of a change will reflect the date of this review rather than the date of the original Scientific Notebook entry.**

Randy Hale
SWRE-QA
12/01/94

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Task 3: MATERIALS STABILITY

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N. Triftak
11/30/94

TASK 3: MATERIALS STABILITY (20-3704-043)

The initial activity in this task is the determination of the temperature - time - precipitation diagram of alloy 825. For that purpose cubic samples of the alloy will be heat treated at temperatures ranging from 600 to 800°C for different time periods (0.1 to 10 hours). Heat treatments will be performed in furnaces located in Division 06, using calibrated termocouples. Metallographic observations of the resulting microstructures will be done also in Division 06, while corrosion testing experiments to evaluate the susceptibility of the thermally treated samples will be conducted in the IWPE laboratory. In order to conduct the various heat treatments the first step was the calibration of two Chromel-Alumel (Type K) thermocouples. (Thermo Sensor, #1K34-V-60-M) in conjunction with the data logger (Doric Digitrend 235 # 10+24) to be used for recording the temperature of the specimens. A Temptron Freezing Point Unit was used with three NBS standards as

Personnel Involved: Walter Machowski, Gustavo Cragnolino, Darrell Dunn, Joseph Kucharczyk, and Narasi Sridhar

detailed in the attached records of the calibration and summarized in pages 1 and 2 of the data sheets.

STANDARD OR REFERENCE TEMPERATURE (°F)	MEASURED TEMPERATURE (°F)	
	TC #1	TC #2
449.39	448.1	448.2
1220	1215.8	1216.4
1984.1	1976.6	1977.4

By lineal regresion

$T_M = A_0 + A_1 T_{st}$

T_M: measured temperature

T_{st}: standard temperature

$T_M = 0.56942 + 9.9618 \times 10^{-1} T_{st}$

N. Sridhar

11/30/94

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San Antonio, Texas 78284

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Project: 20-3704-043

Temptron Inc.

Freezing Point Standard - Tin
NBS Standard Sample - 42 F
Freezing Point - 449.39 °F / 231.88 °C
Model # - 501
Serial No - 136

Freezing Point Standard - Aluminum
NBS Sample No - 44E
Freezing Point - 1220°F / 660 °C
Model # - 504
Serial # - 178

Freezing Point Standard - Copper
NBS Sample # - No NUMBER
Freezing Point - 1984.1°F / 1084.5°C
Model # - 525
Serial # - 626

Recorded on Doric Digitrend Model 235 Serial # 10429
Channel 2

TSC Type "K" thermocouples Nos "1" + "2"

Date: 04 Nov. 1991

Signature: [signature]

(SwR 17) Rev 6/75

		T_{cal} °F		T_{cal} °F		T_{cal} °F			
		449.39		1220		1984.1			
T/C-1		448.0	448.2	1215.8		1976.5			
				1215.9		1976.7			
				1215.8		1976.6			
				1215.8					
		448.1		1215.8		1976.6			
T/C-2		448.1	448.3	1216.3		1977.4			
				1216.3		1977.5			
				1216.7		1977.5			
				1216.5		1977.3			
				1216.3		1977.1			
						1977.3			
		448.2		1216.4		1977.4			

Date: 05 Nov 1991

Signature: Arthur E. Nicholl

(SwR 17) Rev 6/75

002 1975.1°F
308+17:26:26

002 1976.0°F
308+17:25:21

002 1976.2°F
308+17:24:22

002 1976.6°F
308+17:23:24

002 1976.7°F
308+17:22:23

002 1976.5°F
308+17:21:22

Cal. 1984.7 °F

002 1978.1°F
308+17:20:23

002 1981.3°F
308+17:19:22

002 1984.6°F
308+17:18:23

002 1986.5°F
308+17:17:24

002 1985.0°F
308+17:16:24

002 1980.3°F
308+17:15:26

002 1214.9°F
308+15:47:24

002 1215.3°F
308+15:46:24

002 1215.6°F
308+15:45:22

002 1215.0°F
308+15:44:23

002 1215.8°F
308+15:43:24

Tcal: 1220°F

002 1215.9°F
308+15:42:23

002 1215.8°F
308+15:41:23

002 1215.0°F
308+15:40:23

002 1214.5°F
308+15:39:23

002 1218.9°F
308+15:38:23

002 1224.4°F
308+15:37:23

002 448.1°F
308+15:16:23

002 448.2°F
308+15:15:24

002 448.2°F
308+15:14:23

002 448.2°F
308+15:13:27

002 448.1°F
308+15:12:23

002 448.1°F
308+15:11:24

002 448.0°F
308+15:10:25

002 448.0°F
308+15:09:24

002 448.1°F
308+15:08:24

002 448.1°F
308+15:07:23

002 448.1°F
308+15:06:24

Tcal: 448.5°F

002 448.1°F
308+15:05:25

002 448.1°F
308+15:04:24

002 448.0°F
308+15:03:24

002 448.1°F
308+15:02:26

Cal T/C #1
04 Nov 1991
20-3704-043

002 1975.3°F
309*10:23:21

002 1976.0°F
309*10:22:21

002 1976.6°F
309*10:21:21

002 1977.0°F
309*10:20:21

---

002 1977.0°F
309*10:19:21

002 1977.0°F
309*10:18:21

002 1977.2°F
309*10:17:21

002 1977.3°F
309*10:16:21

002 1977.1°F
309*10:15:21

002 1977.3°F
309*10:14:21

T cal = 1984.1 °F

002 1977.5°F
309*10:13:21

002 1977.5°F
309*10:12:21

002 1977.4°F
309*10:11:21

002 1977.1°F
309*10:10:20

002 1979.6°F
309*10:09:21

002 1987.8°F
309*10:08:20

002 1997.9°F
309*10:07:20

002 2005.4°F
309*10:06:21

002 2009.6°F
309*10:05:20

---

002 1215.5°F
309*09:54:22

002 1215.9°F
309*09:53:22

002 1216.0°F
309*09:52:20

002 1216.1°F
309*09:51:22

002 1216.1°F
309*09:50:22

002 1216.3°F
309*09:49:22

002 1216.5°F
309*09:48:21

002 1216.7°F
309*09:47:21

T cal = 1220.0 °F

002 1216.3°F
309*09:46:21

002 1216.3°F
309*09:45:19

002 1217.5°F
309*09:44:21

002 1220.1°F
309*09:43:21

002 1224.1°F
309*09:42:20

002 1228.9°F
309*09:41:22

002 1233.4°F
309*09:40:23

---

002 448.2°F
309*09:08:23

002 448.2°F
309*09:07:20

002 448.3°F
309*09:06:22

002 448.2°F
309*09:05:23

002 448.2°F
309*09:04:22

002 448.2°F
309*09:03:26

002 448.3°F
309*09:02:21

002 448.3°F
309*09:01:22

002 448.2°F
309*09:00:21

T cal = 449.39 °F

002 448.2°F
309*08:59:21

002 448.2°F
309*08:58:22

002 448.1°F
309*08:57:21

002 448.2°F
309*08:56:21

power off

002 448.2°F
309*08:55:23

002 448.1°F
309*08:54:22

002 448.2°F
309*08:53:21

002 448.1°F
309*08:52:22

---

002 448.0°F
309*08:51:23

002 447.8°F
309*08:50:21

002 447.5°F
309*08:49:21

Cal T/C # 2
05 Nov 1991
20-3704-043
A.E. Mitchell

Heat treatment of Alloy 825 Specimens.

Purpose: Determination temperature-time-precipitation

To determine the temperature-time-precipitation diagram of alloy 825 and the intergranular corrosion behavior of the resulting microstructures 40 samples of approximately 0.5 x 0.5 x 0.5 in. were cut from a 0.5 in thick plate of heat N° HH4371 FG of Inconel 825. The chemical composition of this heat, as used in other tables of INPE, is given in the next page.

The samples were mechanically polished finishing with Si C paper grade 600 and degreased with acetone.

To compare the effect of heat treatment within the temperature range of 600 to 800°C for as-received WS. Solution annealed material, 20 cubic samples were heat treated at 1200°C ≡ 2192°F

A tube furnace (PERENY) was used in which a constant temperature region (plateau) of about 5 in. was measured with the calibrated termocouple #1 and the DORIC DIGITREND 235 data logger.

The 20 samples were held together by winding a stainless wire which was passed through a small hole in each sample.

CHEMICAL COMPOSITION IN WT% OF ALLOYS IN INPE

MATERIAL	304L	304L	316L	316L	IN825	IN825	HA C-22	HA C-22	CDA 102	CDA 102	CDA 613	CDA 613	CDA 715	CDA 715
ORIGIN	G.O.CARLSON		EASTERN STAINLESS		INCO/METAL GOODS		HAYNES/CORR MATLS				AMPCO METAL		REVERE	
HEAT NO.	T0954		P80746		HH4371FG		2277-8-3175				M5459		7037-61326	
ELEMENTS	VENDOR	KAWIN	VENDOR	KAWIN	VENDOR	KAWIN	VENDOR	KAWIN	VENDOR	KAWIN	VENDOR	KAWIN	VENDOR	KAWIN
Ag												<0.01		
Al		<0.01		<0.01	0.07	0.05		0.18			6.66	7.05		<0.01
As												<0.01		
B										0.004				
C	0.022	0.029	0.014	0.019	0.010	0.013		0.015*				0.005	0.013	0.019
Cb														
Cd												<0.001		<0.001
Co			0.17					0.09						
Cr	18.27	18.44	16.35	16.64	22.09	22.98		21.40				<0.005		0.01
Cu		0.19	0.27	0.29	1.79	1.80					90.61		69.20	BAL.
Fe	BAL.	BAL.	BAL.	BAL.	30.41	28.09		3.80			2.44	2.56	0.54	0.55
Mg									99.95 MIN.					
Mn	1.46	1.38	1.58	1.56	0.35	0.33		0.12			<0.01	0.02	0.57	0.62
Mo		0.15	2.07	2.16	3.21	3.56		13.60						
N		0.07	0.06	0.06										
Ni	9.14	9.00	10.04	10.43	41.06	41.76		BAL.			0.03	0.02	29.57	29.85
P	0.026	0.024	0.026			0.008		0.008			0.006	0.001	0.004	0.001
Pb											<0.01	0.008	0.010	0.004
S	0.005	0.005	0.018		<0.001	0.003		<0.002				0.001	0.006	0.011
Sb												<0.01		<0.01
Si	0.47	0.44	0.49		0.19	0.13		0.03			<0.01	0.02		0.01
Sn											0.27	0.29		
Ta														
Ti		0.01			0.82	0.93		<0.01						
V		0.05				0.04		0.15						
W								3.00						

the end of the thermocouple was placed into a small bore hole in the center of one of the specimens to record the temperature variation following the insertion of the sample in the furnace. After approximately 11 minutes a temperature reading of 2181.7°F was reached as noted in the following table, where all the readings from the ~~intro~~ insertion of the samples into the furnace up to their removal are noted

Time (minutes)	Reading (°F)	Corrected temperature (°F)
0	472.7	
1	969.7	
2	1324.1	
3	1649.1	
4	1875.8	
5	2024.1	
6	2093.7	
7	2152.3	
8	2153.9	
9	2166.3	2174.0
10	2175.3	2183.1
11	2181.7	2189.5
12	2189.4	2197.2
13	2189.6	2197.4
14	2189.1	2196.9
15	2187.6	2195.4

11/6/91

16	2186.8	2194.6
17	2186.7	2194.5
18	2187.2	2195.0
19	2187.6	2195.4
20	2187.4	2195.2
21	2187.6	2195.4
22	61.2	61.3

11/6/91
10 minutes at 2195.7°F
Walter J. Machowski

The samples were exposed by 10 minutes at a corrected temperature of 2195.7°F which is ~4°F above the target temperature of 2192°F and then water quenched as noted by the temperature drop to 61.4°F. These samples were identified as solution annealed (SA) samples, while the as-received ~~were~~ samples are designated as mill-annealed $(MA)_A$ samples because the plate is cold rolled and annealed.

Location of plateau:

Position (in)	1st reading	2nd reading
+3.5	2184.6	2184.6
+2.5	2192.7	2192.6
+1.5	2196.7	2196.8
+0.5	2199.7	2199.6
-0.5	2199.2	2199.3
-1.5	2196.5	2196.4
-2.5	2190.4	2190.1
-3.5	2176.5	2177.5

11/6/91
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Plateau ± 5.8°F.

11/6/1991

Heat treatments at 600°C (1112°F)

After the solution annealing, a pair of samples, one SA and the other MA, will be heat treated at 600°C for various time periods. Three time periods were chosen: 0.1, 1.0 and 15.0 hours. In these heat treatments a vacuum of 10^{-3} Tor was used to avoid unnecessary oxidation in the case of the prolonged heat treatments. As before, the furnace temperature was controlled at the desired temperature and the pair of samples (in which the thermocouple was located in the SA sample) was introduced into the furnace. A LINDBERG furnace was used and the evolution of temperature is reproduced in the following tables, as measured every ~~1/2~~ 30 seconds.

0.1 hour treatment:

Time (minutes)	Reading (°F)	Al*Tl Corrected temperature (°F)
0	470.2	
0.5	676.0	
1.0	772.7	
1.5	840.5	
2.0	893.2	
2.5	936.2	

11/14/91
Walter J. Mackwell

3.0		
3.5	922.7	
4.0	1002.6	
4.5	1027.3	
5.0	1046.0	
5.5	1062.9	
6.0	1072.8	
6.5	1080.0	
7.0	1085.4	
7.5	1089.4	
8.0	1092.4	1096.0
8.5	1094.8	1098.4
9.0	1096.6	1100.2
9.5	1097.9	1101.5
10.0	1099.1	1103.3
10.5	1099.9	1103.5
11.0	1100.9	1104.5
11.5	1101.3	1104.9
12.0	1101.8	1105.5
12.5	1102.7	1106.4
13.0	1105.4	1109.1
13.5	1103.3	1107.0
14.0	1103.5	1107.3
14.5	1103.6	1107.3
15.0	1103.8	1107.5
15.5	1104.2	1107.9
16.0	1104.5	1108.2
16.5	1104.8	1108.5

17.0	1104.7	1108.5

1 hour treatment:

Time (minutes)	Reading (°F)	A1 * T2 Corrected temperature (°F)
0	594.2	
1	840.1	
2	939.3	
3	997.3	
4	1037.6	
5	1063.7	
6	1080.5	
7	1089.0	
8	1093.9	
9	1097.1	
10	1099.2	
11	1099.4	1103.6
16	1104.0	1108.2
21	1107.0	1111.2
26	1107.5	1111.7
31	1107.2	1111.4
36	1107.5	1111.7
41	1107.9	1112.1
46	1107.5	1111.7
51	1107.0	1111.2
56	1102.3	1106.5
61	1075.5	1079.6
66	1066.3	1070.4

60 minutes at temperature drop.

11/14/91
Walter J Machowski

11/14/91

11/15/91

71	1091.3	1095.5

15 hours treatment:

Time	Reading (°F)	A1 * T3 Corrected temperature (°F)
0 min	764.7	
1	886.6	
2	960.0	
3	1011.4	
4	1043.8	
5	1067.6	
6	1080.5	
7	1087.5	
8	1091.5	
9	1094.8	
10	1097.1	
11	1098.9	
12	1100.0	
13	1101.0	
1h 13 min	1105.8	1110.0
2h 13 min	1106.9	1111.1
3h 13m	1106.7	1111.1
4h 13m	1107.9	1112.1
5h 13m	1107.3 (11/24/94)	1111.5
6h 13m	~~1107.3~~ 1107.8	1112.0
7h 13m	±0.7 ~~±0.7~~ 1107.4	1111.6
8h 13m	1107.3 (11/30/94)	1111.5
9h 13m	1107.7	1111.9

15 hours at

N. Sigfred 11/30/94

10h 13m	1108.0	1112.2
11h 13m	1106.3	1110.5
12h 13m	1107.1	1111.3
13h 13m	1108.2	1112.4
14h 13m	1107.0	1111.2
15h 13m	1107.4	1111.6

11/15/91
Walter J. Machowski

0.1 hr heat treatment @ 638°C (1180.4°F) A2*T1

11/21/91
Walter J. Machowski

Time	Reading (°F)	Corrected Temp (°F)
0 min	628.8	
5 "	1140.8	
8 "	1165.5	
8.5 "	1167.4	1171.3
9.0 "	1169.1	1173.0
9.5 "	1170.3	1174.2
10.0 "	1171.7	1175.6
10.5 "	1172.7	1176.6
11.0 "	1173.6	1177.5
11.5 "	1174.2	1178.1
12.0 "	1175.1	1179.0
12.5 "	1175.6	1179.5
13.0 "	1176.2	1180.1
13.5 "	1176.9	1180.8
14.0 "	1177.5	1181.4
14.5 "	1177.9	1181.8
15.0 "	1178.3	1182.2
15.5 "	1178.3	1182.2
16.0 "	1178.5	1182.4
16.5 "	1080.5	1084.1

6 minutes @ Temp

1.0 hr heat treatment @ 638°C (1180.4°F) A2*T2

11/21/91

Time	Reading (°F)	Corrected Temp (°F)
5 min	1103.5	1107.0
10 "	1167.9	1171.8
12 "	1171.8	1175.7
13 "	1173.0	1176.9
14 "	1175.7	1179.6
14.5 "	1175.1	1179.0
18.5 "	1176.4	1180.3
22.5 "	1177.8	1181.7
26.5 "	1179.2	1183.2
30.5 "	1179.0	1183.0
34.5 "	1179.4	1183.4
38.5 "	1179.5	1183.5
42.5 "	1179.8	1183.8
46.5 "	1179.9	1183.9
48.5 "	1179.8	1183.8
52.5 "	1180.0	1184.0
56.5 "	1181.3	1184.3
60.5 "	1180.7	1184.7
64.5 "	1180.7	1184.7
68.5 "	1180.6	1184.6
72.5 "	1180.1	1184.1
74.5 "	1180.1	1184.1

1.0 hr at Temp

15.0 hr heat treatment @ 638°C (1180.4°F) A2*T3

Time	Reading (°F)	Corrected Reading (°F)
0	615.4	617.2
5 min	1107.8	1111.5
15 "	1171.4	1175.3
16 "	1171.4	1175.3
17 "	1172.3	1176.2
18 "	1173.0	1176.9
19 "	1173.9	1176.9
29 "	1176.3	1180.2
49 "	1176.8	1180.7
1 hr 09 min	1176.9	1180.8
" 29 "	1178.4	1182.3
" 49 "	1178.9	1182.8
2 hr 09 min	1178.1	1182.0
3 " "	1179.2	1183.2
4 " "	1179.0	1183.0
5 " "	1179.3	1183.3
6 " "	1179.0	1183.0
7 hr 09 min	1179.0	1183.0
8 " "	1178.1	1182.0
9 " "	1178.8	1182.7
10 " "	1179.1	1183.0
11 " "	1179.2	1183.2
12 " 09 min	1179.2	1183.2
13 " "	1178.4	1182.3
14 " "	1179.0	1182.9
15 " "	1179.4	1183.6
16 hr 09 min	1179.6	1183.6

15.0 hr @ Temp

11/21/91
Walter J. Maciowski

11/22/92 91
wjmaciowski 7/1/92

wjmaciowski 7/1/92
91
11/22/92

0.1 hr heat treatment @ 700°C (1292°F) A3*T1

Time	Reading (°F)	Corrected Temperature (°F)
0	129.1	
5 min	1237.6	1241.8
10 "	1275.1	1279.4
11 "	1276.4	1280.7
12 "	1278.5	1282.8
12.5 "	1279.1	1283.4
13.0 "	1279.7	1284.0
13.5 "	1280.2	1284.5
14.0 "	1280.5	1284.8
14.5 "	1281.0	1285.3
15.0 "	1281.2	1285.5
15.5 "	1281.2	1285.5
16.0 "	1281.6	1285.9
16.5 "	1281.7	1286.0
17.0 "	1282.3	1286.6
17.5 "	1283.0	1287.3
18.0 "	1283.1	1287.4
18.5 "	1283.2	1287.5
19.0 "	1096.1	1099.7
19.5 "	904.1	907.0

6 minutes @ Temp

11/25/91
Walter J. Maciowski

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W J Machowski 7/7/92

11/~~29~~ 25/91

1.0 hr heat treatment @ 700°C (1292°F) A3*T2

Time	Reading (°F)	Corrected Temp (°F)
0	185.1	185.2
8 min	1266.1	1271.1
10 "	1274.5	1278.8
12 "	1280.3	1284.6
13 "	1281.7	1286.0
15 "	1283.5	1287.9
19 "	1285.0	1289.4
23 "	1285.6	1290.0
27 "	1285.4	1289.8
31 "	1285.2	1289.6
35 "	1285.3	1289.7
39 "	1286.3	1290.7
43 min	1286.4	1290.8
47 "	1286.3	1290.7
51 "	1286.6	1291.0
55 "	1286.3	1290.7
59 "	1286.4	1290.8
63 "	1286.6	1291.0
67 "	1286.0	1290.4
71 "	1286.6	1291.0
73 "	1291.3	1295.7
75 "	775.9	778.3

1.0 hour @ temp

23

15.0 hour heat treatment @ 700°C (1292°F) A3*T3

Time	Reading (°F)	Corrected Temp (°F)
0	169.9	170.0
5 min	1213.5	1217.6
10 "	1278.5	1282.8
16 min	1284.3	1288.7
27 "	1285.4	1289.8
57 "	1285.6	1290.0
1 hr 57 min	1286.9	1291.3
2 " "	1285.5	1289.9
3 " "	1285.6	1290.0
4 " "	1285.5	1289.9
5 " "	1285.6	1290.0
6 " "	1285.5	1289.9
7 " "	1286.4	1289.8
8 hr 57 min	1286.5	1289.9
9 " "	1285.4	1289.8
10 " "	1286.3	1290.7
11 " "	1285.4	1289.8
12 " "	1287.0	1291.4
13 " "	1285.9	1290.3
14 " "	1285.4	1289.8
15 hr 07 min	1286.4	1290.8
15 hr 17 min	1286.3	1290.7
15 hr 27 min	873.3	881.1

11/25/91

Walter J. Machowski

11/26/91

15.0 hours @ temp

11/26/91

0.1 hr heat treatment @ 750°C (1382°F) A4*T1

Time	Reading (°F)	Corrected Temp (°F)
0	152.7	152.7
5 min	1342.3	1346.9
10 "	1368.0	1372.7
11 "	1369.7	1373.4
11.5 "	1370.4	1375.1
12.0 "	1371.2	1375.9
12.5 "	1372.0	1376.7
13.0 "	1372.3	1377.0
13.5 "	1372.8	1377.5
14.0 "	1373.6	1378.3
14.5 "	1373.9	1378.6
15.0 "	1374.0	1378.7
15.5 "	1373.9	1378.6
16.0 "	1374.3	1379.0
16.5 "	1374.3	1379.0
17.0 "	1374.5	1379.2
17.5 "	1374.6	1379.3
18.0 "	1374.5	1379.2
18.5 "	1373.3	1378.0
19.0 "	1026.4	1029.8

6.0 minutes @ temp

11/26/91
Walter J. Moelowski

1.0 hr heat treatment @ 750°C (1382°F) A4*T2

Time	Reading (°F)	Corrected Temp (°F)
0	182.3	182.4
5 min	1321.8	1326.3
10 "	1367.7	1372.4
11 "	1370.0	1374.7
12 "	1371.4	1376.1
12.5 min	1372.0	1376.7
13.0 "	1372.7	1377.4
14.0 "	1373.8	1378.5
15.0 "	1374.4	1379.1
19.0 "	1375.2	1379.9
23.0 "	1375.5	1380.2
27.0 "	1375.2	1379.9
31.0 "	1375.2	1379.9
35.0 "	1375.4	1380.1
39.0 "	1375.9	1380.6
43.0 "	1375.9	1380.6
47.0 "	1376.2	1380.9
51.0 "	1375.9	1380.6
55.0 "	1375.9	1380.6
59.0 "	1375.9	1380.6
63.0 "	1376.0	1380.7
67.0 "	1376.2	1380.9
71.0 "	1375.8	1380.5
73.0 "	1376.0	1380.7
75.0 "	823.8	826.4

1.0 hrs @ temp

11/26/91
Walter J. Moelowski

15.0 hrs heat treatment @ 750°C (1382°F) A4+T3

	Time	Reading (°F)	Corrected Temp (°F)
11/26/91	0	156.6	156.6
	5 min	1326.8	1331.3
	10 "	1367.3	1372.0
	11 "	1369.6	1374.3
	12 "	1371.6	1376.3
	14 "	1374.1	1378.8
	1 hr 14 min	1375.9	1380.6
	2 " "	1376.1	1380.8
	3 " "	1376.5	1381.2
	4 " "	1376.5	1381.2
	5 " "	1376.6	1381.3
	6 " "	1376.5	1381.2
11/27/91	7 hr 14 min	1376.5	1381.2
	8 " "	1376.6	1381.3
	9 " "	1377.0	1381.7
	10 " "	1376.3	1381.0
	11 " "	1376.6	1381.3
	12 " "	1376.7	1381.4
	13 " "	1376.8	1381.5
	14 " "	1377.0	1381.7
	15 hr 14 min	1376.5	1381.2
11/27/91	15 hr 16 min	919.8	922.8

Walter J. Machowski

15.0 hrs @ Temp

0.1 hrs heat treatment @ 800°C (1472°F) A5+T1

Time	Reading (°F)	Corrected Temp (°F)
0	135.2	135.1
5 min	1438.6	1443.5
8 "	1461.9	1466.9
9 "	1464.8	1469.8
10.0 "	1467.0	1472.1
10.5 "	1467.7	1473.8
11.0 "	1468.1	1473.2
12.0 "	1469.2	1474.3
12.5 "	1469.5	1474.6
13.0 "	1469.7	1474.8
13.5 "	1469.8	1474.9
14.0 "	1469.9	1475.0
14.5 "	1470.2	1475.3
15.0 "	1470.5	1475.6
15.5 "	1470.3	1475.4
16.0 "	1470.4	1475.5
16.5 "	1470.4	1475.5
17.0 "	1286.9	1291.3
17.5 "	1063.5	1067.0

12/2/91
~~11/26/91~~
Walter Machowski
12/2/91

6 minutes @ Temp

1.0 hr heat treatment @ 800°C (1472°F) A5*T2

12/3/91
Walter J. Machowski

Time	Reading (°F)	Corrected Temp (°F)
0	168.5	168.6
5 min	1432.6	1437.5
8 "	1460.3	1465.3
9 "	1463.4	1468.4
10.0 "	1465.6	1470.6
16.0 "	1460.8	1465.8
15.0 "	1470.8	1475.9
19.0 "	1470.9	1476.0
23.0 "	1471.6	1476.7
27.0 "	1471.5	1476.6
31.0 "	1471.8	1476.9
35.0 "	1471.6	1476.7
39.0 "	1471.7	1476.8
43.0 "	1471.7	1476.8
47.0 "	1471.5	1476.6
51.0 "	1471.9	1477.0
55.0 "	1471.7	1476.8
59.0 "	1471.9	1477.0
63.0 "	1471.1	1476.2
67.0 "	1470.9	1476.0
71.0 "	1471.0	1476.1
72.0 "	1098.7	1102.3

1.0 hr @ Temp

15.0 hr heat treatment @ 800°C (1472°F) A5*T3

12/2/91

Time	Reading (°F)	Corrected Temp (°F)
0	358.5	359.3
5 min	1432.0	1436.9
9 "	1463.0	1468.0
10 "	1465.9	1470.9
11 min	1468.2	1473.3
1 hr 11 min	1471.7	1476.8
2 " "	1473.9	1479.0
3 " "	1473.0	1478.1
4 " "	1473.5	1478.6
5 " "	1473.4	1478.5
6 " "	1471.8	1476.9
7 " "	1472.6	1477.7
8 hr 11 min	1473.5	1478.6
9 " "	1473.3	1478.4
10 " "	1474.1	1479.2
11 " "	1473.8	1478.9
12 " "	1473.1	1478.2
13 " "	1473.7	1478.8
14 " "	1473.7	1478.8
15 hrs 11 min	1472.9	1478.0
15 hrs 13 min	1110.4	1114.1

15.0 hrs @ Temp

12/3/91

12/3/91
Walter J. Machowski

0.1 hr heat treatment @ 900°C (1652°F) X

Time	Reading (°F)	Corrected Temp (°F)
12/2/91 Walter J. Mackowiak 0	236.8	237.1
5 min	1619.8	1625.4
8 "	1640.0	1645.7
9 "	1642.1	1647.8
10.0 "	1643.5	1636
10.5 "	1644.0	1649.7
11.0 "	1644.3	1650.0
11.5 "	1644.5	1650.2
12.0 "	1644.7	1650.4
12.5 "	1644.9	1650.6
13.0 "	1649.5	1656.3
13.5 "	1644.9	1650.6
14.0 "	1645.1	1650.8
14.5 "	1645.5	1651.2
15.0 "	1645.7	1651.4
15.5 "	1645.5	1651.2
16.0 "	1645.5	1651.2
16.5 "	139517	1400.5

6.0 minutes @ Temp

The Alloy 825 specimens were exposed to boiling 65% nitric acid in general accordance with "ASTM A262 Practice "C": "Nitric acid Test for Detecting Susceptibility to Intergranular Attack in Austenitic Stainless Steels."

First, the cubic specimens were cut in half on a water cooled abrasive cut-off wheel. They were cut such that part of the thermocouple and/or hanging hole remained in each half of the specimen after cutting. The "half" specimen were then wet polished to 220 grit w/ SiC paper. Samples were rinsed w/ ultrapure water and rinsed w/ acetone. The specimen dimension were taken with Fowler caliper S/N 30-8C-1.

Each half of the same heat treatment specimen was placed in a glass "cradle" or holder and separated with a piece of microscope slide which was cut to fit in the cradle basket such that the two metallic specimens were kept electrically isolated from each other. Each duplicate specimen pair was tested alone in a 1000 ml Erlenmeyer flask. Each flask had ~~550~~ 450 ml of 65% nitric acid, purchased as such specially for the Huey test from Fisher (cat. # A200C-212). Fisher lot ino. 913616 After each exposure period, the acid was replaced with fresh acid.

Specimens were weighed on Mettler

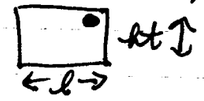
balance AE 240 ser. no. 10237
and on Sartorious balance RC 210P Ser#10704379.

All exposures were done on hot plates using 1000 ml Erlenmeyer flasks w/ $ joints and 4-bulb Allihn condensers. which were open to the air at the top. The 45/50 flask joint was reduced with an adapter to 24/40 to fit the condenser.

w J Machowski 7/8/92

Five exposure periods were used which totalled ~~120~~ 240 hours for each test. In most cases, 48 hours was the duration of the test period. In some cases the 2nd period was 32 hours + the the 3rd was 63 hours, in order to accomodate the weekend.

Note on specimen dimension, the hole was oriented as diagrammed.



Specimens were scrubbed with a nylon brush, rinsed with water + rinsed w/ acetone and dried.

Specimens designated as "B" have a piece of TFE string tied through the hanging hole.

NOTE: "A" + "B" are replicates of same heat treatment

SPECIMEN ID	Pd.	Wt. (g)	Hours	
HH4371FG * SA	0	5.9455	0	12/10/91
"A" 1.170 cm × 1.318 cm × 0.518 cm	1	5.9409	48	
(H × L × W)	2	5.9394	32	
	3	5.9363	63	
	4	5.9338	48	
	5	5.9311	48	12/20/91
HH4371FG * SA	0	6.0523	0	12/10/91
"B"	1	6.0477	48	
1.189 cm × 1.299 cm × 0.503 cm	2	6.0462	32	
(H × ~~W~~ L × ~~L~~ W)	3	6.0425	63	
w J Machowski 7/8/92	4	6.0400	48	
	5	6.0374	48	12/20/91
HH 4371 FG * MA	0	8.7996	0	12/10/91
"A"	1	8.7958	48	
1.528 cm × 1.319 cm × 0.589 cm	2	8.7942	32	
(H × L × W)	3	8.7898	63	
	4	8.7858	48	
	5	8.7807	48	12/20/91
HH 4371 FG * MA	0	7.7994	0	12/10/91
"B"	1	7.7957	48	
1.527 cm × 1.516 cm × 0.527 cm	2	7.7943	32	
(H × L × W)	3	7.7901	63	
	4	7.7862	48	
	5	7.7814	48	12/20/91

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	Specimen ID	Pd.	wt (g)	Hours	
1/7/92	HH4371FC*MA*A5*T2	0	8.9344	0	
	"A"	1	8.9306	48	
	1.319cm * 1.532cm * 0.547cm	2	8.9294	32	
	(H*L*W)	3	8.9244	63	
	800°C @ 1.0 hr	4	8.9203	48	
1/17/92		5	8.9153	48	
1/7/92	HH4371FC*MA*A5*T2	0	10.3057	0	
	"B"	1	10.3012	48	
	1.320cm * 1.559cm * 0.617cm	2	10.2994	32	
	(H*L*W)	3	10.2934	63	
	800°C @ 1.0 hr	4	10.2870	48	
1/17/92		5	10.2800	48	
1/7/92	HH4371FC*MA*A1*T2	0	6.2934	0	
	"A"	1	6.2901	48	
	1.241cm * 1.303cm * 0.476cm	2	6.2888	32	
	(H*L*W)	3	6.2835	63	
	600°C @ 1.0 hr	4	6.2798	48	
1/17/92		5	6.2749	48	
1/7/92	HH4371FC*MA*A1*T2	0	7.3958	0	
	"B"	1	7.3924	48	
	1.241cm * 1.307cm * 0.572cm	2	7.3908	32	
	(H*L*W)	3	7.3863	63	
	600°C @ 1.0 hr	4	7.3824	48	
1/17/92		5	7.3771	48	

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"A" and "B" are replicate of same heat treatment.

Specimen ID	Pd.	wt (g)	Hours	
HH4371FC*MA*A5*T1	0	8.8412	0	1/7/92
"A"	1	8.8378	48	
1.311cm * 1.399cm * 0.589cm	2	8.8361	32	
(H*L*W)	3	8.8315	63	
800°C @ 0.1 hr	4	8.8280	48	
	5	8.8233	48	1/17/92
HH4371FC*MA*A5*T1	0	6.4186	0	1/7/92
"B"	1	6.4155	48	
1.309cm * 1.417cm * 0.440cm	2	6.4142	32	
(H*L*W)	3	6.4101	63	
800°C @ 0.1 hr	4	6.4067	48	
	5	6.4026	48	1/17/92
HH4371FC*MA*A5*T3	0	12.9010	0	1/7/92
"A"	1	12.8947	48	
1.521cm * 1.680cm * 0.627cm	2	12.8914	32	
(H*L*W)	3	12.8810	63	
800°C @ 15.0 hr	4	12.8712	48	
	5	12.8597	48	1/17/92
HH4371FC*MA*A5*T3	0	11.0150	0	1/7/92
"B"	1	11.0100	48	
1.501cm * 1.680cm * 0.530	2	11.0069	32	
(H*L*W)	3	10.9949	63	
800°C @ 15.0 hr	4	10.9846	48	
	5	10.9719	48	1/17/92

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"A" and "B" are replicates of same heat treatment

Specimen ID	Pd.	Wt (g)	Hours	
HH4371FC*MA*A1*T1 "A"	0	7.5394	0	1/7/92
	1	7.5359	48	
1.309cm * 1.368cm * 0.519cm (H*L*W)	2	7.5345	32	
	3	7.5303	63	
600°C @ 0.1 h	4	7.5247	48	
	5	7.5175	48	1/17/92
HH4371FC*MA*A1*T1 "B"	0	6.9366	0	1/7/92
	1	6.9334	48	
1.312cm * 1.378cm * 0.516cm (H*L*W)	2	6.9320	32	
	3	6.9283	63	
600°C @ 0.1 h	4	6.9261	48	
	5	6.9225	48	1/17/92
HH4371FC*SA*A1*T1 "A"	0	7.4775	0	1/7/92
	1	7.4699	48	
1.310cm * 1.252cm * 0.575cm (H*L*W)	2	7.4682	32	
	3	7.4606	63	
600°C @ 0.1 h	4	7.4579	48	
	5	7.4491	48	1/17/92
HH4371FC*SA*A1*T1 "B"	0	7.3270	0	1/7/92
	1	7.3176	48	
1.261cm * 1.286cm * 0.563cm (H*L*W)	2	7.3156	32	
	3	7.3075	63	
600°C @ 0.1 h	4	7.3046	48	
	5	7.2987	48	1/17/92

wjmachowski 7/9/92

Walter J Machowski

"A" and "B" are replicates of same heat treatment

Specimen ID	Pd.	Wt (g)	Hours	
HH4371FC*SA*A5*T1 "A"	0	8.6191	0	1/7/92
	1	8.6138	48	
1.311cm * 1.441cm * 0.577cm (H*L*W)	2	8.6116	32	
	3	8.6050	63	
800°C @ 0.1 h	4	8.6008	48	
	5	8.5934	48	1/17/92
HH4371FC*SA*A5*T1 "B"	0	8.4286	0	1/7/92
	1	8.4219	48	
1.313cm * 1.442cm * 0.584cm (H*L*W)	2	8.4193	32	
	3	8.4030	63	
800°C @ 0.1 h	4	8.3915	48	
	5	8.3615	48	1/17/92
HH4371FC*SA*A5*T3 "A"	0	11.3843	0	1/7/92
	1	11.3771	48	
1.339cm * 1.718cm * 0.602cm (H*L*W)	2	11.3718	32	
	3	11.3261	63	
800°C @ 15.0 h	4	11.3901	48	
	5	11.1559	48	1/17/92
HH4371FC*SA*A5*T3 "B"	0	9.9352	0	1/7/92
	1	9.9271	48	
1.732cm * 1.352cm * 0.520cm (H*L*W)	2	9.9200	32	
	3	9.8499	63	
800°C @ 15.0 h	4	9.8059	48	
	5	9.6601	48	1/17/92

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"A" and "B" are replicates of same heat treatment

	Specmen ID	Pd.	wt (g)	Hours	
1/21/92	HH4371FC*MA*A4*T2	0	8.5487	0	
	"A"	1	8.5456	48	
	1.305cm*1.576cm*0.551cm (H*L*W)	2	8.5439	32	
		3	8.5397	63	
	750°C @ 1.0 h	4	8.5358	48	
1/31/92		5	8.5317	48	
1/21/92	HH4371FC*MA*A4*T2	0	9.3012	0	
	"B"	1	9.2982	48	
	1.302cm*1.591cm*0.592cm (H*L*W)	2	9.2963	32	
		3	9.2921	63	
	750°C @ 1.0 h.	4	9.2884	48	
1/31/92		5	9.2839	48	
1/21/92	HH4371FC*MA*A4*T3	0	12.2940	0	
	"A"	1	12.2857	48	
	1.474cm*1.800cm*0.621cm (H*L*W)	2	12.2750	32	
		3	12.2253	63	
	750°C @ 15.0 h	4	12.1225	48	
1/31/92		5	11.9961	48	
1/21/92	HH4371FC*MA*A4*T3	0	10.9296	0	
	"B"	1	10.9241	48	
	1.561cm*1.694cm*0.545cm (H*L*W)	2	10.9187	32	
		3	10.8949	63	
	750°C @ 15.0 h	4	10.8367	48	
1/31/92		5	10.7581	48	

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"A" and "B" are replicates of same heat treatment

Specmen ID	Pd.	wt (g)	Hours	
HH4371FC*MA*A4*T1	0	7.2681	0	1/21/92
"A"	1	7.2651	48	
1.310cm*1.370cm*0.560cm (H*L*W)	2	7.2633	32	
	3	7.2598	63	
750°C @ 0.1 h	4	7.2563	48	
	5	7.2515	48	1/31/92
HH4371FC*MA*A4*T1	0	7.8761	0	1/21/92
"B"	1	7.8722	48	
1.310cm*1.361cm*0.578cm (H*L*W)	2	7.8696	32	
	3	7.8647	63	
750°C @ 0.1 h	4	7.8600	48	
	5	7.8551	48	1/31/92
HH4371FC*MA*A1*T3	0	6.7587	0	1/21/92
"A"	1	6.7548	48	
1.350cm*1.390cm*0.461cm (H*L*W)	2	6.7522	32	
	3	6.7443	63	
600°C @ 15.0 h	4	6.7348	48	
	5	6.7245	48	1/31/92
HH4371FC*MA*A1*T3	0	8.0169	0	1/21/92
"B"	1	8.0132	48	
1.309cm*1.408cm*0.605cm (H*L*W)	2	8.0108	32	
	3	8.0025	63	
600°C @ 15.0 h	4	7.9929	48	
	5	7.9821	48	1/31/92

Walter J. Mackowski

"A" and "B" are replicates of same heat treatment

	Specimen ID	Pd.	Wt (g)	Hours	
1/21/92	HH4371FG*SA*A4*T1	0	6.2498	0	
	"A"	1	6.2449	48	
	1.301cm × 1.200cm × 0.570cm (H×L×W)	2	6.2431	32	
		3	6.2398	63	
	750°C @ 0.1 hr	4	6.2368	48	
1/31/92		5	6.2350	48	
1/21/92	HH4371FG*SA*A4*T1	0	5.3075	0	
	"B"	1	5.3025	48	
	1.200cm × 1.309cm × 0.446cm (H×L×W)	2	5.3008	32	
		3	5.2970	63	
	750°C @ 0.1 hr	4	5.2936	48	
1/31/92		5	5.2903	48	
1/21/92	HH4371FG*SA*A1*T3	0	8.8817	0	
	"A"	1	8.8746	48	
	1.318 cm × 1.561 cm × 0.542 cm (H×L×W)	2	8.8723	32	
		3	8.8544	63	
	600°C @ 15.0 hr	4	8.8453	48	
1/31/92		5	8.8388	48	
1/21/92	HH4371FG*SA*A1*T3	0	9.7223	0	
	"B"	1	9.7192	48	
	1.320cm × 1.569cm × 0.590cm (H×L×W)	2	9.7098	32	
		3	9.7031	63	
	600°C @ 15.0 hr	4	9.6965	48	
1/31/92		5	9.6907	48	

Walter J. Mackowski

"A" and "B" are replicates of same heat treatment

Specimen ID	Pd.	Wt (g)	Hours	
HH4371FG*SA*A4*T3	0	11.2705	0	1/21/92
"A"	1	11.2617	48	
1.320 cm × 1.842 cm × 0.579 cm (H×L×W)	2	11.2502	32	
	3	11.1432	63	
750°C @ 15.0 hr	4	10.8544	48	
	5	10.3451	48	1/31/92
HH4371FG*SA*A4*T3	0	12.3578	0	1/21/92
"B"	1	12.3543	48	
1.315cm × 1.849cm × 0.640cm (H×L×W)	2	12.3302	32	
	3	12.1977	63	
750°C @ 15.0 hr	4	11.8681	48	
	5	11.3238	48	1/31/92
HH4371FG*SA*A4*T2	0	7.5906	0	1/21/92
"A"	1	7.5843	48	
1.291cm × 1.572cm × 0.475cm (H×L×W)	2	7.5694	32	
750°C @ 1.0 hr	3	7.4106	63	
	4	7.2076	48	
	5	7.0110	48	1/31/92
HH4371FG*SA*A4*T2	0	8.8891	0	1/21/92
"B"	1	8.8799	48	
1.299cm × 1.572cm × 0.510cm (H×L×W)	2	8.8614	32	
	3	8.6774	63	
750°C @ 1.0 hr	4	8.4438	48	
	5	8.2271	48	1/31/92

Walter J. Mackowski

"A" and "B" are replicates of same heat treatment

	Specimen ID	Pd.	Wt (g)	Hours
2/17/92	HH4371FG *MA*A3*T1	ϕ	8.0313	0
	"A"	1	8.0283	48
2/21/92	1.337cm × 1.331cm × 0.657cm	2	8.0254	48
2/24/92	(H×L×W)	3	8.0225	48
2/28/92	700°C @ 0.1 hr	4	8.0180	48
3/2-3/4 92		5	8.0138	48
	HH4371FG *MA*A3*T1	0	6.9091	0
	"B"	1	6.9062	48
	1.273cm × 1.323cm × 0.553cm	2	6.9033	48
	(H×L×W)	3	6.9005	48
	700°C @ 0.1 hr	4	6.8956	48
		5	6.8907	48
	HH4371FG *MA*A3*T2	ϕ	7.8801	0
	"A"	1	7.8768	48
	1.318cm × 1.428cm × 0.531cm	2	7.8735	48
	(H×L×W)	3	7.8700	48
	700°C @ 1.0 hr	4	7.8639	48
		5	7.8573	48
	HH4371FG *MA*A3*T2	ϕ	10.3420	0
	"B"	1	10.3380	48
	1.326cm × 1.428cm × 0.707cm	2	10.3337	48
	(H×L×W)	3	10.3275	48
	700°C @ 1.0 hr	4	10.3227	48
		5	10.3075	48

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Walter J Machowski

"A" and "B" are replicates of same heat treatment

Specimen ID	Pd.	Wt (g)	Hours	
HH4371FG *MA*A3*T3	ϕ	6.5658	0	
"A"	1	6.5625	48	
1.316cm × 1.184cm × 0.549cm	2	6.5582	48	
(H×L×W)	3	6.5428	48	
700°C @ 15.0 hrs	4	6.49507	48	
	5	6.4081	48	
HH4371FG *MA*A3*T3	ϕ	5.8431 ~~6.5658~~	0	
"B"	1	5.8403 ~~6.5625~~	48	7/8/92 w/ feedback
1.202cm × 1.325cm × 0.487cm	2	5.8354 ~~6.5582~~	48	
(H×L×W)	3	5.8189 ~~6.5428~~	48	
700°C @ 15.0 hr	4	5.7694 ~~6.49507~~	48	
	5	5.6773 ~~6.4081~~	48	
HH4371FG *SA*A5*T2	ϕ	10.4566	0	
"A"	1	10.4566	48	
1.491cm × 1.475cm × 0.585cm	2	10.4401	48	
(H×L×W)	3	10.4167	48	
800°C @ 1.0 hr	4	10.3726	48	
	5	10.3053	48	
HH4371FG *SA*A5*T2	ϕ	10.4412	0	
"B"	1	10.4357	48	
1.440cm × 1.531cm × 0.561cm	2	10.4314	48	
(H×L×W)	3	10.4271	48	
800°C @ 1.0 hr.	4	10.4208	48	
	5	10.4052	48	

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Walter J Machowski

"A" and "B" are replicates of same heat treatment

Specimen ID	Pd.	wt (g)	Hours
HH4371FG*SA*A3*T1	ϕ	7.1276	ϕ
"A"	1	7.1217	48
1.310cm × 1.451cm × 0.498cm (H×L×w)	2	7.1181	48
	3	7.1150	48
700°C 0.1 hr.	4	7.1109	48
	5	7.1101	48
HH4371FG*SA*A3*T1	ϕ	7.2792	ϕ
"B"	1	7.2758	48
1.302cm × 1.444cm × 0.491cm (H×L×w)	2	7.2730	48
	3	7.2707	48
700°C 0.1 hr.	4	7.2671	48
	5	7.2637	48
HH4371FG*SA*A3*T2	ϕ	5.6838	ϕ
"A"	1	5.6833	48
1.149cm × 1.308cm × 0.493cm (H×L×w)	2	5.6737	48
	3	5.6668	48
700°C 1.0 hr.	4	5.6543	48
	5	5.6475	48
HH4371FG*SA*A3*T2	ϕ	6.7918	ϕ
"B"	1	6.7879	48
1.194cm × 1.308cm × 0.612cm (H×L×w)	2	6.7783	48
	3	6.7649	48
700°C 1.0 hr.	4	6.7522	48
	5	6.7435	48

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"A" and "B" are replicate of same heat treatment

Specimen ID	Pd.	wt (g)	Hours
HH4371FG*SA*A3*T3	ϕ	8.3549	ϕ
"A"	1	8.3437	48
1.320cm × 1.439cm × 0.579cm (H×L×w)	2	8.0144	48
	3	7.3177	48
700°C @ 15.0 hr.	4	6.5642	48
	5	5.9440	48
HH4371FG*SA*A3*T3	ϕ	8.2328	ϕ
"B"	1	8.2211	48
1.325cm × 1.389cm × 0.616cm (H×L×w)	2	7.8379	48
	3	7.1492	48
700°C @ 15.0 hr.	4	6.4103	48
	5	5.8294	48
HH4371FG*SA*A1*T2	ϕ	7.6034	ϕ
"A"	1	7.5994	48
1.356cm × 1.357cm × 0.558cm (H×L×w)	2	7.5949	48
	3	7.5921	48
600°C @ 1.0 hr.	4	7.5886	48
	5	7.5856	48
HH4371FG*SA*A1*T2	ϕ	7.5648	ϕ
"B"	1	7.5612	48
1.316cm × 1.308cm × 0.569cm (H×L×w)	2	7.5588	48
	3	7.5564	48
600°C @ 1.0 hr.	4	7.5539	48
	5	7.5512	48

Walter J. Mackowski

"A" and "B" are replicate of same heat treatment

	Specimen ID	Pd	wt (g)	Hours
3/23/92	HH4371FB * MA * A2 * T1	ϕ	8.1658	ϕ
	"A"	1	8.1630	48
3/25/92	1.566cm * 1.578cm * 0.228cm	2	8.1602	48
	(H * L * W)	3	8.1577	48
3/27/92	688°C @ 0.1 hr.	4	8.1555	48
3/30/-4/1/92		5	8.1516	48
	HH4371FB * MA * A2 * T1	ϕ	6.7228	ϕ
	"B"	1	6.7203	48
	1.562cm * 1.517cm * 0.189cm	2	6.7179	48
	(H * L * W)	3	6.7158	48
	638°C @ 0.1 hr.	4	6.7134	48
		5	6.7097	48
	HH4371FB * MA * A2 * T3	ϕ	9.8731	ϕ
	"A"	1	9.8670	48
	1.562cm * 1.560cm * 0.254cm	2	9.8578	48
	(H * L * W)	3	9.8171	48
	638°C @ 15.0 hr.	4	9.7685	48
		5	9.6920	48
	HH4371FC * MA * A2 * T3	ϕ	8.8589	ϕ
	"B"	1	8.8533	48
	1.564cm * 1.581cm * 0.218cm	2	8.8433	48
	(H * L * W)	3	8.8235	48
	638°C @ 15.0 hr.	4	8.7933	48
		5	8.7461	48

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"A" and "B" are replicates of same heat treatment

Specimen ID	Pd	wt (g)	Hours
HH4371FB * MA * A2 * T2	ϕ	6.1613	ϕ
"A"	1	6.1588	48
1.517cm * 1.579cm * 0.195cm	2	6.1560	48
(H * L * W)	3	6.1531	48
638°C @ 1.0 hr.	4	6.1507	48
	5	6.1444	48
HH4371FB * MA * A2 * T2	ϕ	8.1149	ϕ
"B"	1	8.1121	48
1.518cm * 1.575cm * 0.256cm	2	8.1090	48
(H * L * W)	3	8.1050	48
638°C @ 1.0 hr.	4	8.0986	48
	5	8.0889	48
HH4371FB * MA * X	ϕ	7.8212	ϕ
"A"	1	7.8188	48
1.515cm * 1.574cm * 0.208cm	2	7.8165	48
(H * L * W)	3	7.8139	48
900°C @ 0.1 hr.	4	7.8106	48
	5	7.8066	48
HH4371FB * MA * X	ϕ	7.4908	ϕ
"B"	1	7.4886	48
1.574cm * 1.614cm * 0.201cm	2	7.4860	48
(H * L * W)	3	7.4830	48
900°C @ 0.1 hr.	4	7.4788	48
	5	7.4750	48

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"A" and "B" are replicates of same heat treatment

SPECIMEN ID	Pd	wt (g)	Hours
HH4371FC * SA * A2 * T2 "A"	ϕ	8.4050	0
	1	8.3967	48
1.583cm × 1.522cm × 0.220cm (H × L × W)	2	8.3934	48
	3	8.3888	48
638°C @ 1.0 hr.	4	8.3863	48
	5	8.3801	48
HH4371FC * SA * A2 * T2 "B"	ϕ	8.4240	0
	1	8.4203	48
1.584cm × 1.514cm × 0.221cm (H × L × W)	2	8.4170	48
	3	8.4142	48
638°C @ 1.0 hr.	4	8.4112	48
	5	8.4055	48
HH4371FC * SA * A2 * T1 "A"	0	7.8181	0
	1	7.8147	48
1.534cm × 1.516cm × 0.221cm (H × L × W)	2	7.8118	48
	3	7.8087	48
638°C @ 0.1 hr.	4	7.8061	48
	5	7.8027	48
HH4371FC * SA * A2 * T1 "B"	ϕ	7.6899	0
	1	7.6859	48
1.515cm × 1.557cm × 0.211cm (H × L × W)	2	7.6819	48
	3	7.6786	48
638°C @ 0.1 hr.	4	7.6762	48
	5	7.6730	48

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"A" and "B" are replicates of same heat treatment

SPECIMEN ID	Pd	wt (g)	Hours
HH4371FC * SA * A2 * T3 "A"	ϕ	7.9709	0
	1	7.9559	48
1.516cm × 1.516cm × 0.219cm (H × L × W)	2	7.9196	48
	3	7.8743	48
638°C @ 15.0 hr.	4	7.8325	48
	5	7.8051	48
HH4371FC * SA * A2 * T3 "B"	ϕ	7.4878	0
	1	7.4675	48
1.509cm × 1.518cm × 0.236cm (H × L × W)	2	7.4183	48
	3	7.3654	48
638°C @ 15.0 hr.	4	7.3178	48
	5	7.2816	48
HH4371FC * SA * X "A"	ϕ	7.6992	0
	1	7.6959	48
1.575cm × 1.518cm × 0.204cm (H × L × W)	2	7.6935	48
	3	7.6897	48
900°C @ 0.1 hr.	4	7.6873	48
	5	7.6841	48
HH4371FC * SA * X "B"	ϕ	8.7051	0
	1	8.7002	48
1.583cm × 1.518cm × 0.239cm (H × L × W)	2	8.6961	48
	3	8.6918	48
900°C @ 0.1 hr.	4	8.6834	48
	5	8.6724	48

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"A" and "B" are replicates of same heat treatment

CORROSION Rate Calculations

(T43VAL.WQ1)

CR mm/yr units
cr mg/dm²/day units

Specimen ID	H (cm data	L (cm) data	W (cm data	A (cm2) 2*(H*L+	wt (g) data	W* (g) wt(i-1)-	W (g) wt(0)-wt	t* (h data	t (hr) data	CR* (mm/ (87600/8.14)*W/(A*t)	CR (mm/	cr* (mdd) (2400000)*W/(A*t)	cr (mdd)	avgCR*	avgCR	avgcr*	avgcr	stdCR*	stdCR	stdCR*/avgC	stdCR/avgC
MA 'A'	1.53	1.32	0.59	7.385	8.7996	0	0	0	0					0.113	0.107	25.258	23.624	0.027	0.007	0.236	0.068
	1.53	1.32	0.59	7.385	8.7958	0.0038	0.0038	48	48	0.115	0.115	25.729	25.729								
	1.53	1.32	0.59	7.385	8.7942	0.0016	0.0054	32	80	0.073	0.098	16.250	21.987								
	1.53	1.32	0.59	7.385	8.7898	0.0044	0.0098	63	143	0.102	0.100	22.698	22.273								
	1.53	1.32	0.59	7.385	8.7858	0.004	0.0138	48	191	0.121	0.105	27.083	23.482								
	1.53	1.32	0.59	7.385	8.7807	0.0051	0.0189	48	239	0.155	0.115	34.531	25.701								
MA 'B'	1.53	1.52	0.53	7.837	7.7994	0	0	0	0					0.101	0.096	22.585	21.454	0.025	0.007	0.251	0.076
	1.53	1.52	0.53	7.837	7.7957	0.0037	0.0037	48	48	0.106	0.106	23.605	23.605								
	1.53	1.52	0.53	7.837	7.7943	0.0014	0.0051	32	80	0.060	0.088	13.398	19.522								
	1.53	1.52	0.53	7.837	7.7901	0.0042	0.0093	63	143	0.092	0.089	20.415	19.916								
	1.53	1.52	0.53	7.837	7.7862	0.0039	0.0132	48	191	0.112	0.095	24.881	21.164								
	1.53	1.52	0.53	7.837	7.7814	0.0048	0.018	48	239	0.137	0.103	30.623	23.064								
SA 'A'	1.17	1.32	0.52	5.662	5.9455	0	0	0	0					0.114	0.136	25.455	30.745	0.035	0.025	0.302	0.187
	1.17	1.32	0.52	5.662	5.9409	0.0046	0.0046	48	48	0.182	0.182	40.624	40.624								
	1.17	1.32	0.52	5.662	5.9394	0.0015	0.0061	32	80	0.089	0.145	19.870	32.323								
	1.17	1.32	0.52	5.662	5.9363	0.0031	0.0092	63	143	0.094	0.122	20.859	27.272								
	1.17	1.32	0.52	5.662	5.9338	0.0025	0.0117	48	191	0.099	0.116	22.078	25.967								
	1.17	1.32	0.52	5.662	5.9311	0.0027	0.0144	48	239	0.107	0.115	23.844	25.541								
SA 'B'	1.19	1.3	0.5	5.592	6.0523	0	0	0	0					0.118	0.141	26.411	31.533	0.034	0.023	0.285	0.165
	1.19	1.3	0.5	5.592	6.0477	0.0046	0.0046	48	48	0.184	0.184	41.131	41.131								
	1.19	1.3	0.5	5.592	6.0462	0.0015	0.0061	32	80	0.090	0.147	20.118	32.726								
	1.19	1.3	0.5	5.592	6.0425	0.0037	0.0098	63	143	0.113	0.132	25.206	29.413								
	1.19	1.3	0.5	5.592	6.04	0.0025	0.0123	48	191	0.100	0.124	22.354	27.639								
	1.19	1.3	0.5	5.592	6.0374	0.0026	0.0149	48	239	0.104	0.120	23.248	26.757								
MA*A1*T1 'A'	1.31	1.37	0.52	6.360	7.5394	0	0	0	0					0.152	0.124	33.961	27.552	0.065	0.018	0.424	0.148
	1.31	1.37	0.52	6.360	7.5359	0.0035	0.0035	48	48	0.123	0.123	27.515	27.515								
	1.31	1.37	0.52	6.360	7.5345	0.0014	0.0049	32	80	0.074	0.104	16.509	23.113								
	1.31	1.37	0.52	6.360	7.5303	0.0042	0.0091	63	143	0.113	0.108	25.157	24.013								
	1.31	1.37	0.52	6.360	7.5247	0.0056	0.0147	48	191	0.197	0.130	44.024	29.042								
	1.31	1.37	0.52	6.360	7.5175	0.0072	0.0219	48	239	0.254	0.155	56.602	34.577								
MA*A1*T1 'B'	1.31	1.38	0.51	6.338	6.9366	0	0	0	0					0.098	0.101	21.961	22.460	0.020	0.007	0.206	0.067
	1.31	1.38	0.51	6.338	6.9334	0.0032	0.0032	48	48	0.113	0.113	25.244	25.244								
	1.31	1.38	0.51	6.338	6.932	0.0014	0.0046	32	80	0.074	0.098	16.566	21.773								
	1.31	1.38	0.51	6.338	6.9283	0.0037	0.0083	63	143	0.100	0.099	22.239	21.878								
	1.31	1.38	0.51	6.338	6.9261	0.0022	0.0105	48	191	0.078	0.093	17.355	20.816								
	1.31	1.38	0.51	6.338	6.9225	0.0036	0.0141	48	239	0.127	0.100	28.399	22.339								
SA*A1*T1 'A'	1.31	1.25	0.58	6.227	7.4775	· 0	0	0	0					0.198	0.212	44.070	47.349	0.091	0.032	0.460	0.152
	1.31	1.25	0.58	6.227	7.4699	0.0076	0.0076	48	48	0.274	0.274	61.029	61.029								
	1.31	1.25	0.58	6.227	7.4682	0.0017	0.0093	32	80	0.092	0.201	20.477	44.808								
	1.31	1.25	0.58	6.227	7.4606	0.0076	0.0169	63	143	0.208	0.204	46.498	45.553								
	1.31	1.25	0.58	6.227	7.4579	0.0027	0.0196	48	191	0.097	0.177	21.681	39.554								
	1.31	1.25	0.58	6.227	7.4491	0.0088	0.0284	48	239	0.317	0.205	70.665	45.802								
SA*A1*T1 'B'	1.26	1.29	0.56	6.111	7.327	0	0	0	0					0.201	0.250	44.789	55.797	0.088	0.050	0.439	0.201
	1.26	1.29	0.56	6.111	7.3176	0.0094	0.0094	48	48	0.345	0.345	76.908	76.908								
	1.26	1.29	0.56	6.111	7.3156	0.002	0.0114	32	80	0.110	0.251	24.545	55.953								
	1.26	1.29	0.56	6.111	7.3075	0.0081	0.0195	63	143	0.226	0.240	50.493	53.553								
	1.26	1.29	0.56	6.111	7.3046	0.0029	0.0224	48	191	0.106	0.207	23.727	46.057								
	1.26	1.29	0.56	6.111	7.2987	0.0059	0.0283	48	239	0.216	0.209	48.272	46.502								
MA*A1*T2 'A'	1.24	1.3	0.48	5.656	6.2934	0	0	0	0					0.142	0.131	31.627	29.202	0.038	0.012	0.271	0.094
	1.24	1.3	0.48	5.656	6.2901	0.0033	0.0033	48	48	0.131	0.131	29.173	29.173								
	1.24	1.3	0.48	5.656	6.2888	0.0013	0.0046	32	80	0.077	0.109	17.239	24.369								
	1.24	1.3	0.48	5.656	6.2835	0.0053	0.0099	63	143	0.160	0.132	35.623	29.377								
	1.24	1.3	0.48	5.656	6.2798	0.0037	0.0136	48	191	0.147	0.135	32.709	30.214								
	1.24	1.3	0.48	5.656	6.2749	0.0049	0.0185	48	239	0.194	0.147	43.317	32.846								
MA*A1*T2 'B'	1.24	1.31	0.57	6.159	7.3958	0	0	0	0					0.134	0.122	29.922	27.135	0.034	0.009	0.256	0.075
	1.24	1.31	0.57	6.159	7.3924	0.0034	0.0034	48	48	0.124	0.124	27.602	27.602								
	1.24	1.31	0.57	6.159	7.3908	0.0016	0.005	32	80	0.087	0.109	19.484	24.365								
	1.24	1.31	0.57	6.159	7.3863	0.0045	0.0095	63	143	0.125	0.116	27.834	25.888								
	1.24	1.31	0.57	6.159	7.3824	0.0039	0.0134	48	191	0.142	0.123	31.662	27.339								
	1.24	1.31	0.57	6.159	7.3771	0.0053	0.0187	48	239	0.193	0.137	43.027	30.490								

Verify: MA·A First Period: 0.0038/(7.385×48) * 87600/8.14
= 0.11536 mm/yr ✓

N. [illegible] 11/30/94

* corrosion rate calculated for each period as separate
no * corrosion rate calculated for time from begining to end of that period

Specimen ID	H (cm data	L (cm) data	W (cm data	A (cm2) 2*(H*L+	wt (g) data	W* (g) wt(i-1)-	W (g) wt(0)-wt	t* (h data	t (hr) data	CR* (mm/ (87600/8.14)*W/(A*t)	CR (mm/	cr* (mdd) (2400000)*W/(A*t)	cr (mdd)	avgCR*	avgCR	avgcr*	avgcr	stdCR*	stdCR	stdCR*/avgC	stdCR/avgC
SA*A1*T2 'A'	1.36	1.35	0.56	6.685	7.6034	0	0	0	0					0.119	0.129	26.627	28.866	0.021	0.008	0.176	0.063
	1.36	1.35	0.56	6.685	7.5994	0.004	0.004	48	48	0.134	0.134	29.918	29.918								
	1.36	1.35	0.56	6.685	7.5949	0.0045	0.0085	48	96	0.151	0.143	33.658	31.788								
	1.36	1.35	0.56	6.685	7.5921	0.0028	0.0113	48	144	0.094	0.126	20.943	28.173								
	1.36	1.35	0.56	6.685	7.5886	0.0035	0.0148	48	192	0.117	0.124	26.178	27.674								
	1.36	1.35	0.56	6.685	7.5856	0.003	0.0178	48	240	0.101	0.119	22.439	26.627								
SA*A1*T2 'B'	1.32	1.31	0.57	6.429	7.5648	0	0	0	0					0.095	0.104	21.155	23.092	0.016	0.012	0.167	0.112
	1.32	1.31	0.57	6.429	7.5612	0.0036	0.0036	48	48	0.126	0.126	27.999	27.999								
	1.32	1.31	0.57	6.429	7.5588	0.0024	0.006	48	96	0.084	0.105	18.666	23.333								
	1.32	1.31	0.57	6.429	7.5564	0.0024	0.0084	48	144	0.084	0.098	18.666	21.777								
	1.32	1.31	0.57	6.429	7.5539	0.0025	0.0109	48	192	0.087	0.095	19.444	21.194								
	1.32	1.31	0.57	6.429	7.5512	0.0027	0.0136	48	240	0.094	0.095	20.999	21.155								
MA*A1*T3 'A'	1.35	1.39	0.46	6.279	6.7587	0	0	0	0					0.240	0.182	53.540	40.923	0.097	0.042	0.404	0.230
	1.35	1.39	0.46	6.279	6.7548	0.0039	0.0039	48	48	0.139	0.139	31.055	31.055								
	1.35	1.39	0.46	6.279	6.7522	0.0026	0.0065	32	80	0.139	0.139	31.055	31.055								
	1.35	1.39	0.46	6.279	6.7443	0.0079	0.0144	63	143	0.215	0.173	47.928	38.488								
	1.35	1.39	0.46	6.279	6.7348	0.0095	0.0239	48	191	0.339	0.214	75.646	47.826								
	1.35	1.39	0.46	6.279	6.7245	0.0103	0.0342	48	239	0.368	0.245	82.016	54.693								
MA*A1*T3 'B'	1.31	1.41	0.61	6.974	8.0169	0	0	0	0					0.219	0.162	48.789	36.156	0.095	0.042	0.436	0.259
	1.31	1.41	0.61	6.974	8.0132	0.0037	0.0037	48	48	0.119	0.119	26.528	26.528								
	1.31	1.41	0.61	6.974	8.0108	0.0024	0.0061	32	80	0.116	0.118	25.811	26.241								
	1.31	1.41	0.61	6.974	8.0025	0.0083	0.0144	63	143	0.203	0.155	45.340	34.656								
	1.31	1.41	0.61	6.974	7.9929	0.0096	0.024	48	191	0.309	0.194	68.830	43.244								
	1.31	1.41	0.61	6.974	7.9821	0.0108	0.0348	48	239	0.347	0.225	77.434	50.110								
SA*A1*T3 'A'	1.32	1.56	0.54	7.236	8.8817	0	0	0	0					0.247	0.246	54.989	54.822	0.104	0.043	0.423	0.173
	1.32	1.56	0.54	7.236	8.8746	0.0071	0.0071	48	48	0.220	0.220	49.063	49.063								
	1.32	1.56	0.54	7.236	8.8723	0.0023	0.0094	32	80	0.107	0.175	23.840	38.974								
	1.32	1.56	0.54	7.236	8.8544	0.0179	0.0273	63	143	0.423	0.284	94.243	63.323								
	1.32	1.56	0.54	7.236	8.8453	0.0091	0.0364	48	191	0.282	0.283	62.883	63.212								
	1.32	1.56	0.54	7.236	8.8388	0.0065	0.0429	48	239	0.201	0.267	44.917	59.538								
SA*A1*T3 'B'	1.32	1.57	0.59	7.551	9.7223	0	0	0	0					0.206	0.177	45.959	39.563	0.112	0.044	0.542	0.251
	1.32	1.57	0.59	7.551	9.7192	0.0031	0.0031	48	48	0.092	0.092	20.527	20.527								
	1.32	1.57	0.59	7.551	9.7098	0.0094	0.0125	32	80	0.419	0.223	93.363	49.681								
	1.32	1.57	0.59	7.551	9.7031	0.0067	0.0192	63	143	0.152	0.191	33.801	42.674								
	1.32	1.57	0.59	7.551	9.6965	0.0066	0.0258	48	191	0.196	0.193	43.702	43.932								
	1.32	1.57	0.59	7.551	9.6907	0.0058	0.0316	48	239	0.172	0.188	38.405	42.023								
MA*A2*T1 'A'	1.57	1.52	0.23	6.161	8.1658	0	0	0	0					0.103	0.100	23.049	22.262	0.021	0.003	0.202	0.035
	1.57	1.52	0.23	6.161	8.163	0.0028	0.0028	48	48	0.102	0.102	22.725	22.725								
	1.57	1.52	0.23	6.161	8.1602	0.0028	0.0056	48	96	0.102	0.102	22.725	22.725								
	1.57	1.52	0.23	6.161	8.1577	0.0025	0.0081	48	144	0.091	0.098	20.290	21.913								
	1.57	1.52	0.23	6.161	8.1555	0.0022	0.0103	48	192	0.080	0.094	17.855	20.899								
	1.57	1.52	0.23	6.161	8.1516	0.0039	0.0142	48	240	0.142	0.103	31.652	23.049								
MA*A2*T1 'B'	1.56	1.52	0.19	5.903	6.7228	0	0	0	0					0.100	0.093	22.192	20.758	0.021	0.004	0.212	0.043
	1.56	1.52	0.19	5.903	6.7203	0.0025	0.0025	48	48	0.095	0.095	21.176	21.176								
	1.56	1.52	0.19	5.903	6.7179	0.0024	0.0049	48	96	0.091	0.093	20.329	20.752								
	1.56	1.52	0.19	5.903	6.7158	0.0021	0.007	48	144	0.080	0.089	17.788	19.764								
	1.56	1.52	0.19	5.903	6.7134	0.0024	0.0094	48	192	0.091	0.089	20.329	19.905								
	1.56	1.52	0.19	5.903	6.7097	0.0037	0.0131	48	240	0.141	0.100	31.340	22.192								
SA*A2*T1 'A'	1.55	1.52	0.22	6.069	7.8181	0	0	0	0					0.114	0.116	25.376	25.975	0.011	0.005	0.099	0.043
	1.55	1.52	0.22	6.069	7.8147	0.0034	0.0034	48	48	0.126	0.126	28.013	28.013								
	1.55	1.52	0.22	6.069	7.8118	0.0029	0.0063	48	96	0.107	0.116	23.893	25.953								
	1.55	1.52	0.22	6.069	7.8087	0.0031	0.0094	48	144	0.115	0.116	25.541	25.816								
	1.55	1.52	0.22	6.069	7.8061	0.0026	0.012	48	192	0.096	0.111	21.422	24.717								
	1.55	1.52	0.22	6.069	7.8027	0.0034	0.0154	48	240	0.126	0.114	28.013	25.376								
SA*A2*T1 'B'	1.52	1.56	0.21	6.014	7.6899	0	0	0	0					0.126	0.138	28.101	30.880	0.022	0.010	0.176	0.072
	1.52	1.56	0.21	6.014	7.6859	0.004	0.004	48	48	0.149	0.149	33.255	33.255								
	1.52	1.56	0.21	6.014	7.6819	0.004	0.008	48	96	0.149	0.149	33.255	33.255								
	1.52	1.56	0.21	6.014	7.6786	0.0033	0.0113	48	144	0.123	0.140	27.436	31.315								
	1.52	1.56	0.21	6.014	7.6762	0.0024	0.0137	48	192	0.089	0.128	19.953	28.475								
	1.52	1.56	0.21	6.014	7.673	0.0032	0.0169	48	240	0.119	0.126	26.604	28.101								
MA*A2*T2 'A'	1.52	1.52	0.2	5.793	6.1613	0	0	0	0					0.131	0.109	29.175	24.919	0.057	0.012	0.435	0.111
	1.52	1.52	0.2	5.793	6.1588	0.0025	0.0025	48	48	0.097	0.097	21.579	21.579								

	1.5	1.68	0.53	8.415	10.985	0.0103	0.0304	48	191	0.274	~~0.204~~	61.199	~~45.553~~								
	1.5	1.68	0.53	8.415	10.972	0.0127	0.0431	48	239	0.338	0.231	75.459	51.431								
SA*A5*T3 'A'	1.34	1.72	0.6	8.281	11.384	0	0	0	0					1.192	~~0.592~~	265.859	~~125.317~~	1.266	~~0.395~~	1.062	~~0.691~~
	1.34	1.72	0.6	8.281	11.377	0.0072	0.0072	48	48	0.195	~~0.195~~	43.471	~~43.474~~								
	1.34	1.72	0.6	8.281	11.372	0.0053	0.0125	32	80	0.215	~~0.203~~	47.999	~~45.262~~								
	1.34	1.72	0.6	8.281	11.326	0.0457	0.0582	63	143	0.943	~~0.529~~	210.224	~~117.349~~								
	1.34	1.72	0.6	8.281	11.29	0.036	0.0942	48	191	0.975	~~0.641~~	217.354	~~142.930~~								
	1.34	1.72	0.6	8.281	11.156	0.1342	0.2284	48	239	3.633	1.242	810.246	276.952								
SA*A5*T3 'B'	1.72	1.35	0.57	8.164	9.9362	0	0	0	0					1.439	~~0.764~~	320.852	~~163.631~~	1.373	~~0.477~~	0.954	~~0.950~~
	1.72	1.35	0.57	8.164	9.9271	0.0061	0.0061	48	48	0.222	~~0.222~~	49.605	~~49.605~~								
	1.72	1.35	0.57	8.164	9.92	0.0071	0.0152	32	80	0.292	~~0.259~~	65.221	~~55.882~~								
	1.72	1.35	0.57	8.164	9.8499	0.0701	0.0853	63	143	1.467	~~0.788~~	327.084	~~175.346~~								
	1.72	1.35	0.57	8.164	9.8059	0.044	0.1293	48	191	1.208	~~0.892~~	269.460	~~166.997~~								
	1.72	1.35	0.57	8.164	9.6601	0.1458	0.2751	48	239	4.004	1.517	892.891	338.357								
MA*X 'A'	1.52	1.57	0.21	6.054	7.8212	0	0	0	0					0.108	~~0.094~~	24.115	~~21.065~~	0.024	~~0.008~~	0.220	~~0.063~~
	1.52	1.57	0.21	6.054	7.8188	0.0024	0.0024	48	48	0.089	~~0.089~~	19.821	~~19.821~~								
	1.52	1.57	0.21	6.054	7.8165	0.0023	0.0047	48	96	0.085	~~0.087~~	18.995	~~19.408~~								
	1.52	1.57	0.21	6.054	7.8139	0.0026	0.0073	48	144	0.096	~~0.090~~	21.473	~~20.096~~								
	1.52	1.57	0.21	6.054	7.8106	0.0033	0.0106	48	192	0.122	~~0.098~~	27.254	~~21.885~~								
	1.52	1.57	0.21	6.054	7.8066	0.004	0.0146	48	240	0.148	0.108	33.035	24.115								
MA*X 'B'	1.57	1.61	0.2	6.362	7.4908	0	0	0	0					0.111	~~0.094~~	24.833	~~20.998~~	0.026	~~0.013~~	0.235	~~0.135~~
	1.57	1.61	0.2	6.362	7.4886	0.0022	0.0022	48	48	0.078	~~0.078~~	17.289	~~17.289~~								
	1.57	1.61	0.2	6.362	7.486	0.0026	0.0048	48	96	0.092	~~0.085~~	20.432	~~18.861~~								
	1.57	1.61	0.2	6.362	7.483	0.003	0.0078	48	144	0.106	~~0.092~~	23.576	~~20.432~~								
	1.57	1.61	0.2	6.362	7.4788	0.0042	0.012	48	192	0.148	~~0.106~~	33.006	~~23.576~~								
	1.57	1.61	0.2	6.362	7.475	0.0038	0.0158	48	240	0.134	0.111	29.863	24.833								
SA*X 'A'	1.58	1.52	0.2	6.044	7.6992	0	0	0	0					0.112	~~0.114~~	24.985	~~25.365~~	0.020	~~0.005~~	0.181	~~0.061~~
	1.58	1.52	0.2	6.044	7.6959	0.0033	0.0033	48	48	0.122	~~0.122~~	27.301	~~27.301~~								
	1.58	1.52	0.2	6.044	7.6935	0.0024	0.0057	48	96	0.089	~~0.105~~	19.856	~~23.578~~								
	1.58	1.52	0.2	6.044	7.6897	0.0038	0.0095	48	144	0.141	~~0.117~~	31.438	~~26.198~~								
	1.58	1.52	0.2	6.044	7.6873	0.0024	0.0119	48	192	0.089	~~0.110~~	19.856	~~24.613~~								
	1.58	1.52	0.2	6.044	7.6841	0.0032	0.0151	48	240	0.119	0.112	26.474	24.985								
SA*X 'B'	1.58	1.52	0.24	6.288	8.7051	0	0	0	0					0.233	~~0.184~~	52.002	~~41.026~~	0.097	~~0.028~~	0.416	~~0.150~~
	1.58	1.52	0.24	6.288	8.7002	0.0049	0.0049	48	48	0.175	~~0.175~~	38.961	~~38.961~~								
	1.58	1.52	0.24	6.288	8.6961	0.0041	0.009	48	96	0.146	~~0.160~~	32.600	~~35.781~~								
	1.58	1.52	0.24	6.288	8.6918	0.0043	0.0133	48	144	0.153	~~0.158~~	34.191	~~35.251~~								
	1.58	1.52	0.24	6.288	8.6834	0.0084	0.0217	48	192	0.299	~~0.193~~	66.791	~~43.136~~								
	1.58	1.52	0.24	6.288	8.6724	0.011	0.0327	48	240	0.392	0.233	87.484	52.002								

Donald L. Pile 8/20/92

Corrected table
[signature] 10/15/92

CORROSION Rates (consolidated)

Average of samples A & B for each treatment (T3. WQ1)

Specimen ID	Temp (C)	Time (hr)	A+B/2* (mm/yr)	A+B/2	a+b/2* (mg/dm²/day)	a+b/2
MA			0.107	0.102	23.922	22.639
SA			0.116	0.139	25.933	30.939
MA*A1*T1	600	0.1	0.125	0.112	27.961	25.041
MA*A1*T2	600	1	0.138	0.126	30.775	28.168
MA*A1*T3	600	15	0.229	0.172	51.164	38.390
SA*A1*T1	600	0.1	0.199	0.231	44.430	51.573
SA*A1*T2	600	1	0.107	0.116	23.891	25.964
SA*A1*T3	600	15	0.226	0.212	50.474	47.193
MA*A2*T1	638	0.1	0.101	0.096	22.621	21.510
MA*A2*T2	638	1	0.160	0.121	35.717	26.902
MA*A2*T3	638	15	1.029	0.557	229.472	124.158
SA*A2*T1	638	0.1	0.120	0.127	26.738	28.428
SA*A2*T2	638	1	0.158	0.168	35.250	37.520
SA*A2*T3	638	15	1.397	1.202	311.472	268.075
MA*A3*T1	700	0.1	0.123	0.107	27.368	23.932
MA*A3*T2	700	1	0.177	0.138	39.513	30.793
MA*A3*T3	700	15	1.262	0.508	281.341	113.296
SA*A3*T1	700	0.1	0.113	0.130	25.282	28.987
SA*A3*T2	700	1	0.341	0.286	76.026	63.814
SA*A3*T3	700	15	15.459	9.517	3447.627	2122.432
MA*A4*T1	750	0.1	0.128	0.118	28.525	26.300
MA*A4*T2	750	1	0.103	0.095	23.071	21.209
MA*A4*T3	750	15	1.125	0.555	250.821	123.822
SA*A4*T1	750	0.1	0.127	0.151	28.434	33.632
SA*A4*T2	750	1	3.775	2.032	841.767	453.275
SA*A4*T3	750	15	4.937	1.950	1100.908	434.767
MA*A5*T1	800	0.1	0.115	0.109	25.696	24.230
MA*A5*T2	800	1	0.132	0.120	29.337	26.765
MA*A5*T3	800	15	0.211	0.173	47.010	38.486
SA*A5*T1	800	0.1	0.288	0.218	64.195	48.641
SA*A5*T2	800	1	0.533	0.285	118.917	68.601
SA*A5*T3	800	15	1.315	0.648	293.355	144.474
MA*X	900	0.1	0.110	0.094	24.474	21.032
SA*X	900	0.1	0.173	0.149	38.493	33.181

A+B units of mm/yr

a+b units of mg/dm²/day

* corrosion rate calculated for each period as separate

no * ~~corrosion rate calculated for time from beginning to end of that period~~

Columns designated as no * are not valid [signature] 10/15/92 Donald L. Pile 8/20/92

CORROSION Rates (consolidated)

see notes p.57

(T1.WQ1)

Specimen ID	Temp (c)	Time (hr)	avgCR* (mm/yr)	avgCR	avgcr* (mg/dm²/day)	avgcr	stdCR*	stdCR	stdCR*/av	stdCR/avg
MA "A"			0.113	0.107	25.258	23.824	0.027	0.007	0.236	0.068
MA "B"			0.101	0.096	22.585	21.454	0.025	0.007	0.251	0.076
SA "A"			0.114	0.136	25.455	30.345	0.035	0.025	0.302	0.187
SA "B"			0.118	0.141	26.411	31.538	0.034	0.023	0.285	0.165
MA*A1*T1 "A	600	0.1	0.152	0.124	33.961	27.652	0.065	0.018	0.424	0.148
MA*A1*T1 "B	600	0.1	0.098	0.101	21.961	22.430	0.020	0.007	0.206	0.067
MA*A1*T2 "A	600	1	0.142	0.131	31.627	29.202	0.038	0.012	0.271	0.094
MA*A1*T2 "B	600	1	0.134	0.122	29.922	27.135	0.034	0.009	0.256	0.075
MA*A1*T3 "A	600	15	0.240	0.182	53.540	40.623	0.097	0.042	0.404	0.230
MA*A1*T3 "B	600	15	0.219	0.162	48.789	36.156	0.095	0.042	0.436	0.259
SA*A1*T1 "A	600	0.1	0.198	0.212	44.070	47.349	0.091	0.032	0.460	0.152
SA*A1*T1 "B	600	0.1	0.201	0.250	44.789	55.797	0.088	0.050	0.439	0.201
SA*A1*T2 "A	600	1	0.119	0.129	26.627	28.886	0.021	0.008	0.176	0.063
SA*A1*T2 "B	600	1	0.095	0.104	21.155	23.092	0.016	0.012	0.167	0.112
SA*A1*T3 "A	600	15	0.247	0.246	54.989	54.822	0.104	0.043	0.423	0.173
SA*A1*T3 "B	600	15	0.206	0.177	45.959	39.563	0.112	0.044	0.542	0.251
MA*A2*T1 "A	638	0.1	0.103	0.100	23.049	22.262	0.021	0.003	0.202	0.035
MA*A2*T1 "B	638	0.1	0.100	0.093	22.192	20.758	0.021	0.004	0.212	0.043
MA*A2*T2 "A	638	1	0.131	0.108	29.175	24.019	0.057	0.012	0.435	0.111
MA*A2*T2 "B	638	1	0.189	0.134	42.260	29.785	0.094	0.032	0.496	0.242
MA*A2*T3 "A	638	15	1.257	0.658	280.366	146.742	0.910	0.394	0.723	0.598
MA*A2*T3 "B	638	15	0.801	0.455	178.577	101.574	0.531	0.217	0.663	0.475
SA*A2*T1 "A	638	0.1	0.114	0.116	25.376	25.975	0.011	0.005	0.099	0.043
SA*A2*T1 "B	638	0.1	0.126	0.138	28.101	30.880	0.022	0.010	0.176	0.072
SA*A2*T2 "A	638	1	0.182	0.210	40.496	46.874	0.072	0.048	0.396	0.229
SA*A2*T2 "B	638	1	0.135	0.126	30.005	28.167	0.038	0.008	0.282	0.061
SA*A2*T3 "A	638	15	1.255	1.064	279.854	237.335	0.413	0.274	0.329	0.258
SA*A2*T3 "B	638	15	1.538	1.340	343.091	298.815	0.443	0.308	0.288	0.230
MA*A3*T1 "A	700	0.1	0.114	0.102	25.345	22.750	0.023	0.007	0.200	0.073
MA*A3*T1 "B	700	0.1	0.132	0.113	29.392	25.113	0.036	0.012	0.271	0.104
MA*A3*T2 "A	700	1	0.153	0.125	34.111	27.792	0.049	0.017	0.323	0.137
MA*A3*T2 "B	700	1	0.201	0.152	44.915	33.795	0.077	0.033	0.383	0.217
MA*A3*T3 "A	700	15	1.206	0.490	269.053	109.173	1.226	0.409	1.016	0.836
MA*A3*T3 "B	700	15	1.317	0.527	293.628	117.419	1.345	0.452	1.022	0.858
SA*A3*T1 "A	700	0.1	0.119	0.153	26.558	34.033	0.055	0.026	0.465	0.174
SA*A3*T1 "B	700	0.1	0.108	0.107	24.006	23.941	0.017	0.006	0.155	0.059
SA*A3*T2 "A	700	1	0.332	0.288	73.972	64.216	0.113	0.056	0.341	0.195
SA*A3*T2 "B	700	1	0.350	0.284	78.080	63.412	0.122	0.082	0.348	0.287
SA*A3*T3 "A	700	15	15.457	9.342	3447.156	2083.304	8.882	5.680	0.575	0.608
SA*A3*T3 "B	700	15	15.461	9.693	3448.099	2161.561	8.503	5.649	0.550	0.583
MA*A4*T1 "A	750	0.1	0.113	0.102	25.287	22.706	0.027	0.006	0.238	0.062
MA*A4*T1 "B	750	0.1	0.142	0.134	31.763	29.894	0.016	0.005	0.113	0.035
MA*A4*T2 "A	750	1	0.104	0.096	23.119	21.483	0.017	0.006	0.167	0.059
MA*A4*T2 "B	750	1	0.103	0.094	23.023	20.935	0.018	0.006	0.173	0.061
MA*A4*T3 "A	750	15	1.394	0.697	310.920	155.440	1.138	0.469	0.816	0.673
MA*A4*T3 "B	750	15	0.855	0.418	190.722	92.205	0.745	0.281	0.871	0.679
SA*A4*T1 "A	750	0.1	0.112	0.139	24.967	30.997	0.039	0.026	0.348	0.185
SA*A4*T1 "B	750	0.1	0.143	0.163	31.900	36.267	0.035	0.025	0.245	0.151
SA*A4*T2 "A	750	1	3.633	1.932	810.238	430.899	2.756	1.449	0.758	0.750
SA*A4*T2 "B	750	1	3.916	2.133	873.296	475.650	2.904	1.545	0.742	0.724
SA*A4*T3 "A	750	15	4.764	1.863	1062.439	415.432	5.070	1.762	1.064	0.946
SA*A4*T3 "B	750	15	5.109	2.086	1139.377	454.102	5.171	1.908	1.012	0.937
MA*A5*T1 "A	800	0.1	0.115	0.109	25.734	24.237	0.022	0.006	0.194	0.053
MA*A5*T1 "B	800	0.1	0.115	0.109	25.659	24.223	0.025	0.007	0.221	0.067
MA*A5*T2 "A	800	1	0.116	0.110	25.850	24.490	0.033	0.010	0.283	0.088
MA*A5*T2 "B	800	1	0.147	0.130	32.825	29.041	0.045	0.014	0.304	0.106
MA*A5*T3 "A	800	15	0.199	0.170	44.357	37.872	0.058	0.022	0.290	0.129
MA*A5*T3 "B	800	15	0.223	0.175	49.663	39.099	0.083	0.039	0.372	0.225
SA*A5*T1 "A	800	0.1	0.163	0.157	36.279	34.934	0.044	0.010	0.271	0.065
SA*A5*T1 "B	800	0.1	0.413	0.280	92.110	62.349	0.291	0.087	0.705	0.311
SA*A5*T2 "A	800	1	0.862	0.415	192.282	92.532	0.664	0.296	0.770	0.715
SA*A5*T2 "B	800	1	0.204	0.155	45.553	34.671	0.121	0.026	0.593	0.164
SA*A5*T3 "A	800	15	1.192	0.562	265.859	125.317	1.266	0.383	1.062	0.681
SA*A5*T3 "B	800	15	1.439	0.734	320.852	163.631	1.373	0.477	0.954	0.650
MA*X "A"	900	0.1	0.108	0.094	24.115	21.065	0.024	0.008	0.220	0.083
MA*X "B"	900	0.1	0.111	0.094	24.833	20.998	0.026	0.013	0.235	0.135
SA*X "A"	900	0.1	0.112	0.114	24.985	25.335	0.020	0.006	0.181	0.051
SA*X "B"	900	0.1	0.233	0.184	52.002	41.026	0.097	0.028	0.416	0.150

Columns designated as no* are not valid specifying 10/15/92

Donald L. Pile
8/20/92

After reviewing these calculations, it was concluded that the method used as no* is erroneous. The corrosion rate should be calculated for the overall exposure time (5X 48 hs) ≡ 240 hours. Therefore in Tables presented in pages 50 to 56, only the last value of corrosion rate (for the accumulated 240 hours) was adopted as the alternate method of calculation.

10/15/92

The values of corrosion rates were taken from previous tables. * was designated as Method 1 and the calculations for overall 240hr-period as Method 2. Both set of values are given in attached tables.

Specimen	Temp (°C)	Time (h)	Corrosion Rate (mm/year) Method 1	Corrosion Rate (mm/year) Method 2	Corrosion Rate (mdd) Method 1	Corrosion Rate (mdd) Method 2
SA			0.116	0.118	25.9	26.1
SA*A1*T1	600	0.1	0.199	0.207	44.4	46.2
SA*A1*T2	600	1	0.107	0.107	23.9	23.9
SA*A1*T3	600	15	0.226	0.228	50.5	50.8
SA*A2*T1	638	0.1	0.120	0.120	26.7	26.8
SA*A2*T2	638	1	0.158	0.159	35.3	32.3
SA*A2*T3	638	15	1.397	1.397	311.5	311.4
SA*A3*T1	700	0.1	0.113	0.114	25.3	25.3
SA*A3*T2	700	1	0.341	0.341	76.0	76.1
SA*A3*T3	700	15	15.459	15.459	3447.6	3447.7
SA*A4*T1	750	0.1	0.127	0.128	28.4	28.5
SA*A4*T2	750	1	3.775	3.999	841.8	892.0
SA*A4*T3	750	15	4.937	5.059	1100.9	1123.1
SA*A5*T1	800	0.1	0.288	0.299	64.2	66.7
SA*A5*T2	800	1	0.533	0.533	118.9	119.0
SA*A5*T3	800	15	1.315	1.380	293.4	307.7
SA*A6*T1	900	0.1	0.173	0.173	38.5	38.5

Specimen	Temp (°C)	Time (h)	Corrosion Rate (mm/year) Method 1	Corrosion Rate (mm/year) Method 2	Corrosion Rate (mdd) Method 1	Corrosion Rate (mdd) Method 2
MA			0.107	0.109	23.9	24.4
MA*A1*T1	600	0.1	0.125	0.128	28.0	28.5
MA*A1*T2	600	1	0.138	0.142	30.8	31.7
MA*A1*T3	600	15	0.229	0.235	51.2	52.4
MA*A2*T1	638	0.1	0.101	0.102	22.6	22.6
MA*A2*T2	638	1	0.160	0.160	35.7	35.8
MA*A2*T3	638	15	1.029	1.029	229.5	229.5
MA*A3*T1	700	0.1	0.123	0.123	27.4	27.4
MA*A3*T2	700	1	0.177	0.177	39.5	39.5
MA*A3*T3	700	15	1.262	1.262	281.3	281.4
MA*A4*T1	750	0.1	0.128	0.128	28.5	28.5
MA*A4*T2	750	1	0.103	0.105	23.1	23.3
MA*A4*T3	750	15	1.125	1.153	250.8	257.1
MA*A5*T1	800	0.1	0.115	0.118	25.7	26.3
MA*A5*T2	800	1	0.132	0.136	29.3	30.3
MA*A5*T3	800	15	0.211	0.218	47.0	48.5
MA*A6*T1	900	0.1	0.110	0.110	24.5	24.5

JC Augustine
12/7/92

5/13/93

EPR SPECIMEN PREPARATION.

SPECIMENS: ALLOY 825 HN4371FG

OBJECTIVE: SOLUTION ANNEAL AND SENSITIZE ALLOY 825 SPECIMENS AT TWO TIME INTERVALS. USE ELECTROCHEMICAL POTENTIOKINETIC REACTIVATION (EPR) TO DETERMINE THE DEGREE OF SENSITIZATION

PROCEDURE: SOLUTION ANNEAL 12 ALLOY 825 SPECIMENS 1/2" x 1/2" x 3/4" AT 1200°C FOR 10 MIN. SENSITIZE 3 SOLUTION ANNEALED SPECIMENS AT 750°C FOR 15 HOURS AND 3 SOLUTION ANNEALED SPECIMENS AT 750°C FOR 1000 hr. SOLUTION ANNEAL AND SENSITIZATION OF ALL SPECIMENS PERFORMED IN DIVISION 6 WITH THE ASSISTANCE OF MR. ANDY NAGY.

SOLUTION ANNEAL: SPECIMENS PLACED IN WIRE BASKET. ONE SPECIMEN CONTAINED END OF THERMOCOUPLE IN THREADED HOLE. THERMOCOUPLE CONNECTED TO OMEGA HH22 THERMOCOUPLE METER. TUBE FURNACE SET AT 2195°F

TUBE FURNACE: PERENY MT 30K4.102

5/13/93

5/14/93 EPR SPECIMEN PREPARATION.

DATE	TIME	TEMP	
5/14/93	2:08 PM	824°F	INSERT SPECIMENS
5/14/93	2:09 PM	1024°F	
5/14/93	2:10 PM	1674°F	
5/14/93	2:11 PM	1919°F	
5/14/93	2:12 PM	2014°F	
5/14/93	2:13 PM	2090°F	
5/14/93	2:14 PM	2127°F	
5/14/93	2:15 PM	2158°F	
5/14/93	2:16 PM	2176°F	
5/14/93	2:17 PM	2185°F	t=0 SPECIMENS AT TEMP
5/14/93	2:18 PM	2193°F	
5/14/93	2:19 PM	2196°F	
5/14/93	2:20 PM	2196°F	
5/14/93	2:21 PM	2196°F	
5/14/93	2:22 PM	2196°F	
5/14/93	2:23 PM	2195°F	
5/14/93	2:24 PM	2195°F	
5/14/93	2:25 PM	2195°F	
5/14/93	2:26 PM	2195°F	
5/14/93	2:27 PM	2195°F	
5/14/93	2:28 PM	2194°F	
5/14/93	2:29 PM	2195°F	
5/14/93	2:30 PM	2195°F	
5/14/93	2:31 PM	2186°F	t=15 MIN SPECIMENS REMOVED AND WATER QUENCHED.

5/14/93

5/19/93

EPR SPECIMEN PREPARATION.

OBJECTIVE SENSITIZE SOLUTION ANNEALED SPECIMENS.

TEMP SET 751°F
TEMP MEASURED WITH OMEGA HH22
THERMOCOUPLE METER WITH THERMOCOUPLE #1
TEMP RECORDED WITH DATA LOGGER

TEMP CHECK 4:24:55 PM 5/17/93
DATA LOGGER 757.9 °F THERMOCOUPLE #1
HH22 757.2 °F THERMOCOUPLE #1
SPECIMENS INSERTED AT 4:30 PM 5/17/93

DATE	TIME	TEMP °F
5/17/93	4:31:53 pm	~~618.4~~ 618.4 °F
5/17/93	4:35:04 pm	745.5 °F t=0
5/17/93	~~4:44~~ 4:45:04 pm	768.9 °F
5/17/93	4:55:04 pm	756.8
5/17/93	5:05:04 pm	757.8
5/17/93	5:15:04 pm	757.3
5/17/93	5:25:04 pm	748.4
5/17/93	5:35:04 pm	749.7
5/17/93	5:45:04 pm	750.1
5/17/93	5:55:04 pm	750.9
5/17/93	6:05:04 pm	750.4

N Swickard 11/30/94

11/30/94

DATE	TIME	TEMP
5/17/93	6:15:04 pm	750.5
5/17/93	6:25:04 pm	750.6
5/17/93	6:35:04 pm	750.7
5/17/93	6:45:04 pm	750.4
5/17/93	6:55:04 pm	750.4
5/17/93	7:05:04 pm	750.4
5/17/93	7:15:04 pm	750.5
5/17/93	7:25:04 pm	750.6
5/17/93	7:35:04 pm	750.2
5/17/93	7:45:04 pm	750.3
5/17/93	7:55:04 pm	750.1
5/17/93	8:05:04 pm	750.2
5/17/93	8:15:04 pm	750.5
5/17/93	8:25:04 pm	750.4
5/17/93	8:35:04 pm	750.4
5/17/93	8:45:04 pm	750.5
5/17/93	8:55:04 pm	750.7
5/17/93	9:05:04 pm	750.9
5/17/93	9:15:04 pm	751.0
5/17/93	9:25:04 pm	751.1
5/17/93	9:35:04 pm	751.0
5/17/93	9:45:04 pm	751.2
5/17/93	9:55:04 pm	751.0
5/17/93	10:05:04 pm	751.0
5/17/93	10:15:04 pm	750.9
5/17/93	10:25:04 pm	750.8

5/19/93

5/19/93

DATE	TIME	TEMP
5/17/93	10:35:04	750.8
5/17/93	10:45:04	750.8
5/17/93	10:55:04	750.7
5/17/93	11:05:04	750.9
5/17/93	11:15:04	751.0
5/17/93	11:25:04	750.9
5/17/93	11:35:04	751.1
5/17/93	11:45:04	750.9
5/17/93	11:55:04	750.5
5/18/93	12:05:04	750.4
5/18/93	12:15:04	750.4
5/18/93	12:25:04	750.4
5/18/93	12:35:04	750.5
5/18/93	12:45:04	750.4
5/18/93	12:55:04	750.4
5/18/93	1:05:04	750.4
5/18/93	1:15:04	750.4
5/18/93	1:25:04	750.5
5/18/93	1:35:04	750.4
5/18/93	1:45:04	750.5
5/18/93	1:55:04	750.4
5/18/93	2:05:04	750.5
5/18/93	2:15:04	750.4
5/18/93	2:25:04	750.4
5/18/93	2:35:04	750.3
5/18/93	2:45:04	750.3

5/19/93

5/19/93

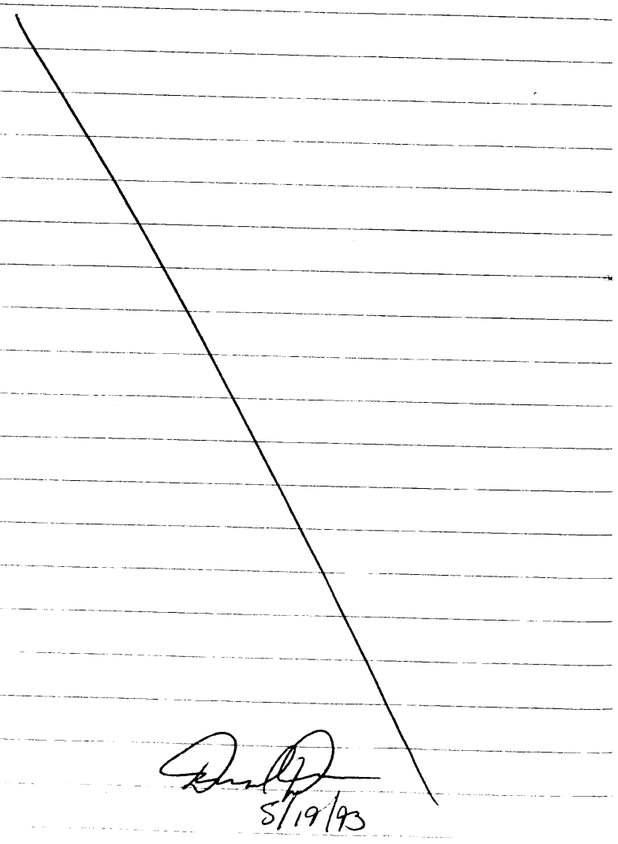
DATE	TIME	TEMP
5/18/93	2:55:04	750.1
5/18/93	3:05:04	750.0
5/18/93	3:15:04	750.0
5/18/93	3:25:04	750.3
5/18/93	3:35:04	750.1
5/18/93	3:45:04	750.1
5/18/93	3:55:04	750.1
5/18/93	4:05:04	750.2
5/18/93	4:15:04	750.4
5/18/93	4:25:04	750.3
5/18/93	4:35:04	750.3
5/18/93	4:45:04	750.2
5/18/93	4:55:04	750.0
5/18/93	5:05:04	750.2
5/18/93	5:15:04	750.0
5/18/93	5:25:04	750.1
5/18/93	5:35:04	750.1
5/18/93	5:45:04	750.1
5/18/93	5:55:04	750.2
5/18/93	6:05:04	750.0
5/18/93	6:15:04	750.1
5/18/93	6:25:04	749.8
5/18/93	6:35:04	750.2
5/18/93	6:45:04	750.1
5/18/93	6:55:04	750.0

5/19/93

5/19/93

DATE	TIME	TEMP	
5/18/93	7:05:04	750.0	
5/18/93	7:15:04	750.1	
5/18/93	7:25:04	750.0	
5/18/93	7:35:04	750.0	t=15 hr

NT 7:36 AM SPECIMENS WERE REMOVED FURNACE: LUCIFER HDL-80120



5/19/93

6/10/93

EPR SPECIMEN PREPARATION.
SPECIMENS: SOLUTION ANNEALED ALLOY 825 HH4871FG.
OBJECTIVE SENSITIZE EPR SPECIMENS
LINDBERG HEVI-DUTY VACUUM TUBE FURNACE
11/29/94 OVEN: MODEL # 54352A SN# 16071
TEMP: 750°F
TEMP MONITORED WITH OMEGA NN22
THERMOCOUPLE METER.
SPECIMENS STARTED 5/31/93
SPECIMENS REMOVED 6/9/93
SENSITIZATION TIME ≈199 HOURS

6/10/93

FURNACE SET TEMP - 740°F

SOUTHWEST RESEARCH INSTITUTE
San Antonio, Texas 78284

Page:

Project: 20-5704-043

DATE	TIME		FURN. TEMP (°F)	SPEC. TEMP (°F)	TIME @ TEMP
5-31-93	START	HEATUP @	09:20		
	09:55		736	671.3	
	10:30		740	759.2	0
	11:00		740	756.5	:30
	12:05		741	752.0	1:35
	12:30		741	751.0	2:05
	13:00		740	750.2	2:35
6-1-93	07:00		740	749.3	20:35
	12:54		741	749.2	26:29
	16:22		740	749.0	
6-2-93	07:17		741	749.6	44:52
	16:32		740	749.2	
6-3-93	07:12		741	749.8	68:47
	13:42		741	749.5	
	16:33		741	749.6	
6-4-93	07:07		741	750.2	92:42
	10:54		741	749.7	
	16:48		741	750.1	
6-5-93	07:22		741	749.8	116:57
6-7-93	07:11		741	749.6	164:46
	15:14		740	750.0	
6-8-93	07:07		740	749.8	188:42
	16:43		741	749.6	198:18
6-9-93	07:16		98	109.1	?

FURNACE SHUTDOWN DURING OFF-WORKING-HOURS.
ACTUAL TIME IS INDETERMINATE.

Date: 6-9-93

Signature:

(SwR 17) Rev 6/75

G108

6/17/93

Sample: 304L heat treated at 621°C for 24 hours. Finish of less than 1 Micron.
l = .83 in W = .553 in AREA = 2.977 cm²

Solution: .5M H_2SO_4 + .01M KSCN
55.8 ml 96% H_2SO_4 Lot# 903026
1.9435 g KSCN Lot # 924916
2000 ml of solution
T = 30° Hg Thermometer 0323008
Calibrated 2 Feb 93 Next due
2 Feb pk Feb 94.
~~Immersed sample and applied~~ pk 6/17/93
~~cathodic potential for 5 minutes. Scanned~~ pk 6/17/93
~~from cathodic potential to anodic passivation~~ pk 6/17/93
~~point. Reversed scan to Ecorr.~~ pk 6/17/93

Potentiostat: EG&G M173 Calibrated 19 May 93
due 19 May 94. Data saved as G108
using M342C software

Reference SCE Fisher 13-620-15 SN 3106337

E_{corr} = -382 mV

Technique: polished sample mounted in Epoxy by starting at 180 grit SiC paper. A pk wet grinding was used to make the surface planar. Scratches were removed by ~~using~~ pk wet grinding using 240, 320, 400 and 600. Polishing continued using 6μ diamond suspension

N. Swidler 11/30/94

G108

The Bridge solution was typically saturated KCl (In some cases, bulk solution in the cell may also be used in the bridge. The error in potential measurement is considered to be less than 5 mV (see p. 102)) and a Metlap 6® lubricating with water. 3 and 1μ using diamond paste followed using ~~diamond~~ pk 11/30/94 UNIVERSAL oil based diamond extender as lubricant. The final step was to polish with Masterpolish solution from Buehler. The sample was ultrasonicly cleaned with degreasing detergent for 6 minutes. The sample is rinsed off with DI water followed by Ethyl Alcohol, 200 proof, and air dried. bridge solution. 1/18/97

The sample was connected to a brass rod electrode and immersed in solution. The bridge is brought close to the sample surface, but not touching. The Reactivation program is selected and parameters inputed as per printout. ~~After 1m~~ pk 11/30/94 The SCE is inserted into the bridge and connected electrolytically to the electrometer of the EG and G. After 2 minutes of immersion in solution the ~~working~~ pk 11/30/94 electrode leads are connected to the sample and platinum electrode. The program is started.

After completion data is saved. The sample is removed and cleaned ultrasonicly in detergent for 5 minutes. The sample is rinsed in DI water and ethyl alcohol and rinsed with DI water again. Allowed sample to dry in air. When dry the sample was viewed at 100X magnification. The etched grain boundry intersections were counted per 1 mm. The average number of intersections

N. Swidler 11/30/94

G108
6/17/93

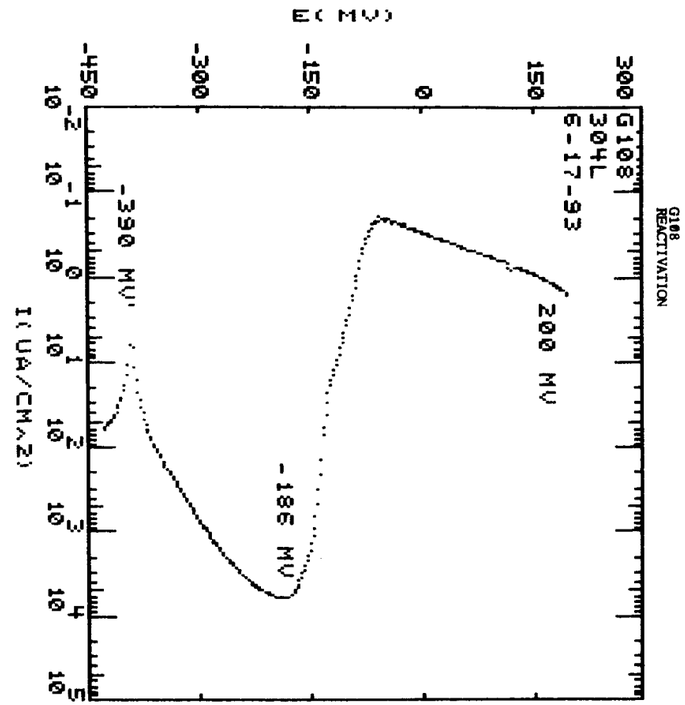
per milimeter was converted to the number of grains per milimeter and to a "G" number using paper, page . The mi. coulombs per cm^2 were calculated by the M342C software. P_A was found by the equation $P_A = (Q/A) / (6.1 \times 10^{-3} [\exp(.35\,G)])$ where "Q/A" is the value found by the software.

$Q/A = 336.38\ mC/cm^2$
$G = \sim 2$
$P_A = 32$

Parameters and graph arrow page 73

Remarks - The P_A value seems a bit too high. There were only ditch marks in the sample.

N. Sickles
11/20/94



RUN PARAMETERS

TECHNIQUE	REACTIVATION
ORIGINAL NAME	G108
INITIAL E(MV)	200 VS R
PASSIVATION T(S)	120
FINAL E(MV)	-50 VS E
SCAN RATE(MV/S)	1.67
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	120 S

SAMPLE PARAMETERS

AREA(CMS^2)	2.977

DATA SCALE

ECORR	-382
MV/PT	2
DATA MAX	5985.892
DATA MIN	-68.79489
ABS MIN	.1981861
ABS MAX	5985.892

RESULTS

START E(MV)	-390
END E(MV)	200
MILLICOULOMBS/CM^2	336.38

LEGEND

G108
304L 24HOURS @ 621C <1MICRON
SOLUTION: .5M H2SO4 + .01M KSCN
6/17/93

Jack E. Kilbane 6/17/93

6/17/93

G108B

Sample: 304L heat treated at 621° for 24 hours.
Polished to a 1 micron finish.
HT# T0964
l = W = Area = 2.868cm²

Solution: .5M H_2SO_4 + .01M KSCN
~~55. pk 11/30/94 used same solution made~~ pk 6/17/93
used ~600ml of the same solution
used for G108 page 70.

Potentiostat: EG&G M173 same as G108 page 70
Saved Data on M342C under G108B

Reference SCE Fisher 13-620-51 SN 3106337

Technique: same as G108 page 70 except no
Master Met polish was used.

$E_{corr.}$ = -439 mV

P/A = 403.5mC/cm²

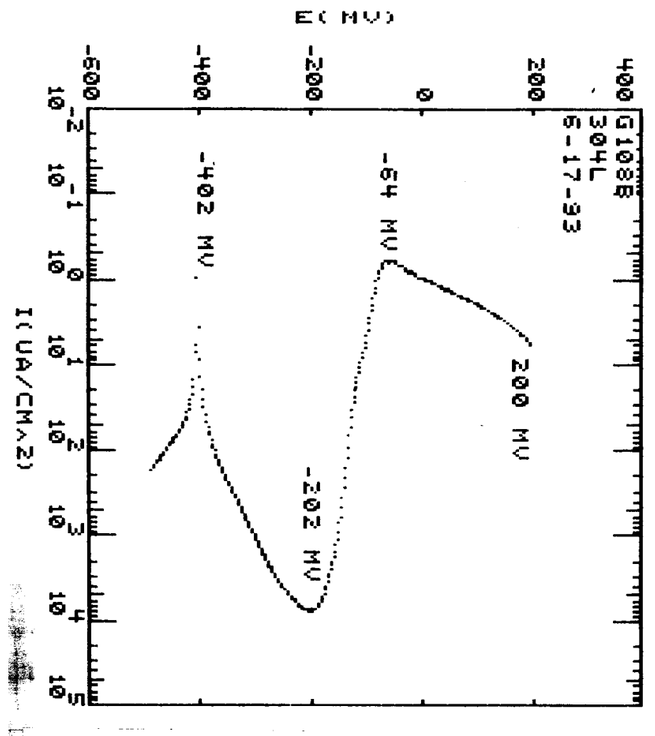
G = 2

P_A =

Remarks: Diamond ~~pk~~ suspention and Metlap 6
appear to deeply scratch the sample.
T = 30°C measured by Hg 0323008 same as
G108 page 70.

Plot and parameters on page 75.

N. Sridhar 11/30/94



RUN PARAMETERS

TECHNIQUE	REACTIVATION
ORIGINAL NAME	G108B
INITIAL E(MV)	200 VS R
PASSIVATION T(S)	120
FINAL E(MV)	-50 VS E
SCAN RATE(MV/S)	1.67
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	120 S

SAMPLE PARAMETERS

AREA(CMS^2)	2.868

DATA SCALE

ECORR	-439
MV/PT	2
DATA MAX	7566.248
DATA MIN	-714.0865
ABS MIN	.5962343
ABS MAX	7566.248

RESULTS

START E(MV)	-402
END E(MV)	200
MILLICOULOMBS/CM^2	403.55

LEGEND

G108B
304L 24HOURS AT 621C 1MICRON
SOLUTION: .5M H2SO4 + .01KSCN
6/17/93

Josh E. Kuhlman Jr. 6/17/93

6/18/93 G108C

Sample: 304L HT# T0954
Mill annealed. 1 Micron finish.
l = w = AREA: 3.057 cm^2

Solution: .5M H_2SO_4 + .01M KSCN
used ~600 ml of solution prepared
6/17/93 for G108. pags 70.
T = 30°C Hg Thermometer 0323008
same as G108 page 70

Potentiostat: EG&G M173 same as G108 page 70.
Data under G108C using M342C software.

Reference SCE 13-620-51 SN 3106337

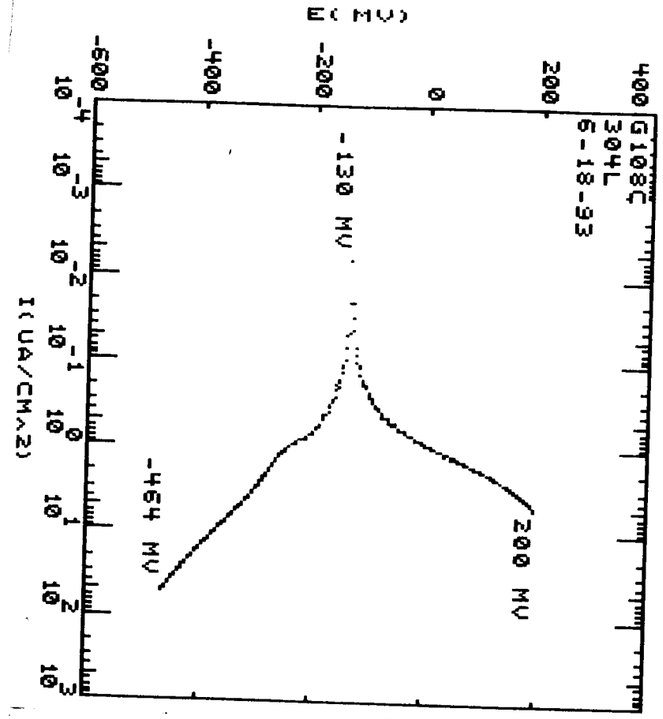
Technique: Same as G108 except no 6μ
suspension with Metlap6 or
Master Met was used.

E_{corr} = -417
Q/A = .28
G: 2
P_A:

Remarks - This appeared to work very well
even though G108 and G108B were
large numbers. The important thing is that
it shows the method works.

Plot and parameters are on page 77

N. Sridhar 4/30/94



G108C
REACTIVATION

RUN PARAMETERS

TECHNIQUE	REACTIVATION
ORIGINAL NAME	G108C
INITIAL E(MV)	200 VS R
PASSIVATION T(S)	120
FINAL E(MV)	-50 VS E
SCAN RATE(MV/S)	1.67
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	120 S

SAMPLE PARAMETERS

AREA(CMS^2)	3.057

DATA SCALE

ECORR	-417
MV/PT	2
DATA MAX	4.952568
DATA MIN	-52.01178
ABS MIN	6.542362E-03
ABS MAX	52.01178

RESULTS

START E(MV)	-130
END E(MV)	200
MILLICOULOMBS/CM^2	.28

LEGEND

G108C
304L NOT SENSITIZED 1MICRON
SOLUTION: .5M H2SO4 + .01M KSCN
6/18/93

Joel E. [illegible] 6/18/93

6/23/93 EPR#1A

Sample: 3042 HT# T 0954
Heat treated at 621°C for 24 hours.
1 Micron finish. Same sample as G108.
page 70. Repolished to give flat new
surface.

Solution: .5M H_2SO_4 + .01 M KSCN
55.8 ml 96% H_2SO_4 Lot # 903026 and
Lot # 925400
1.9438 4g KSCN Lot # 924916
2000 ml of solution
used ~600 ml for this test.

Potentio stat: EG&G M173 62101 same as
G108 page 70. Data saved under EPR#1A
using M342C software.

Reference SCE 13-620-5 SN 0169033
T = 30°C Hg Thermometer 0323008 same
as G108 page 70.

Technique:
Polishing: To Mount sample in epoxy clean in
ultrasonic bath with detergent after oxide ground
off. Dry samples in air. Cut a piece of
clear tape large enough to cover the tapped hole.
Mix epoxy per directions and ~~Mount~~ NS 11/20/94 seal
samples in epoxy so that the tapped hole is
horizontal and furthest from an edge. Do not
allow any part of sample to not be protected
by the epoxy.

N. Sridhar
11/20/94

6/23/93 EPR#1A

When epoxy has set remove from mold.
Clamp in vise, but in a way that will not mar the
surface. Drill a hole to the tape covered hole.
Gently retap the hole. Grind a flat spot at
the hole so the teflon gasket can seal with the
epoxy.

Place 3 mounted samples in the Beuhler
sample holder - or as many as needed to balance
the holder. Grind planar using Automet 3
power head; 6 pounds/sample, complimentary and/or
counter rotation. USE 240 grit to make planar.
Remove scratches by using ~~320~~ NS 11/20/94 320 and 400 grit.
~~Continue to~~ NS 11/20/94 use 6 lbs/sample, complimentary rotation,
2.5 minutes. Polish with 600 grit 4 lbs/sample,
complimentary rotation, 4.5 minutes. All previous
polishing are used with water. Ultrasonicly clean for 6 min.

Remove from sample holder. Polish with 3μ
paste and universal diamond extender until all major
scratches are gone. Ultrasonicly clean for 6 minutes.
Dry sample off. Polish with 1μ diamond paste
and universal diamond extender to mirror polish.
Both 3μ and 1μ are polished by hand on wheel
with wheel speed at 150 rpm.

N. Sridhar
11/20/94

6/23/93 EPR #1A

Set up cell. Make sure G-5 cell, ~~is~~ ~~clean~~ fk counter electrode, other assorted glassware is clean. Prepare bridge. Put cell in temperature regulated device and get to desired temperature. Place bridge and other atachments to cell. Put sample in ultrasonic bath with detergent for 5 minutes. Rinse with D.I. water. Rinse with ethyl alcohol and let dry. Make sure all values for cyclic polarization program are correct and type in comments. When sample dry, connect to sample electrode and immerse exposed sample surface only, try not to get solution on sample electrode. Start cyclic polarization software.

When done remove sample ultrasonicly clean rinse off and dry. Clean cell.

The degree of sensitizations will come from the two peaks of current in the polarization of the sample; I_R/I_a, where I_R is reverse scan and I_a is anodic scan.

Software aborted experiment. Reason unknown.

[signature] 6/23/93

6/23/93 EPR#2

Sample: ~~825~~ 304L fk 6/23/93 HT# T0954

heat treated for ~~200~~ 24 fk 6/23 hours at ~~750~~ 621°C fk 6/23

1 micron finish

l = .83 in W = .553 in AREA = ~~2.37 cm²~~ fk 2.977 cm²

Solution: .5M H_2SO_4 + .01M KSCN

same ~~as~~ fk bulk solution made for EPR#1A page 78.

T = 30°C Hg Thermometer 0323008

same as G108 page 70

Potentiostat: EG&G M1[redacted] 62101 same as G108 page 70. Data saved as EPR#2 using M342C software.

Reference: SCE 13-620-51 SN 0169033

Technique: Since same sample as EPR#1A was used it was only polished with 3μ and 1μ paste by hand as per EPR#1A. All other techniques are the same as EPR#1A page 78.

E_{corr} = -425 MV

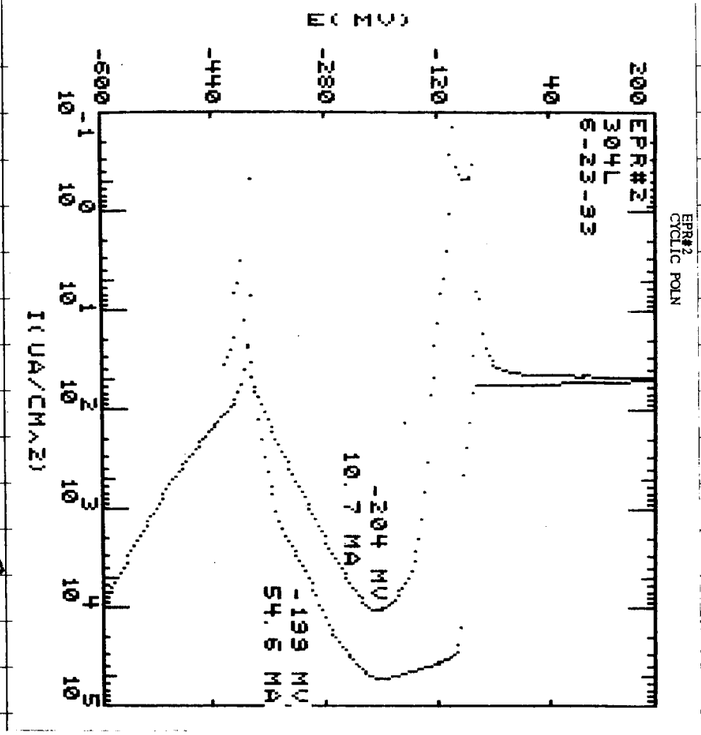
I_R/I_a = .196

Appearance = deep etching. All grains are visible.

Remarks = This technique seems to work well.

Parameters and graph are on page 82.

EPR#2



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#2
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.977
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-425
MV/PT	4
DATA MAX	54618.74
DATA MIN	-10077.26
ABS MIN	.1410816
ABS MAX	54618.74

LEGEND

EPR#1A
SAMPLE: 304L 621C FOR 24HRS
1MICRON FINISH
SOLUTION: .5M H2SO4 + .01M KSCN
EPR#1B IS THE REMAINDER OF THIS
DOUBLE LOOP EXPERIMENT
SAME SAMPLE AS G108
6/23/93

[signature] 6/23/93

6/23/93 EPR#3

Sample: 825 HT# HH 4371FC
Heat treated at 750°C for 200 hours.
1 Micron finish

Solution: .5M H_2SO_4 + .01M KSCN
same bulk solution as made for
EPR#1A page 78.
T = 30°C Hg Thermometer 0323008 same as
G108 page 70.

Potentiostat: EG and G M173 62101 same as G108
page 70. Data saved as EPR#3 using
M342C software.

Reference: SCE Fisher 13-620-51 SN 0169033

Technique: Same as EPR#1A page 78.

E corr:
J_e/I_A = ~~.196~~ [initials] 6/23 .453

Appearance: No attack observed to surface.

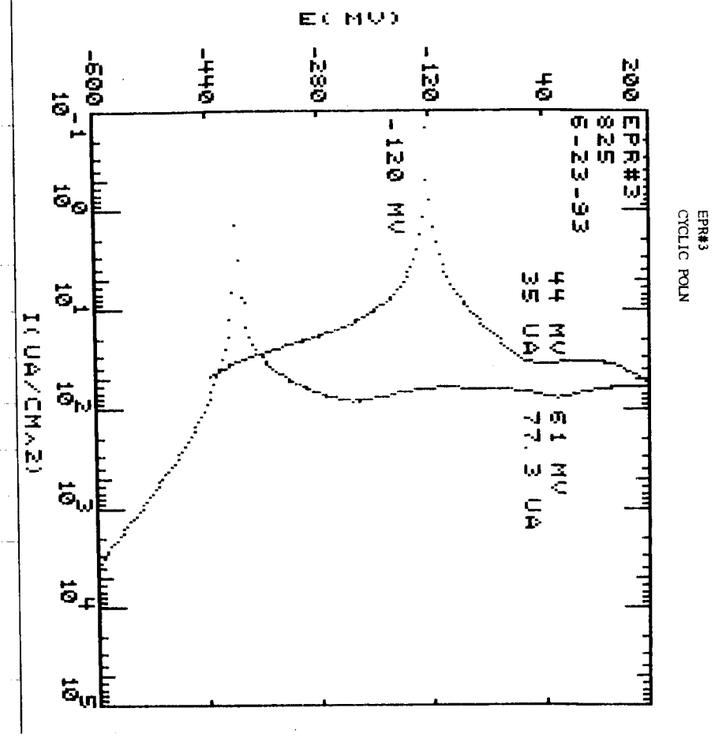
Remarks: Since no attack resulted, higher
SCN^-, H_2SO_4 and temperature will be
tried in sequence for the next 3
experiments to determine their effects.

Parameters and Graph are on page 84.

Sample l: .71 in w = .52 in Area = 2.37 cm²

750°/200 hrs #1 = Sample name.

EPR#3



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#3
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.37
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-437
MV/PT	4
DATA MAX	81.85654
DATA MIN	-3864.979
ABS MIN	.1476793
ABS MAX	3864.979

LEGEND

EPR#3
SAMPLE: 825 750C FOR 200HRS
1MICRON FINISH
SOLUTION: .5M H2SO4 + .01M KSCN
6/23/93

[signature] 6/23/93

6/24/93

EPR #4

Sample: 825 HH HH4371FC
Heat treated at 750°C for 200 hours.
1 micron finish.

Solution: ~~2~~ [initials] 11/30/94 .5M H_2SO_4 + .05M KSCN
27.9 ml 96% H_2SO_4 Lot#
4.8596g KSCN Lot#
1000 ml of solution.

Potentiostat: EG and G M173 62101 Same as G108 page 70. Data saved using M342C software under EPR#4.

Reference: SCE Fisher ~~15~~ [initials] 11/30/94 13-620-51 SN 3106337

Technique: Same as EPR#1A page 78 except used same sample as EPR#3 and ~~re~~ [initials] 11/30/94 only repolished with 3 and 1μ per technique for EPR#1A.

Ecorr
I_R/I_A = ~~.453~~ [initials] 11/30/94 .547

Appearance: No noticible attack on the specimen.

Remarks: None.

Paramiters and graph on page 86.

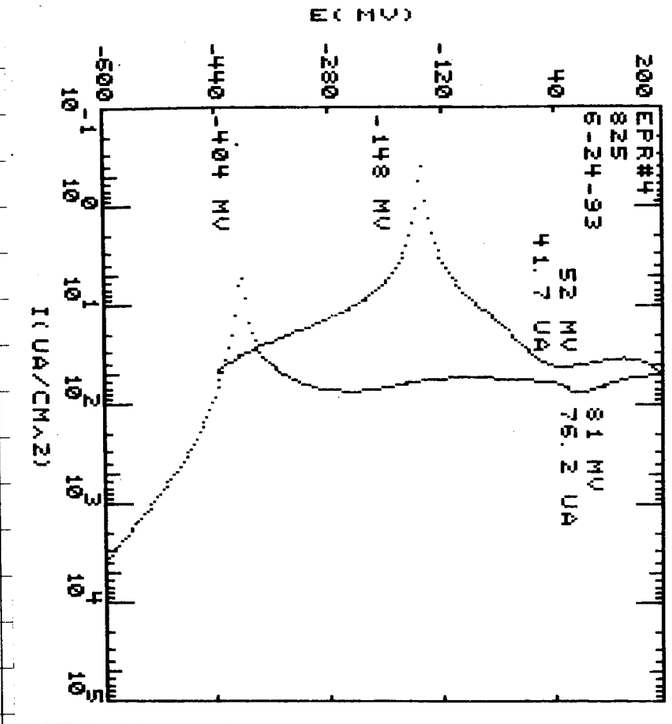
Sample l: .71 in w: .522 in Area = 2.37 cm²

Sample name - 825 750°/200 hrs #1

[signature] 11/30/94

6/24/93

EPR#4



EPR#4
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#4
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CM^2)	2.37
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-441
MV/PT	4
DATA MAX	76.24473
DATA MIN	-4029.536
ABS MIN	.0886076
ABS MAX	4029.536

LEGEND

EPR#4
825 750C FOR 200HRS
1 MICRON FINISH
SOLUTION: .5M H2SO4 + .05M KSCN
6/24/93

6/24/93

6/24/93 EPR#5

Sample: 825 HT# H14371FC
Heat treated at 750°C for 200 hours.
1 Micron finish
Same sample as EPR#4 and EPR#3.

Solution: 2M H_2SO_4 + .01M KSCN
111.5 ml 96% H_2SO_4 Lot# 925400
.9724 g KSCN Lot# 924916
1000ml of solution
T = 30°C Hg thermometer 0323008 same as G108 page 70

Potentiostat: EG and G M173 62101 same as G108 page 70. Data saved as EPR#5 using M342C software.

Technique: Same as EPR#1A except used same sample as EPR#3 so only did 3 and 1μ polish.

Ecorr
I_F/I_A = ~~.547~~ NA 11/30/94 No I_F peak found.

Appearance: No apparent attack on sample

Remarks: None

Parameter and graphs on page 88 11/30/94

Sample l = .522 in w = .71 in Area = 2.37 cm²

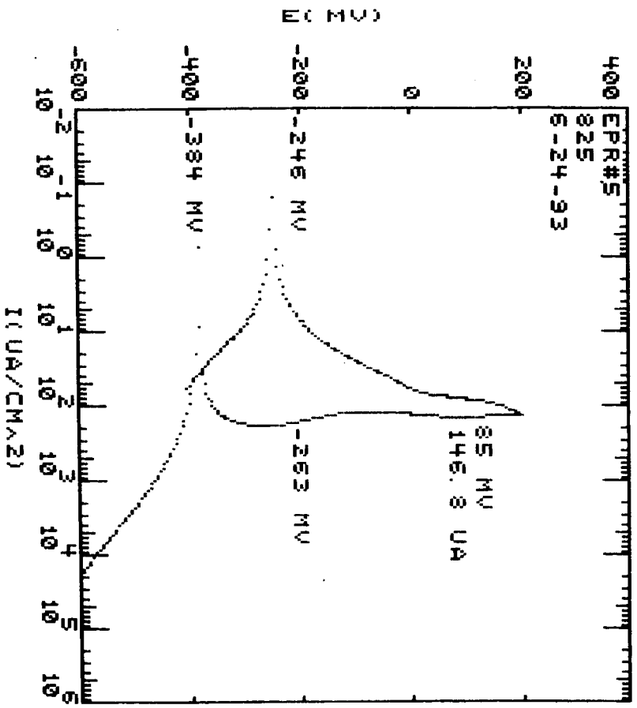
Reference SCE Fisher 13620-51 SN 3[illegible]

Sample name 750°/200 hrs #1[illegible]

[illegible] 11/30/94

EPR#5

6/24/93



EPR#5
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#5
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.37
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-406
MV/PT	4
DATA MAX	191.9831
DATA MIN	-19282.7
ABS MIN	.1603376
ABS MAX	19282.7

LEGEND

EPR#5
SAMPLE: 825 750C FOR 200HRS
1MICRON FINISH
SOLUTION: 2M H2SO4 + .01M KSCN
6/24/93

[signature] 6/24/93

6/24/93 EPR#6

Sample: 825 HT# HH 4371FC
Heat treated at 750°C for 200 hours
1 micron finish
Same sample as EPR #3 page 83
l = .522 in W = .71 in AREA = 2.37 cm²

Solution: .5M H_2SO_4 + .01 M KSCN
27.9 ml 96% H_2SO_4 Lot# 925400
0.9725 g KSCN Lot# 924916
1000 ml of solution.
T = 60°C Hg Thermometer 0323008
Same as G108 page 70

Potentiostat: EG and G M173 62101 same as G108 page 70. Data saved as EPR#6 using M342C software.

Technique: Same as EPR#1A except used same sample as EPR#3. Did only 3 and 1μ polish.

Ecorr
I_R/I_A - N/A - No I_R peak found

Appearance: Gold collored film with dark and light spots.

Remarks: No obvious 2 current peaks needed for ERR so will try raising Molarity and SCN^- concentration.

Parameters and graph on page 90.

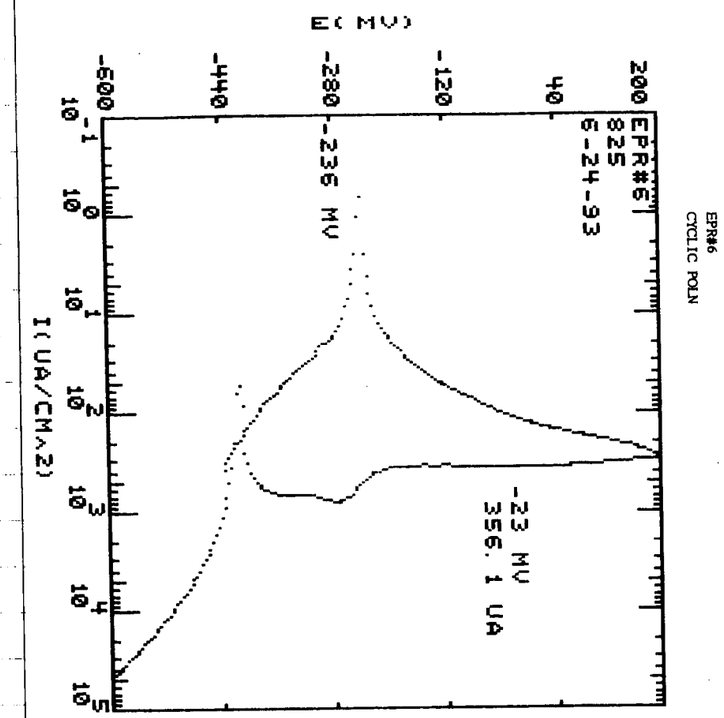
Reference: SCE Fisher 13-620-51 SN 3106337

Sample name 750°/200hrs #1

[signature] 11/30/94

6/24/93

EPR#6



EPR#6
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#6
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.37
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-441
MV/PT	4
DATA MAX	777.2152
DATA MIN	-48481.02
ABS MIN	.6835443
ABS MAX	48481.02

LEGEND

EPR#6
825 750C FOR 200HRS
1 MICRON FINISH
SOLUTION: .5M H2SO4 + .01M KSCN
60C
6/24/93

[signature] 6/24/93

6/25/93

EPR#7

Sample: 825 HT# HH4371FC
Heat treated at 750°C for 200 hours
1 Micron finish
l = .71 in w = .513 in Area: 2.35 cm²

Solution: 2.0M H_2SO_4 + 0.05 M KSCN
223.2 ml 96% H_2SO_4 Lot# 925400
9.7185g KSCN Lot# 924916
2000 ml of solution, about 600 ml used for experiment
T = 30°C Hg Thermometer 0323004
Calibrated 4 Feb 93 Next due 4 Feb 94

Potentiostat: EG and G M173 62101 same as G108 page 70
Data saved as EPR#7 using M342C software.

Reference: SCE Fisher 13-620-51 SN 3106337

Technique: Same as EPR#1A page 78.

E corr: -404 mV

I_e/I_a: N/A - No I_e peak

Appearance: No apparent attack on the surface of the sample.

Remarks: Will try same solution at 60°C.

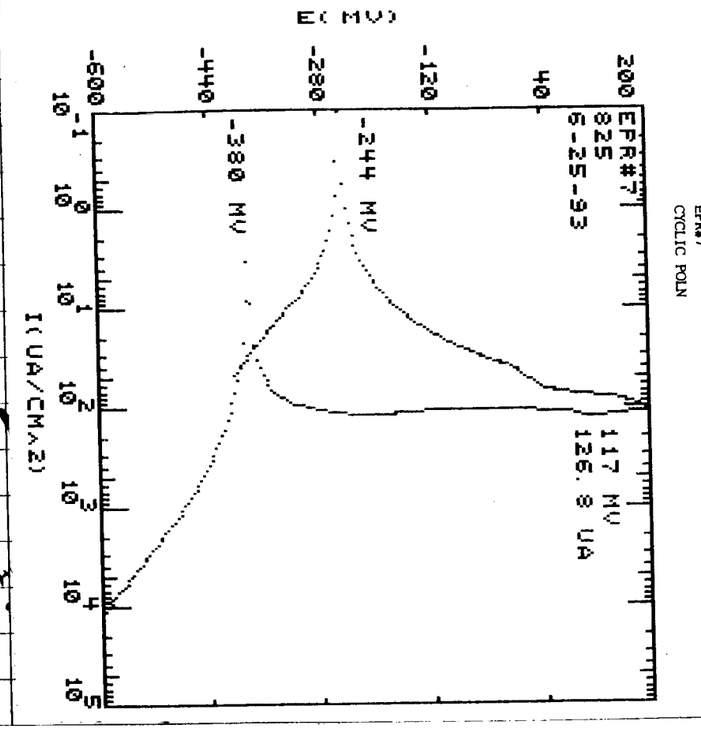
Graph and Parameters on page 92

Sample name 750°/200 hrs #2

[signature] 11/30/94

6/24/93

EPR#7



EPR#7
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#7
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.35
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-404
MV/PT	4
DATA MAX	126.8085
DATA MIN	-12085.11
ABS MIN	.106383
ABS MAX	12085.11

LEGEND

EPR#7
825 750C FOR 200HRS
1 MICRON FINISH
SOLUTION: 2M H2SO4 + .05M KSCN
6/25/93

[illegible] 6/25/93

[illegible]

6/25/93 EPR #8

Sample: 825 HT# HH 4371FC
Heat treated for 200 hours at ~~64~~ 750°C
1 micron finish
l = .71 in N = .513 in AREA = 2.35 cm²
SAME SAMPLE AS EPR#7

Solution: 2M H_2SO_4 + .05M KSCN
SAME AS EPR#7 page 91
T = 60°C Hg Thermometer 0323008 same as G108 page 70

Potentiostat: EG and G M173 ~~of~~ 62101 ~~same~~ same as G108 page 70. Data saved as EPR#8 using M342 software.

Reference: SCE Fisher 13-620-51 SN 3106337

Technique: SAME AS EPR#1A page 78 except only polished sample with 3 and 1μ diamond paste. A condenser tube was also used.

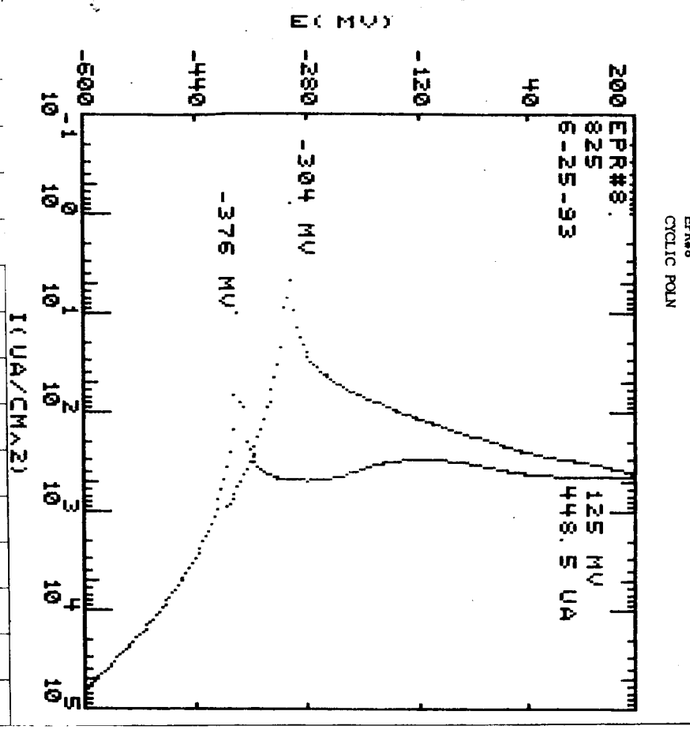
E_{corr} = -396 mV
I_R/I_a N/A no backwards peak
Appearance: no damage by corrosion

Remarks: will try a faster scan rate to have less passive film buildup.
Sample name 758/200 hrs #2
Parameters and graph on page 94.

[illegible] 11/25/94

6/25/93

EPR#8



LEGEND

EPR#8
825 HEAT TREATED @ 750C FOR 200HRS
1 MICRON FINISH
SOLUTION: 2M H2SO4 + .05M KSCN
TEMP: 60C
6/25/93

DATA SCALE

ECORR	-396
MV/PT	4
DATA MAX	487.2341
DATA MIN	-66382.98
ABS MIN	.7787234
ABS MAX	66382.98

SAMPLE PARAMETERS

AREA(CMS^2)	2.35
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#8
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

Paul E. Kelly Jr. 6/25/93

6/25/92 EPR#9

Sample: 825 HT# HH 4371 FC
Heat treated for 200 hours at 750°C
1 Micron finish
L: .7" W: .513" Area = 2.35cm²
Same sample as EPR#7

Solution: 2M H_2SO_4 + .05 M KSCN
Same solution that was used for EPR#8.
Reused old experiment fluid.
T = 60°C Hg Thermometer 0323008 same as G108 page 70

Potentiostat: EG and G M173 62101 same as G108 page 70.
Data saved as EPR#9 using M342C software.

Reference: SCE Fisher 13-620-51 SN 3106337

Technique: Reused same solution used for EPR#7 to save reagents and time. Did not repolish specimen for same reasons and because surface is not marred. All other parts of technique followed as per EPR#1A page 78.

E_{corr} = -381 mV

I_{crit} = NA no peaks

Appearance: Slight discoloration.

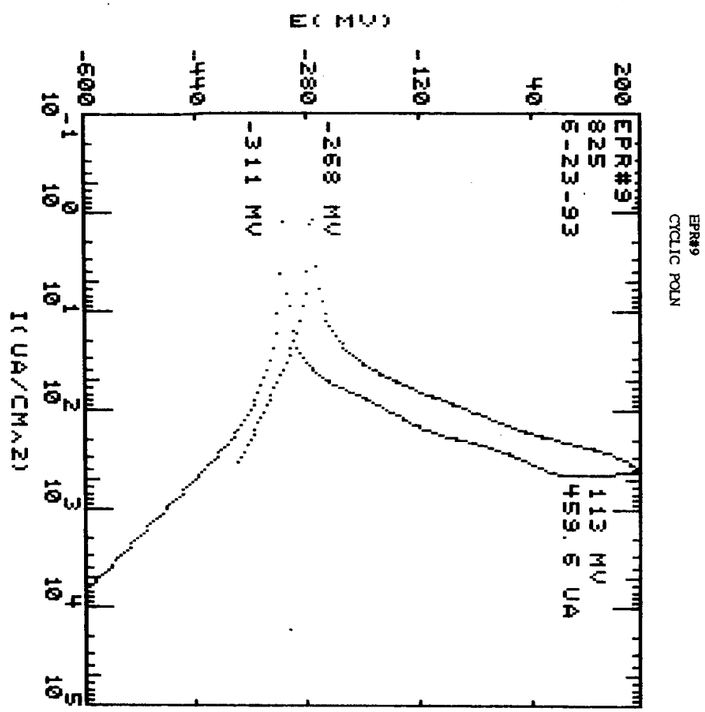
Remarks: Will try a longer depassivation time to see if passive is too thick.

Sample name 750°/200hrs #2

Graph and parameters on page 96.

N. Smith
11/20/94

6/25/93 EPR#9



EPR#9
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#9
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	5
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.35
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-381
MV/PT	4
DATA MAX	459.5745
DATA MIN	-6851.064
ABS MIN	1.217021
ABS MAX	6851.064

LEGEND

EPR#9
825 HEAT TREATED AT 750 FOR 200HRS
1 MICRON FINISH
SOLUTION: 2M H2SO4 + .05 KSCN
TEMP 60C
6/25/93

[signature] 6/25/93

6/25/93 EPR #10

Sample: 825 HT# HH N371FC
Heat treated for 200 hours at 750°C
finish unknown
l = .71 in W = .513 in Area = 2.35 cm²
Same sample as EPR#7

Solution: 2M H_2SO_4 + .05 M
Reused same solution from EPR#9 and EPR#8.
T = 60°C Hg thermometer 0323008 same as G/08 page 70

Potentiostat: EG and G M173 62101 same as G/08 page 70. Data saved as EPR#10 using M342C software

Reference: SCE Fisher 13-620-51 SN 3106337

Technique: Same as EPR#9 page 95.

Ecorr: - 403 mV

I_c/I_a N/A

Appearance: No apparent attack

Remarks: Solution appeared cloudy at beginning of test. Also cloudy after test. Will try slower scan rate to get some passivation.

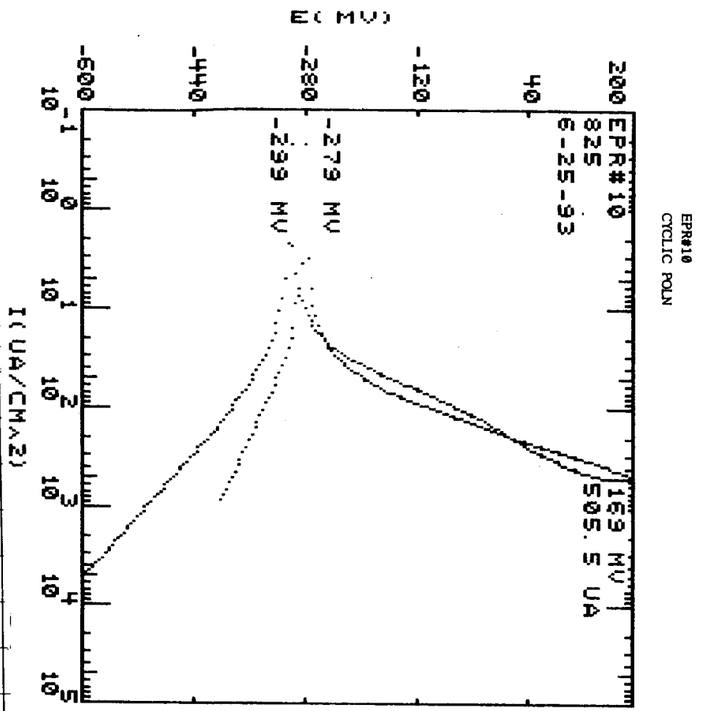
Note: longer time was used at cathodic potential - (15 minutes)

Sample name NS 11/30/94 6/25 750°/200hrs #2
Graph and parameters on page 8

[signature] 11/30/94

6/25/93

EPR#10



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#10
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	5
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	10
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.35
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-403
MV/PT	4
DATA MAX	533.6171
DATA MIN	-5123.404
ABS MIN	.2212766
ABS MAX	5123.404

LEGEND

EPR#10
825 HEAT TREATED AT 750 FOR 200HRS
1 MICRON FINISH
SOLUTION: 2M H2SO4 + .05M KSCN
TEMP 60C
6/25/93

Paul E. Kittle 6/25/93

6/25/93 EPR#11

Sample: 825 HT# HH4371FC
Heat treated for 200 hours at 750°C
Finish unknown.
l = .71 in W.513 in Area 2.35 cm²
Same sample as used in EPR#7

Solution: Reused same solution as EPR#10
1 : ~~30~~ 60°C Hg Thermometer 0323008 pk No 11/30/94
Same as G108 page 70

Potentiostat: EG&G M173 ~~same as G108~~ pk 6/25/93
62101 same as G108 page 70. Default pk 11/30/94
saved as EPR#11 using M342C software.

Reference: SCE Fisher 13-620-51 SN 306337

Technique: Same as EPR#9 page 95

E_{corr} = -387 mV

I_E/I_A N/A

Appearance: ~~No attack apparent.~~ pk 6/25/93 After taking sample out of cell it is apparent that there was attack and delamination.

Remarks: None of these techniques showed any evidence that they would be any use as EPR tests.

Note: faster scan rate was used.

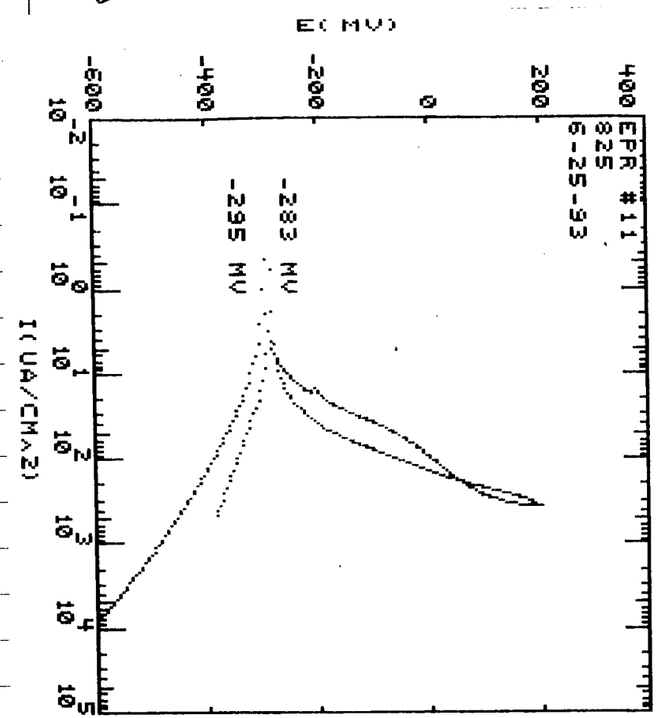
Graph and parameters on page 100

Sample Name 750°/200 hrs #2

Nicholas
11/30/94

EPR #11

6/25/93



LEGEND

EPR#11
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 2M H2SO4 + .05M KSCN
6/25/93

DATA SCALE

ECORR	-387
MV/PT	4
DATA MAX	364.2553
DATA MIN	-8297.873
ABS MIN	.4553192
ABS MAX	8297.873

SAMPLE PARAMETERS

AREA(CMS^2)	1.35
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#11
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.5
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	900
INIT DELAY(MV/S OR S)	PASS

Frank E. Kellogg 6/25/93

6/28/93 Procedure for Selective Pitting. (DSP)

It will be attempted to selectivly pitt Chromium and Molybdenum depleted zones, which will be most ~~typically~~ fk 6/28/93 typically the grain boundries in a sensitized material. If this does selectivly pit then a measure of the current may indicate the degree of sensitization.

To ~~Metalographicly~~ fk 6/28/93 see the surface of the sample and be able to indicate whether or not the pits show any order the surface must be polished to at least ~~1µ~~ fk 6/28/93 1µ finish. As few pits from polishing ~~should be~~ fk 6/28/93 as possible should be made. These could prove to be starting places instead of at depleted zones.

To polish the samples: First Mount in Epoxy and ~~tabet~~ fk 6/28/93 able. 3 samples were Mounted in a sample holder when dry. A Buehler Ecomet 3 was used in conjunction with a Automet 3 power head. The samples are first wet ground planar with 180 grit S:C paper. There was 7 pounds per sample, Complimentry Rotation, and the wheel speed is 120 RPM. This is followed by 320 grit at 120 RPM a 6 pounds per sample, ~~120~~ fk 6/28/93 ~~part~~ for 4 minutes 30 seconds with water.

6/28/93 Procedure for Sellective Pitting (PSP)
This is followed by 600 grit at 5 pounds per sample, 120 RPM, and complimentey rotation for 3 Minutes, Still using 600 grit and condradictey rotation use 4 pounds per sample at 120 RPM for 2 Minutes. Remove from holder

~~Remote~~ fk 6/28/93 To polish to 1μ or to reuse a specimen first take single specimen and ultrasonicly clean with detergent for 5 minutes. Hand polish with 3μ diamond paste and diamond extender untill all non 3μ scratches are gone. (Wheel speed: 150RPM) Ultrasonicly clean in degreasing detergent for 5 minutes. Rinse in D.I. water. ~~Dry~~ fk 6/28/93 Dry. Polish with 1μ diamond paste and extender with wheel speed at 150RPM. Polish until all scratches are gone. Polishing pitts should be avoided. Clean in degreasing detergent ultrasonicly for 5 minutes. Rinse in D.I. water. Rinse in Ethyl Alcohol. Dry.

A typical G-5 cell was used. For low temperature experiments a bridge is used filled with the test solution and a counter electrode in the cell. ~~At~~ fk 6/28 For highest temperature experiments a thermometer, ~~is inside the~~ fk 6/28/93 counter electrode, and salt bridge are used inside the cell. Temperature is controled by a water

6/28/93 (PSP) Procedure for Selective Pitting:
bath for low temperature experiments.

An EG&G M173 #62101, calibrated 19 May 1993 next due 19 May 1994, is used. M342C software controls ~~and~~ fk 6/28/93 the potentiostat (EG&G M173) and collects the data.

Joseph E. Kuhl Jr. 6/28/93

Note: that data graphed out comes out negative. Values are actualy positive.

Joseph E. Kuhl Jr. 6/28/93

N. Sridhar
11/30/94

6/28/93 EPR#12

Sample: 825 HT# HH-371FC
Heat treated at 750°C for 200hours.
1 Micron finish.

Solution: .5M NaCl
29.22 g NaCl Lot#
1000 ml of solution
T = 30°C Hg Therm 0323004 same
as EPR#7 page 91

Reference: SCE Fisher 13-620-51 SN 3106337

Sample l: .521 in w: .705 in Area = 2.37 cm²

Technique: Same as PSP on page ~~102~~ 6/28/93

~~E core:~~ 6/28/93

time: 30 Minutes

E = ~~60~~ 6/28/93 500 mV

Appearance: unchanged

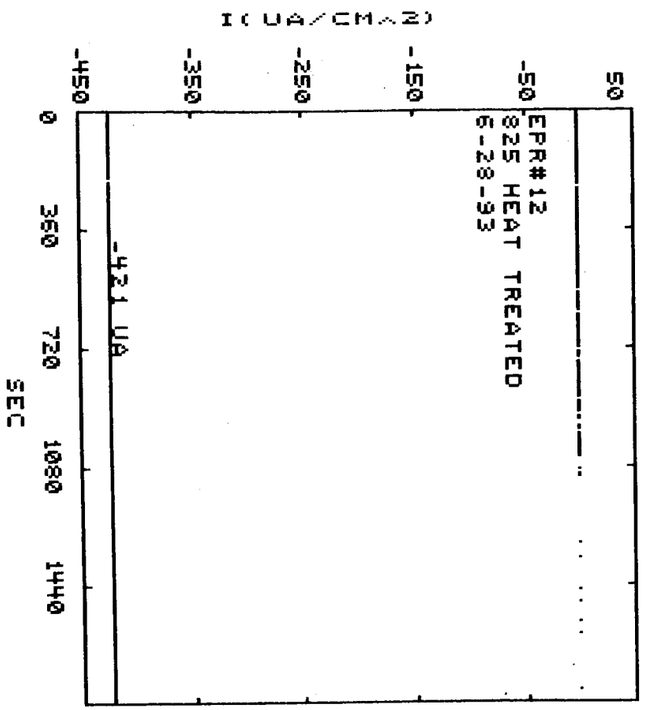
Remarks: possibly a bad connection.

Parameter and graph on page 105.

Data saved as EPR#12

Sample name 750°/200hrs #3

6/28/93 EPR#12



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#12
APPLIED E(MV)	500
I/E RANGE	1 A
SEC/PT	1
TOTAL SEC	1800
TOTAL PTS	1800

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	0
DATA MIN	-421.9409

LEGEND

EPR#12
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: .5M NACL
TEMP 30C
6/28/93

Frank E. Kahl Jr. 6/28/93

6/28/93 EPR #13

Sample : 825 HT# HHN371FC
Heat treated for 200 hours at 750°C.
1 Micron finish.
Same as sample for EPR #12.

Solution : 1M NaCl
58.22 g NaCl Lot#
1000 ml solution
T = 30°C Hg Therm ~~6/28/93~~ 6/28/93 0323C054
SAME AS EPR#7 PAGE 91

Reference : SCE Fisher 13-620-51 SN 3106337

Sample l = .705in w = .521in AREA = 2.37cm²

Technique : Same as PSP page 101

E = 500 mV

time = 30 min

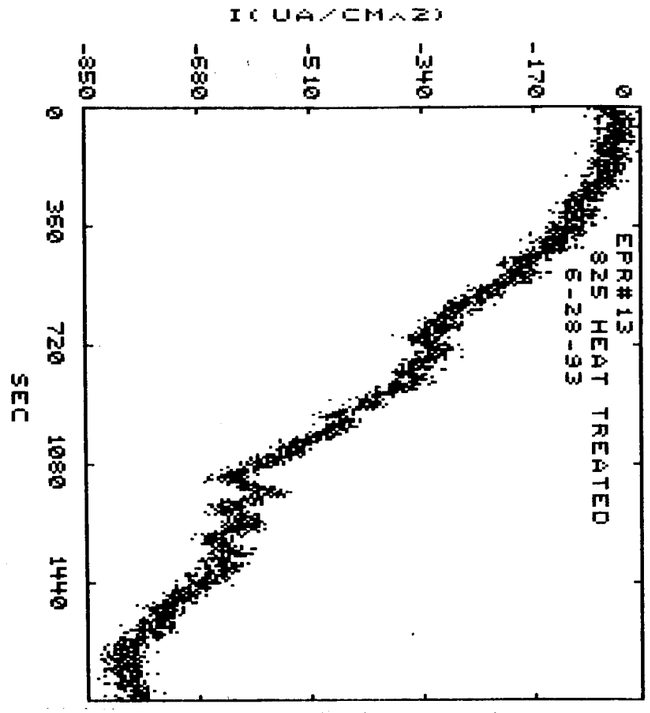
Appearance = NO apparent attack

Remarks : None

Parameters and graph on page 107.

Saved as EPR#13

Sample NAME 750°/200hrs #3



LEGEND

EPR#13
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 1M NACL
TEMP 30
6/28/93

DATA SCALE

DATA MAX	0
DATA MIN	-835.4431

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#13
APPLIED E(MV)	500
I/E RANGE	10 MA
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	3600

Frank E. Kalil Jr. 6/28/93

6/29/93 EPR#14

Sample: 825 HT# HH4371FC
Heat treated for 200 hours at 750°C
1 Micron finish
Same sample as EPR#12

~~So~~ fk 6/29/93 l = .705 in w = .521 in Area = 2.37 cm²

Solution: 2M NaCl
233.761 g NaCl lot# 926368A
2000 ml ~~D.I.~~ fk 6/28/93 solution
used as stock solution. Made on 6/28/93

Reference: SCE Fisher 13-620-51 SN0165415

Saved As: EPR#14

Technique: Same as PSP page 101

E = 450 mV

T = 30°C Hg Therm 0323004 same as EPR#7
page 91

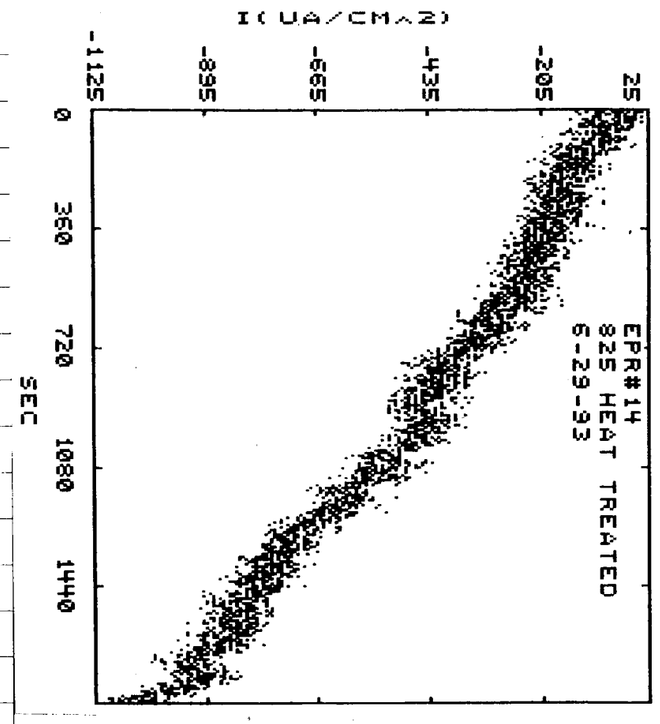
time = 30 minutes.

Appearance: looks like some small pitting.

Remarks ~~none~~ fk 6/29/93 Getting pitts from polishing.

Parameters and graph on page 109.

Sample name 750°/200 hrs #3



EPR#14
POTENTIOSTATIC

RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#14
APPLIED E(MV)	450
I/E RANGE	10 MA
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	3600

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	12.65823
DATA MIN	-1097.047

LEGEND

EPR#14
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 2M NACL
TEMP 30C
6/29/93

[signature] 6/29/93

6/29/93 EPR#15

Sample: 825 HT# HH 4371 FC
Heat treated for 200 hours at 750°C
1 micron finish
SAME AS sample EPR#12
l = .705 in w = .521 in Area = 2.37 cm²
Solution: 2M NaCl Same as ~~solut~~ [illegible] 6/28/93 stock
solution used for EPR#14 page 108
T = 30°C Hg Therm 0323004 same
as EPR#7 page 91
Reference SCE Fisher 13-620-57 SN0165415
Technique: SAME AS PSP page 101
Saved As: EPR#15
E = 600 mV
time = 30 min
Appearance: doesn't seem different. Some pitts.

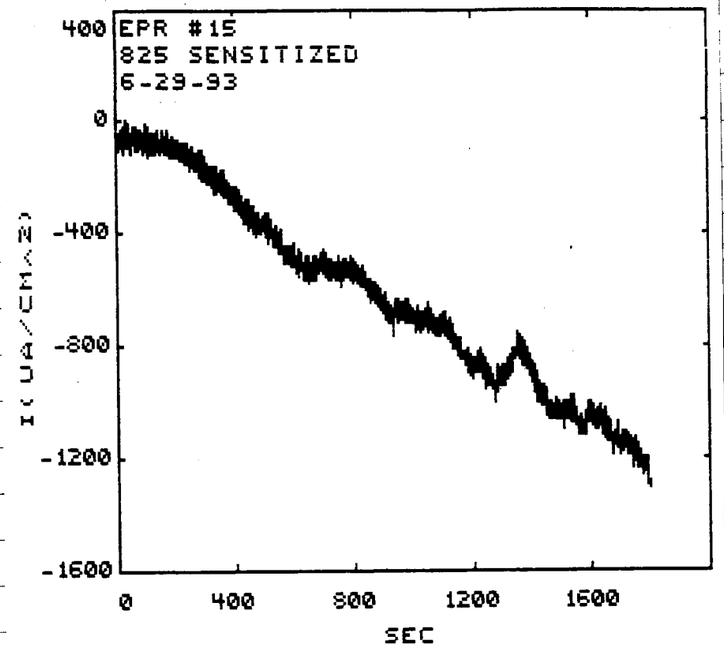
Remarks: ~~[illegible]~~ ~~Used Division~~ [illegible] 11/30/94 Getting pitts from machining only.

parameters and graph page 111

Sample Name 750°/200 hrs #3

N. [illegible]
11/30/94

6/29/93
EPR#15



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#15
APPLIED E(MV)	600
I/E RANGE	10 MA
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	3600

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	4.219409
DATA MIN	-1308.017

LEGEND

EPR#15
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 2M NACL
TEMP 30C
6/29/93

[illegible]
6/29/93

EPR #16
6/29/93

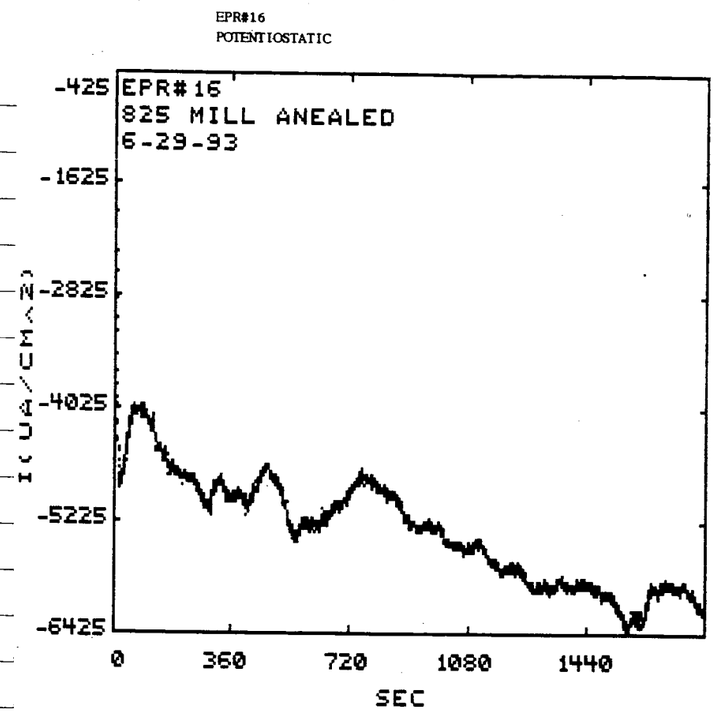
Sample: 825 HT# HH4371 FC
Mill Annealed
1 Micron finish
l = 25 in w = 521 in Area: 2.37 cm²
Solution: 2M NaCl
Same stock solution as EPR#14
page 108
T = 30°C Hg therm 0323004 same
as EPR#7 page 91
Reference SCE Fisher 13-620-51 SN 0165415
Technique: same as PSP page 101
Saved as: EPR#16
E = 600 mV
time = 30 min
Appearance: some pitts

Remarks: getting pitts from machining only.

Parameters and graph on page 113

Sample name Mill annealed #1

EPR#16
6/29/93



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#16
APPLIED E(MV)	600
I/E RANGE	10 MA
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	3600

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	-447.2574
DATA MIN	-6405.063

LEGEND

EPR#16
825 MILL ANEALED
SOLUTION: 2M NACL
30C
6/29/93

Frank E. Kelly Jr.
6/29/93

6/30/93 EPR#17

Tried a solution in hope it would show depletion with an EPR test.

Sample: 825 HT# HH4371FC
Heat treated at 750 for 200 hours
1 Micron finish
Same sample as EPR#12
ℓ = .705in W = .521in Area = 2.37cm²

Solution: 50% H_2SO_4 by weight + .01M KSCN
236 ml 96% H_2SO_4 Lot# 925400
.48617g KSCN Lot# 924916
400ml DI H_2O added
Solution made on 6/28/93
T = 30° Hg Therm 0323004 Same as EPR#7 page 91

Reference: SCE 13-620-51 SN 0165415

Technique: Same as EPR#1A page 78.
Except repolished sample from EPR#12 page 104.

Potentiostat: EG and G M173 62101 Same as G108 page 70. Data Saved as EPR#17.

E_{corr}: -326 mV

I_R/I_A = .105

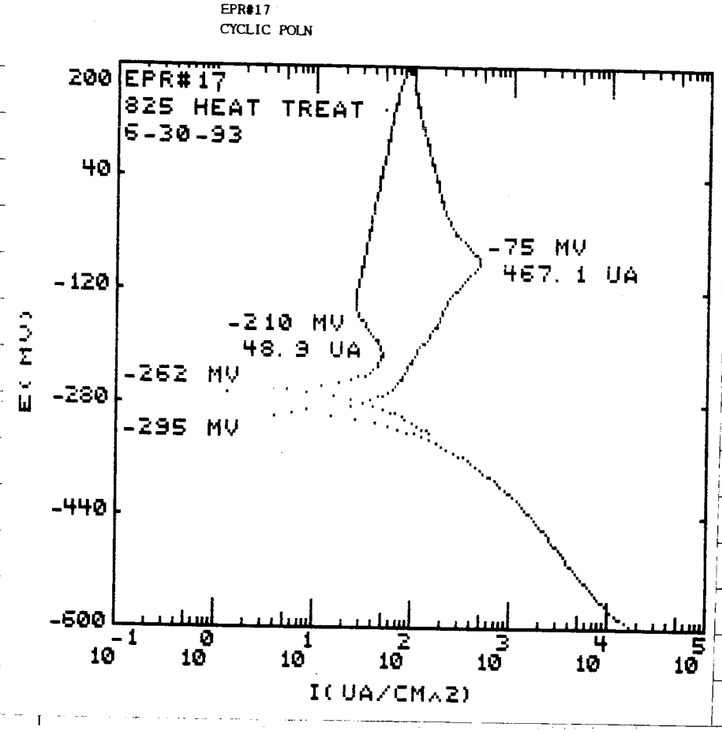
Appearance: No visible change

Remarks: There are 2 peaks.

Parameters and Graph on page 115

Sample name 750°/200hrs #3

6/30/93



LEGEND

EPR#17
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 50% H2SO4 + .01M KSCN
TEMP 30C
6/30/93

DATA SCALE

ECORR	-326
MV/PT	4
DATA MAX	467.0886
DATA MIN	-18438.82
ABS MIN	1.299578
ABS MAX	18438.82

SAMPLE PARAMETERS

AREA(CMS^2)	2.37
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#17
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

Fred S. Kittle Jr.
6/30/93

6/30/93 EPR#18

Sample: 825 ~~HT# [illegible] 6/30~~ HT# HHN371FC

Mill annealed

1 Micron finish

ℓ = .695 in W = .521 in Area = 2.34 cm²

Solution: Same solution; reused from EPR#17

T = ~~6/30~~ 30°C Hg Torch 0323004 same as EPR#7 page 91

Reference: SCE Fisher 13-620-51 ~~SN0165415 6/30~~ SN0165415

Potentiostat: EG and G M173 ~~063 6/30~~ 62101 same as 6/08 page 70. Data saved as EPR#18 using M342C software.

Technique: Same as EPR#1A page 78.

E_{corr}: -329 MV

I_R/I_a: N/A

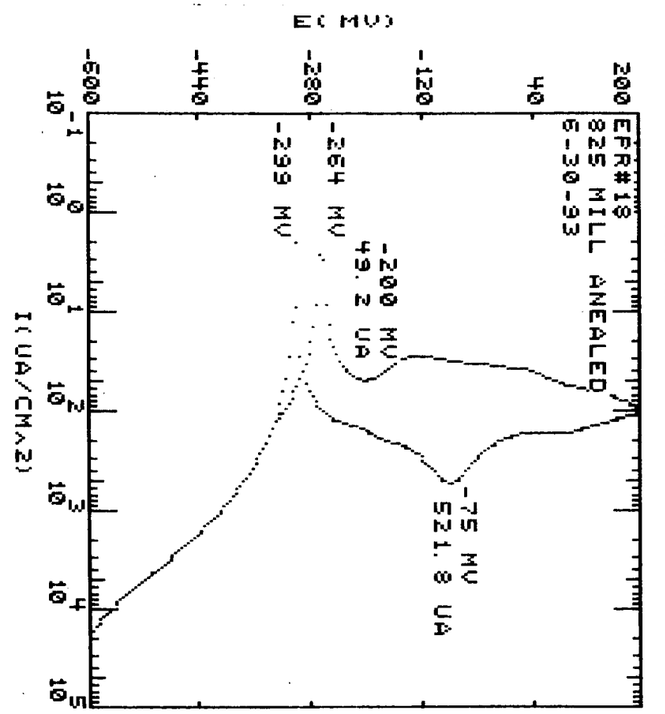
Appearance: unchanged.

Remarks: This also has two peaks the same current values. This shows this is not what we are looking for.

Parameters and graph on page 117.

Sample name Mill annealed #1

6/30/93 EPR#18



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	EPR#18
INITIAL E(MV)	-600 VS R
VERTEX E(MV)	200 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-600
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.34
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-329
MV/PT	4
DATA MAX	521.7949
DATA MIN	-18333.33
ABS MIN	2.000547
ABS MAX	18333.33

LEGEND

EPR#18
825 MILL ANEALED
SOLUTION: 50% BY WIEGHT H2SO4 + .01M KSCN (REUSED SOL FROM EPR#17)
TEMP 30C
6/30/93

Frank E. Huth Jr. 6/30/93

~~6/7/11~~ EPR#19

7/1/93 Sample: 825 HT# HH4371FC
Heat treated at 750°C for 200 hours
1 Micron finish
11/30/94
l = .725 W = .521 in Area: 2.37 cm²
Same sample as EPR#12
Solution: 2M NaCl from stock solution
EPR#14 page 108
Reference: SCE Fisher 13-620-51 SN 0165415
Technique: Same as PSP page 101
T = 60°C Hg Therm 0323008 same as
G108 page 70.
Saved as: EPR#19
E = 600 mV
time = ~800 sec
Appearance: severe pitts.

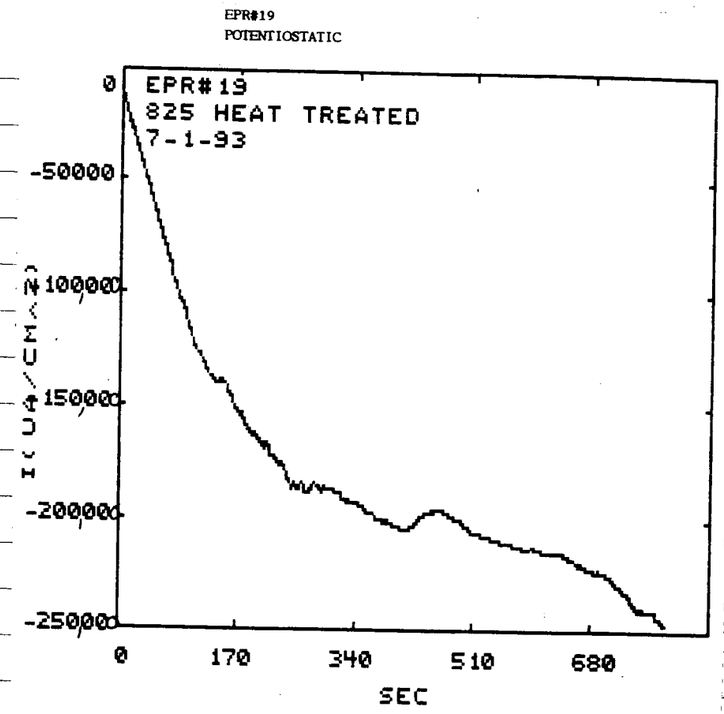
Remarks: This is probably too much voltage and temperature for these samples. Will try Mill Annealed to see if it has the same results

Parameters and graph on page 119.

Note did sample prep at division 6

Sample name 750°/200 hrs #3

EPR#19
7/1/93



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#19
APPLIED E(MV)	600
I/E RANGE	1 A
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	1574

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	0
DATA MIN	-247257.4

LEGEND

EPR#19
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 2M NACL
TEMP 60C
7/1/93

Frank E. Kelly Jr.
7/1/93

7/1/93 EPR#20

Sample: 825 HT# HH4371 FC
Mill Annealed
1 Micron finish
ℓ = .695 in W = .521 in Area = 2.34
Same sample as EPR#18 page 116

Solution: 2M NaCl solution, same stock solution as EPR#14 page 108
T = 60°C Hg Therm. 0323008
Same as 6108 page 70

Reference: SCE Fisher 13-620-57 SN0165415

Technique: Same as PSP pg 101

Saved as: EPR#20

E: 600mV

time = ~800 sec

Appearance: many pitts.

Remarks: This atmosphere is too severe.
will try lower temp and potential.

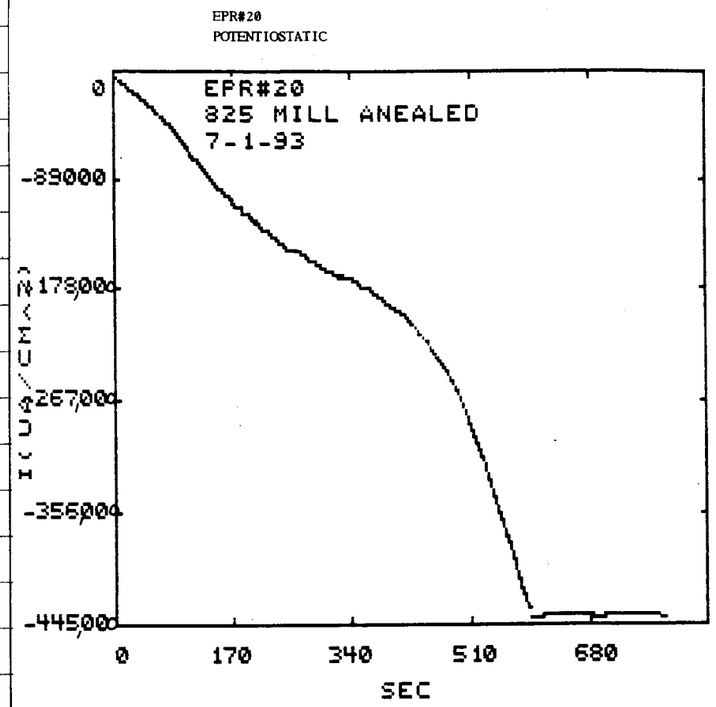
Parameters and Graph on page 121.

Note: did sample at division 6.

Sample name ~~750°F~~ PK 7/1/93 Mill Annealed #1

7/1/93

EPR#20



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#20
APPLIED E(MV)	600
I/E RANGE	1 A
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	1583

SAMPLE PARAMETERS

AREA(CMS^2)	2.34

DATA SCALE

DATA MAX	0
DATA MIN	-441025.7

LEGEND

EPR#20
825 MILL ANEALED
SOLUTION: 2M NACL
TEMP 60C
7/1/93

Frank E. Kruska
7/1/93

6 7/2 7/2/93 EPR#21

SAMPLE: P25 HT# HH4371FC
Heat treated for 200 hours at 750°C
1 Microfinish
SAME SAMPLE AS EPR#3
l = .71in W = .52in Area = 2.37

Solution: 2M NaCl ~~SAME~~ 7/2/93
232.88016g NaCl Lot# 926368A
2000 ml of solution
T = 45°C Hg Therm 0323004 SAME
AS EPR#7 page 91

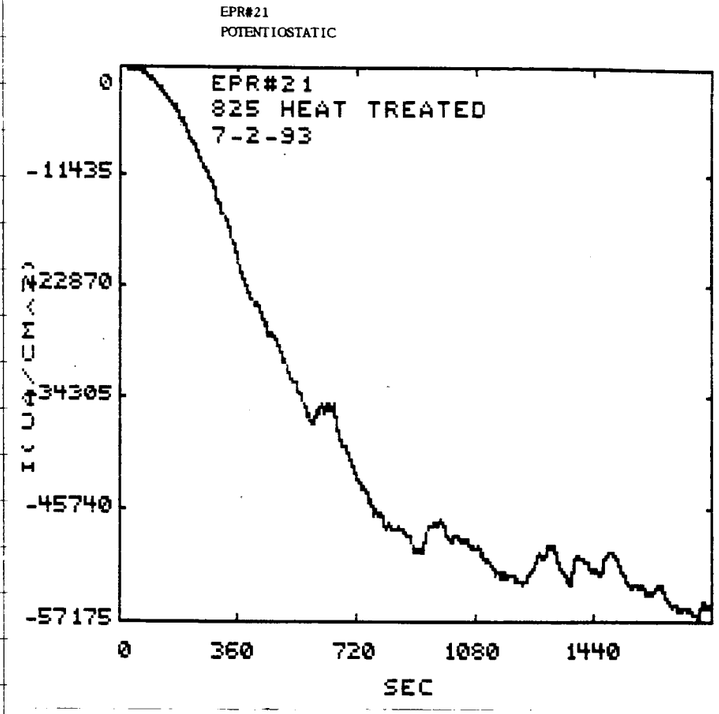
Reference: SCE Fisher 13-620-51 SN 0165435
Technique SAME AS PSP page 101
Saved As: EPR#21
E = 450 mV
t = 30 min
Appearance: Mostly crevice corrosion with some pitts like the last 2.

Remarks: will do cyclic polarization experiments to find Epitt.

Parameters and Graph on page 123.

Sample Name 750/200 #1

EPR#21
7/2/93



RUN PARAMETERS

TECHNIQUE	POTENTIOSTATIC
ORIGINAL NAME	EPR#21
APPLIED E(MV)	450
I/E RANGE	100 MA
SEC/PT	.5
TOTAL SEC	1800
TOTAL PTS	3600

SAMPLE PARAMETERS

AREA(CMS^2)	2.37

DATA SCALE

DATA MAX	0
DATA MIN	-57173

LEGEND

EPR#21
825 HEAT TREATED AT 750 FOR 200HRS
SOLUTION: 2M NACL
TEMP 45C
7/2/93

Fred E. Huff Jr
7/2/93

7/6/93 PROCEDURE to ~~Find~~ LK 7/6 Find Pitting Potential (PFPP)

The purpose of the following experiments is to find the pitting potential of sensitized 825. These pitting potentials will be used with similar data used for Mill ANNEALED 825 to find a suitble potential to selectivly pit sensitized zones in 825.

This test will be a cyclic polarization of alloy 825. It will start at Ecorr and go to a potential that supplies 5000 μA/cm². From this point it should return to Ecorr. This can be stopped once it reaches a current below the passivation current on the return of the cycle. The scan rate should be 0.17 mV/s.

The potentiostat that is used is an EG&G M173 #62101 calibrated 19 May 93 next due 19 May 94. The software used to control the potentiostat is M342C.

The cell used is a standard G-5 cell. For high temperature tests a ~~Mercury~~ thermometer ~~is used~~ LK 7/6, condensee tube, counter electrode and lugin salt bridge are used in the cell. For low temp tests condensee to be, counter electrode and sheet bridge are used in the cell. An Aerator tube is also used in both high and low temp cells.

7/6/93 PFPP continued.

The sample is not mounted. The sample is to have a 600 grit finish on at most 4 of the exposed sides and 1μ finish on at least 1 side of the sample. To obtain the 1μ finish start with 600 grit finish and ultrasonicly clean in degreasing detergent for 5 minutes. Rinse and dry. Polish with 3μ diamond paste. ~~Wash~~ LK 7/6/93 Ultrasonicly clean in degreasing detergent for 5 minutes. Rinse and dry. Polish with 1μ. Ultrasonicly clean in degreasing detergent for 5 minutes. Rinse thoroughly and dry.

~~Once temperature~~ LK 7/6/93 Assemble cell but do not immerse sample. Once desired temperature is reached time one hour of deaeration with Argon. After 1 hour immerse sample for 1 hour while deaerating. After 50 minutes immersion find and record platinum potential (Epot) and open circuit potential (Ecorr). When one hour immersion is over connect potentiostat leads to sample. A 60 second delay is used to verify cell measurements are correct.

When complete rinse sample off and ~~observe~~ LK 7/6/93 inspect for pitting or damage. Sample can be repolished to use again.

Frank E. Kelly Jr. 7/6/93

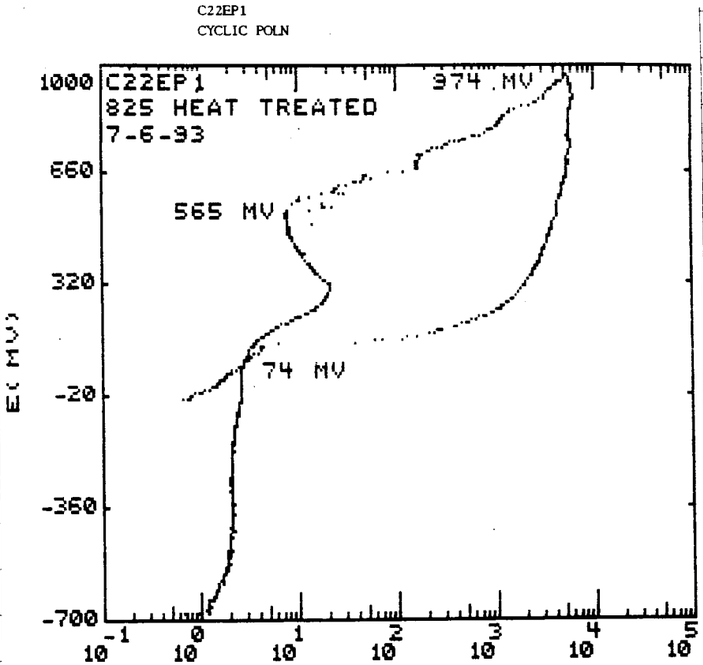
7/6/93 ~~C22EP1~~ ~~fpk 7/6/93~~ 825EP1

Sample: 825 HT# HH4371FC
Heat treated for 200hours at 750°C after solution annealed.
2 sides 1μ finish 3sides 600 grit.

Solution: 1000 ppm Cl^-, 85 ppm HCO_3^-; 20ppm SO_4^{2-};
10ppm NO_3^-, 2ppm F^-
1.6482g NaCl lot # 926368A
.1187 2g $NaHCO_3$ lot #897785
20ml SO_4^{2-} stock solution
10ml NO_3^- stock solution
2ml F^- stock solution
1000ml solution

T = 95°C Hg Therm 0323008 SAME AS G108 page 70.
Technique SAME AS PCPP page 124
Saved as: C22EP1
Reference: SCE Fisher 13-620-51 SN 0165415
E_{corr} = -600mV
E_{pa} = -470 mV
pH start = 8.0
pH end = 9.67

Appearance: pitted. Under microscope can see "necklace" pitting effect.
Remarks: I should have labeled as "825 EP1"
Parameters and Graph on page 127.
Sample NAME 750°/200 #2



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	C22EP1
INITIAL E(MV)	0 VS E
VERTEX E(MV)	100 VS E
FINAL E(MV)	50 VS E
SCAN RATE(MV/S)	.17
THRESHOLD I(UA/CM^2)	5000
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	60 S

SAMPLE PARAMETERS

AREA(CM^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-684
MV/PT	4
DATA MAX	6220
DATA MIN	.67
ABS MIN	.67
ABS MAX	6220

LEGEND

C22EP1
825 HEAT TREATED AT 750 FOR 200HRS
3 SIDES @ 600 2 SIDES @ 1 MICRON
SOLUTION: 1000PPM CL 85PPM HCO3
20PPM SO4 10PPM NO3 2PPM F
TEMP 95C
7/6/93

Frank E. Kalfayan 7/6/93

7/7/93 825 EP2

Sample 825 heat # HH ~~34~~ 4371FC

Heat treated at 750° for 200 hours

1 micron finish 1 side 600 grit 4 sides.

Same sample as EPR#12

Solution: 10,000 ppm Cl^-, 85 ppm HCO_3^-, 20 ppm SO_4^{2-}

10 ppm NO_3^-, 2 ppm F^-

16.48002 g NaCl Lot# 926368A

0.11848 g $NaHCO_3$ Lot# 897789

20 ml SO_4^{2-} stock solution

10 ml NO_3^- stock solution

2 ml F^- stock solution

T = 95°C Hg Therm 0323008 same as G108 page 70.

Technique: same as PFPP page 124

Reference: Fisher 13-620-51 S/N 0165415

Saved as 825EP2

E_{corr} ~~[illegible]~~ 7/7 -630 mV

E_{pe} = -460 mV

pH start = 8.012

pH end = 9.651

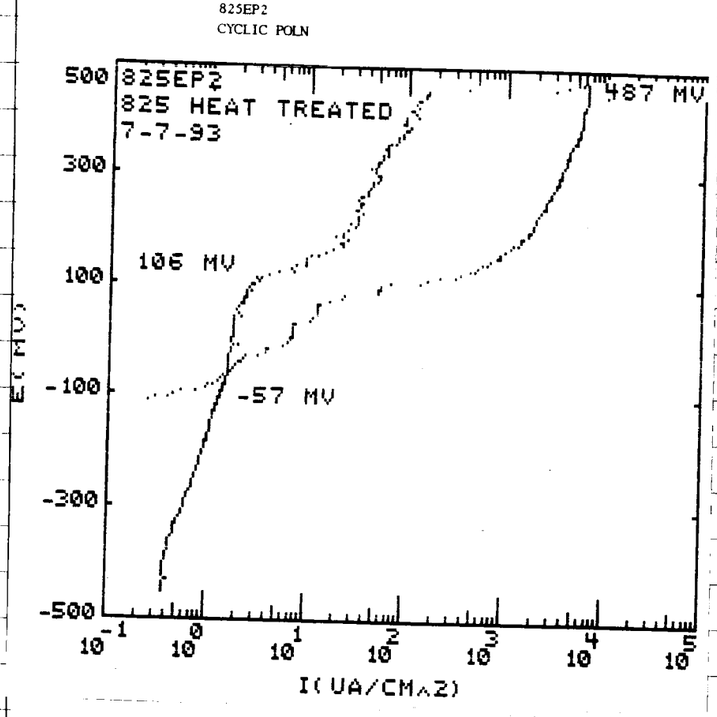
Sample name: 750°/200 #3

Appearance = pitting mostly occurred on edge of one unpolished side. Under microscope no signs of intergranular pitting on polished side, but looks like some on unpolished side.

Parameters and Graphs page 129.

825 EP2.

7/7/93



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825EP2
INITIAL E(MV)	0 VS E
VERTEX E(MV)	100 VS E
FINAL E(MV)	50 VS E
SCAN RATE(MV/S)	.17
THRESHOLD I(UA/CM^2)	5000
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	60 S

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-455
MV/PT	4
DATA MAX	6360
DATA MIN	-409.6
ABS MIN	.258
ABS MAX	6360

LEGEND

825EP2
825 HEAT TREATED AT 750 FOR 200HRS
4 SIDES AT 600 1 SIDE AT 1 MICRON
SOLUTION: 10000PPM CL 85PPM HCO3
20PPM SO4 10PPM NO3 2PPM F
TEMP 95C
7/7/93

[signature] 7/7/93

7/8/93 825 EP3

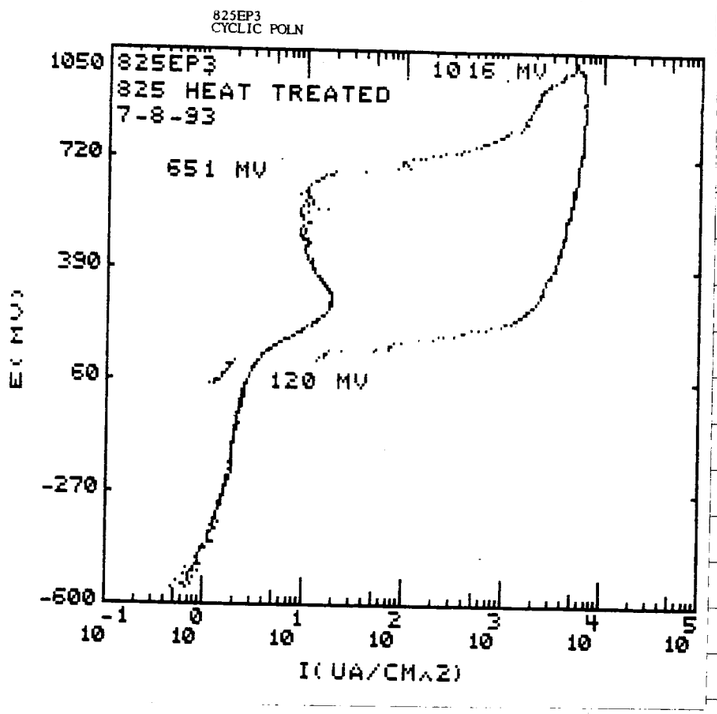
Sample 1 825 HT# HH4371FC
Heat treated at 750° for 15 hours
2 sides 1 Micron finish, 3600 grit
Sample 750°/15hrs #4

Solution: 1000 ppm Cl^- 85ppm HCO_3^- 20ppm SO_4^{2-}
10ppm NO_3^- 2ppm F^-
1.64828g ~~lot~~ 7/8 NaCl Lot# 926368A
0.11848g $NaHCO_3$ Lot #897789
20ml SO_4^{2-} stock solution
10ml NO_3^- stock solution
2ml F^- stock solution
1000 ml of solution
T = ~~950~~ 7/8/93 95°C Hg Therm 0323008
SAME AS G108 page 70.

Technique: SAME AS PFPP page 124
Reference: SCE Fisher ~~15-620~~ 7/8 13-620-51 SN 0165415
Saved as: 825EP3
Ecorr = -554
Ept - No seperate DMM available
~~Estart 8.06~~ 7/8 ~~8.125~~ 7/8
PH start: 8.125
pH end: 9,565
Appearance - pits. small pits visible with microscope.
smaller pits happen seemingly more often at grain boundries. This sample has smaller pits than 825EP3
Graph and parameters on page 131

825EP3

7/8/93



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825EP3
INITIAL E(MV)	0 VS E
VERTEX E(MV)	100 VS E
FINAL E(MV)	50 VS E
SCAN RATE(MV/S)	.17
THRESHOLD I(UA/CM^2)	5000
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	60 S

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-554
MV/PT	4
DATA MAX	6860
DATA MIN	.48
ABS MIN	.48
ABS MAX	6860

LEGEND

825EP3
825 HEAT TREATED AT 750 FOR 15 HRS
2 SIDES 1 MICRON 3 SIDES 600
SOLUTION: 1000PPM CL 85PPM HCO3
20PPM SO4 10PPM NO3 2PPM F
TEMP 95C
7/8/93

[signature] 7/8/93

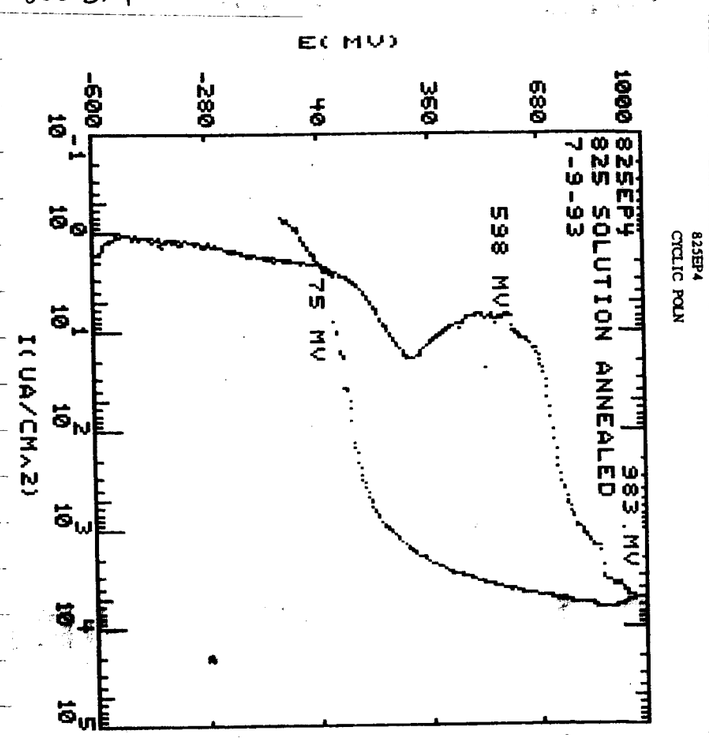
7/9/93 825 EP4

Sample: 825 HT # HH 4371 FC
Solution ANNEALED
2 sides 1 Micron Finish 3 sides 600 grit
Sample Solution annealed #2
Solution: 1000ppm Cl^- 85ppm HCO_3^- 20ppm SO_4^{2-}
10ppm NO_3^- 2ppm F^-
used the rests of 1000ml of
solution made for 825EP3 page 130.
Technique: Same as PFPP page 124
T = 95°C Hg Therm. 0323 008 same as G105 page 20
Reference: SCE Fisher 13-620-51 SN 0165415
Saved as: ~~825EP4~~ 7/9 825 EP4
E_{corr} = -587 mV
E_{pl} = No DMM to check with
pH start = 8.125
pH end: 9.600

Appearance: Pitted

Parameters and Graph on page 133

7/9/93 825 EP4



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825EP4
INITIAL E(MV)	0 VS E
VERTEX E(MV)	100 VS E
FINAL E(MV)	50 VS E
SCAN RATE(MV/S)	.17
THRESHOLD I(UA/CM^2)	5000
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	60 S

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-587
MV/PT	4
DATA MAX	6460
DATA MIN	-702
ABS MIN	-702
ABS MAX	6460

LEGEND

825EP4
825 SOLUTION ANNEALED
2 SIDES 1 MICRON 3 SIDES 600
SOLUTION: 1000PPM CL 85PPM HCO3
20PPM SO4 10PPM NO3 2PPM F
TEMP 95C
7/9/93

Robert E. Kelly Jr. 7/14/93

7/13/93

Procedure for Cyclic Polarization (PCP)

The objective of this section is to find an environment that a double loop technique will work for alloy 825. The first solution to be tried will be 50% H_2SO_4.

The test will be a cyclic polarization from a cathodic potential to a passivation potential and back to the E_{corr}. The scan rate should be 1.67 mV/s.

The potentiostat will be an EG & G M173 # 62101 calibrated 19 May 93 Next due 19 May 94. Software used is M342C. Data is saved under name indicated.

The cell used is a standard ~~with a~~ Pk 11/30/94 G-5 cell. For temperatures above 40°C platinized counter electrode and short ~~luggin~~ tube ~~is~~ Pk with reference electrode. For temperatures above 40°C platinum counter electrode, long luggin tube and Hg thermometer. For temperatures below 40°C the Hg thermometer is used in a water bath.

The sample is not mounted. At least one side is polished to 1μ all other exposed sides are

7/13/93 PCP

polished to 600 grit. When the sample is first used and ~~no sides have~~ Pk 11/30/94 one or more sides have not been polished the unpolished side or sides are brought to a 600 grit finish by starting with 240 grit and proceeding as follows: 320 grit, 400 grit, 600 grit. All are wet polishing. Those sides that are chosen for 1μ polishing first have all the edges on that side bevelled with 600 grit. The face is then polished with 3μ diamond paste using an 8" wheel with a Texmet or similar polishing cloth and diamond extender. When all non 3μ scratches are removed the sample is ultrasonicly cleaned for 5 minutes with detergent. This should be done before the 3μ step as well. Rinse, dry and polish with 1μ diamond paste in the same manner as the 3μ step. Continue until all scratches are removed. Ultrasonicly clean with detergent for 5 minutes, rinse and dry ~~out~~ hole for working electrode.

The solution should be ~~left~~ deaerated for 1 hour using a deaeration tube and typically Argon gas. This is done at the experiment temperature inside the cell. After the solution has deaerated lower the sample into the solution but leave enough above the solution to insure that solution does not interact

7/13/93 PCP

with the working electrode.

After the test is complete remove the sample for observation. Rinse and dry sample.

~~IA~~ FK 7/13/93 If a sample is used after a test all sides should be polished to the finish that they were before that test. This should be done just before reusing.

[signature] 7/13/93

N. Sridhar 11/30/94

7/13/93 825CP1

Sample: 825 HT# HH4371FC

Heat treated at 750°C for 200 hours

2 sides 1μ finish 3 sides 600

Solution: 50% H_2SO_4 by weight

236 g H_2SO_4 96% Lot# 925400

400 ml H_2O (18MΩ)

T = 30°C Hg Therm 0323004 same as EPR#7 page 91

Reference: SCE Fisher 13-62051 SN 0165415

Technique: same as PCP page 134

Saved as: 825CP1

Ecorr: -251 mV

Appearance: didn't take out of cell

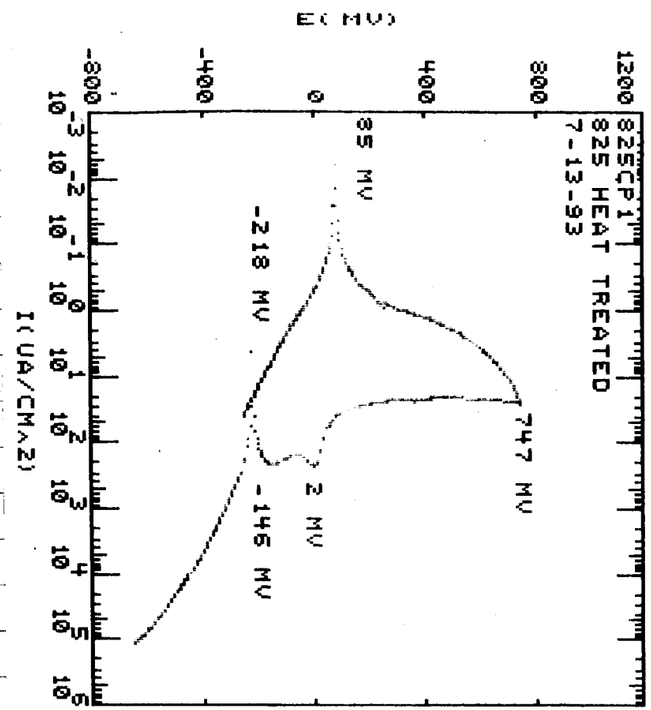
Remarks: current didn't go high enough, will try again.

Parameters and graph on page 138.

N. Sridhar 11/30/94

7/13/93

825CP1



825CP1
CYCLIC POLN

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP1
INITIAL E(MV)	-400 VS E
VERTEX E(MV)	1000 VS E
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	600
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-251
MV/PT	4
DATA MAX	222.6
DATA MIN	-120000
ABS MIN	.006
ABS MAX	120000

LEGEND

825CP1
825 HEAT TREATED AT 750 FOR 200HRS
2 SIDES 1 MICRON 3 SIDES 600
SOLUTION: 50% BY WEIGHT H2SO4
TEMP: 30C
7/13/93

[signature] 7/13/93

7/13/93 825CP2

Sample: 825 HT# HH4371FC
Same sample as 825CP3, Reused.
Solution: Reused 825CP1
T = 30°C Hg Therm 0323004 same as
EPR#7 page 91
Reference: SCE Fisher 13-620-51 SN 0165415
Technique: PCP page 134 except left sample in cell
~~Saved as~~ PK 7/13/93 from last experiment.
Saved as: 825CP2
Ecorr: -243mV

Appearance: No attack seen.

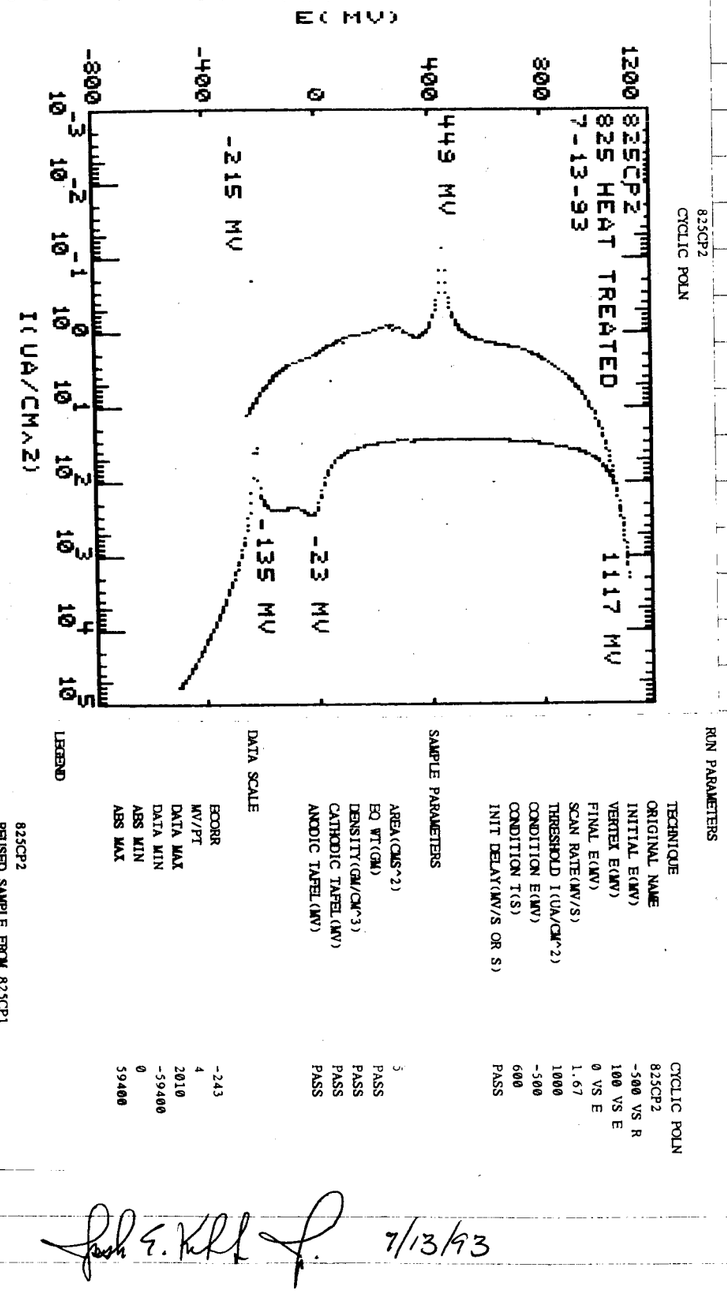
Remarks: will try 750 for 15 hours to see if there is a noticable difference.

Parameters and Graph on page 140

N. Sridhar
11/30/94

7/8/93

825CP2



Josh E. Kohl 7/13/93

7/13/93 825CP3

Sample: 825 HT # HH4371FC
Heat treated at 750°C for 15 hours.
2 sides at 1μ 3 sides at 600 grit.

Solution: Reused from 825CP1
T = 30°C Hg Therm 0323004 SAME AS
EPR #7 page 91 11/30/94

Reference: SCE Fisher ~~13-620-51~~ JK 7/13 13-620-51
SN 0165415

Technique: PCP page 134

Saved as: 825CP3

E corr :- 236

Appearance: No signs of attack

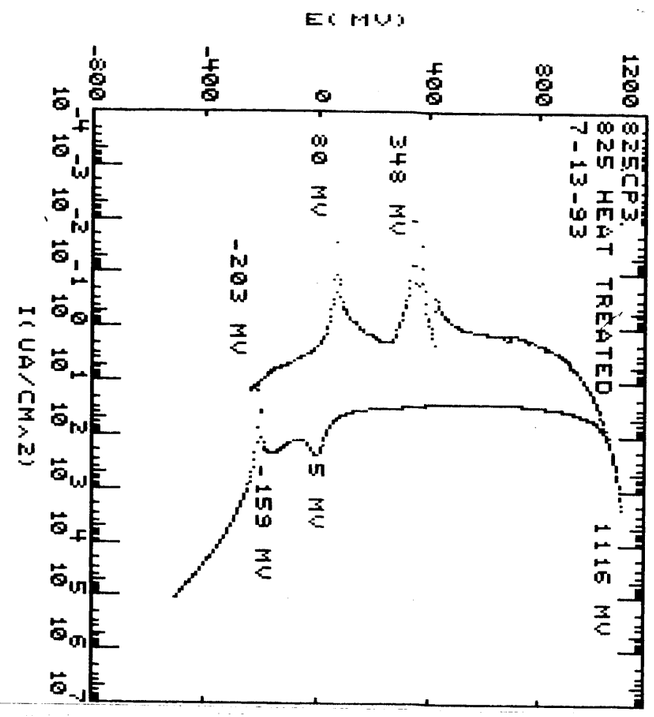
Remarks: Will try a higher temperature.

Graph and Parameters on page 142.

N. Sridhar 11/25/94

7/13/93

825CP3



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP3
INITIAL E(MV)	-500 VS R
VERTEX E(MV)	100 VS E
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	1000
CONDITION E(MV)	-500
CONDITION T(S)	600
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-236
MV/PT	4
DATA MAX	2046
DATA MIN	-109200
ABS MIN	0
ABS MAX	109200

LEGEND

825CP3
825 HEAT TREATED AT 750 FOR 15HRS
2 SIDES 1 MICRON 3 SIDES 600
SOLUTION SAME AS 825CP1
TEMP 30C
7/13/93

Karl E. Kuhl Jr. 7/13/93

7/14/93 825 CP4

Sample: 825 HT # HH #371FC
Heat treated at 750°C for 200 hrs.
2 sides 1μ 3 sides 600 grit

Solution: Reused from 825CP1
T = 100°C Hg Therm 0323008 SAME
AS 6/108 page 70.

Reference: SCE Fisher 13-620-51 SN0165415

Technique: PCP page 134

Saved as: 825CP4

E corr: -416

Appearance: looks like either the microstructure
or a cracked oxide layer on polished surface.

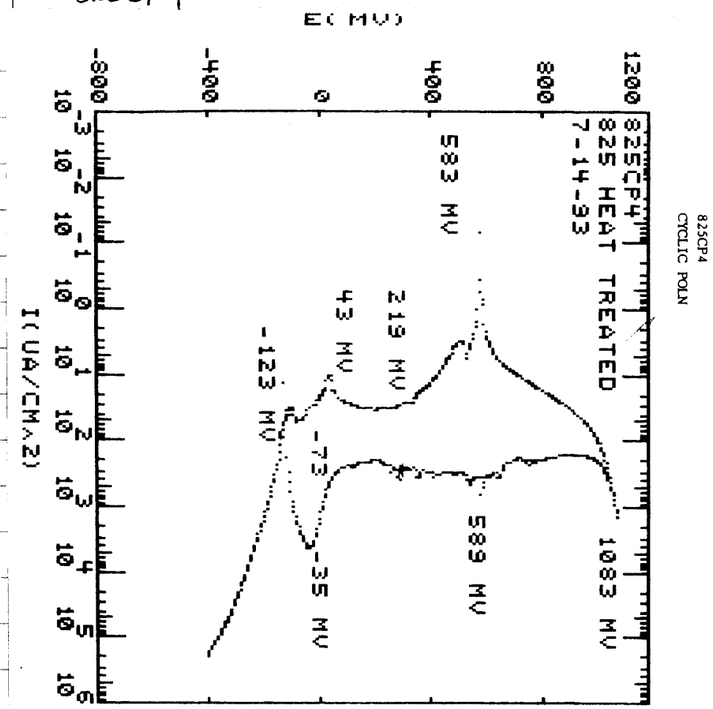
Remarks: will try double loop EPR test with H2
environment.

Graph and Parameters on page 144

N. Smith 11/20/94

7/14/93

825CP4



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP4
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS E
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	1000
CONDITION E(MV)	PASS
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-146
MV/PT	4
DATA MAX	4360
DATA MIN	-188200
ABS MIN	.07
ABS MAX	188200

LEGEND

825CP4
825 HEAT TREATED AT 750 FOR 200HRS
2 SIDES 1 MICRON 3 SIDES 600
SOLUTION: REUSED FROM 825CP1
TEMP 100C
7/14/93

Fred E. Kuchenhoff Jr. 7/14/93

7/14/93 825CP5

Sample: 825 AT# HH 4371FC
Heat treated at 750°C for 200hrs.
2 sides 1μ 3 sides 600 grit

Solution: Reused from 825CP1
T = 100°C Hy Therm 0323008 same
as 6/08 page 70.

Reference: SCE Fisher 13-620-51 SN 0165415

Technique: PCP page 134

Saved as: 825CP5

E_{CORR} = -175

Appearance: No change

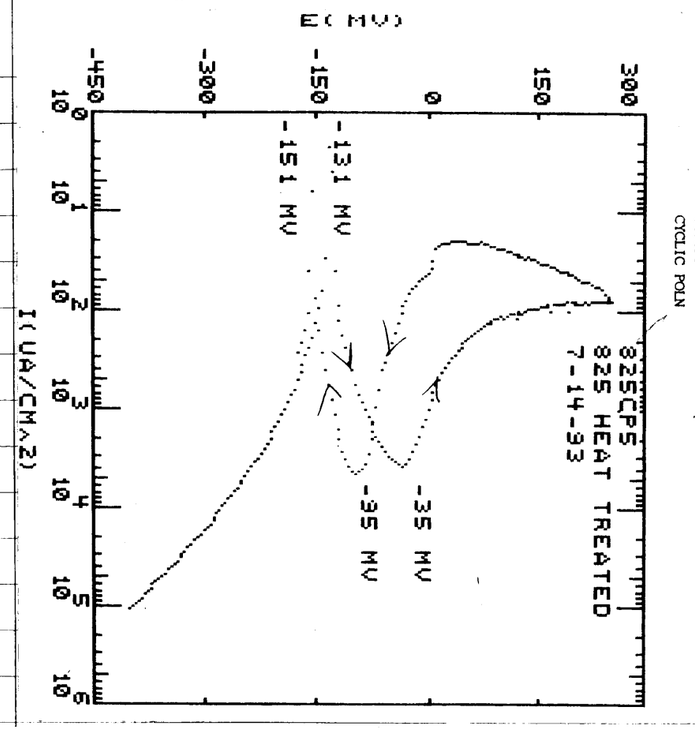
Remarks: will try all samples.

Parameters and Graph on page 146.

N. Smithers
11/30/94

7/14/93

825CP5



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP5
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-175
MV/PT	4
DATA MAX	4420
DATA MIN	-104800
ABS MIN	2.28
ABS MAX	104800

LEGEND

825CP5
825 HEAT TREATED AT 750 FOR 200HRS
2 SIDES 1 MICRON 3 SIDES 600 GRIT
REUSED SAME SOLUTION AS 825CP1
TEMP 100C
7/14/93

[signature] 7/14/93

7/14/93 825CP6

Sample: 825 HT# HH 4371FC
~~Heat treated~~ Pk 7/14/93 Solution Annealed
2 sides at 1μ 3 sides at 600 grit

Solution: Reused from 825CP1
Temp 100°C Hg Therm 0323008 same as
G/08 page 70

Reference: Fisher 13-620-51 SN 0165415

Technique: PCD page 134

Saved As: 825CP6

Ecorr = -1.78 mV

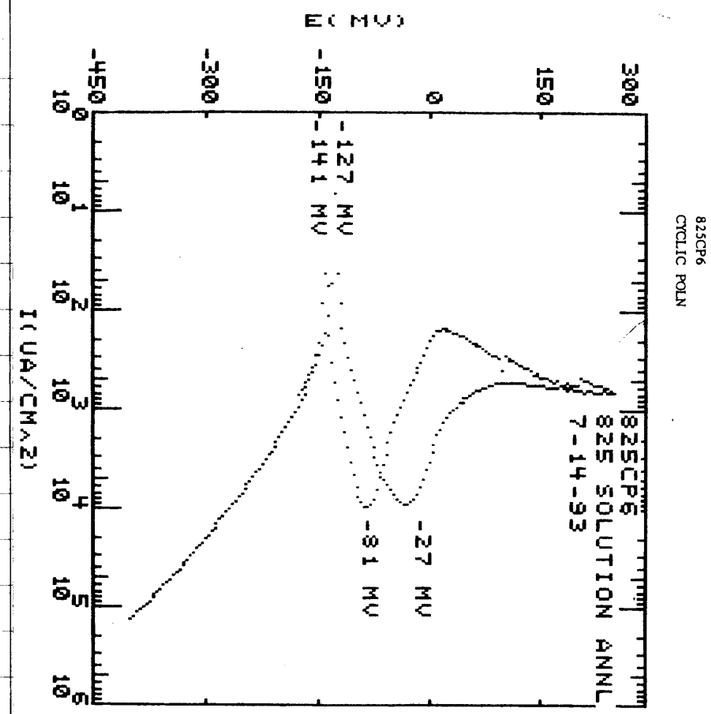
Appearance: No chance

Remarks: Curve has almost the same values.

Parametes and Graph on page 148.

N. Sridhar
11/30/94

7/14/93



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP6
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	2.5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-178
MV/PT	4
DATA MAX	9480
DATA MIN	-131600
ABS MIN	6.84
ABS MAX	131600

LEGEND

825CP6
825 SOLUTION ANNEALED
2 SIDES 1 MICRON 3 SIDES 600 GRIT
SOLUTION REUSED FROM 825CP1
TEMP 100C
7/14/93

[signature] 7/14/93

7/14/93 825 CP7

Sample: 825 ~~HT#~~ 7/14/93 HT# HH4371FC
Mill Annealed
2 sides 1μ 3 sides 600 grit

Solution: Reused from 825 CP1
T = 100°C Hg Therm 0323008 same as
6/08 page 70

Reference: Fisher 13-620-51 SN 0165415

Technique: PCP page 134

Saved as: 825 CP7

Ecorr: -176 mV

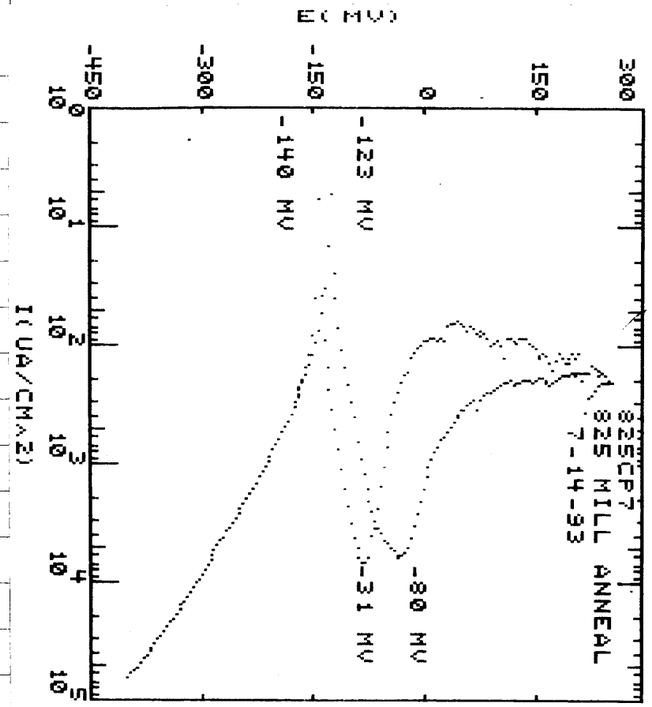
Appearance: No change

Remarks: All the ~~curves~~ 7/14/93 curves are the same

Parameters and graph on page ~~14~~ 7/14 150. 11/30/94

[signature] 4/20/94

7/14/93



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP7
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-176
MV/PT	4
DATA MAX	6800
DATA MIN	-64400
ABS MIN	5.26
ABS MAX	64400

LEGEND

825CP7
825 MILL ANNEALED
2 SIDES 1 MICRON 3 SIDES 6000 GRIT
REUSED SOLUTION FROM 825CP1
TEMP 100C
7/14/93

Paul E. Kyle Jr. 7/14/93

7/22/93 825CP8

~~825:~~ PK 7/22/93

Sample: 825 HTHH 4371 FC
Solution Annealed used as in previous tests but treated at 750°C for 15 hours. Will be known as CNRWRA#1 (Center for Nuclear Waste Regulatory Analysis Re Aged #1)
1 side 1μ 4 sides 600 grit

Solution: 50% H_2SO_4 by weight
236 ml 96% H_2SO_4 Lot # 925400
400 ml 18MΩ H_2O
Solution made 7/14/93

Reference: SCE Fisher ~~#5~~ PK 7/22/93 13-620-51 SN0165415

Technique: PCP page 134

Saved as: 825CP8

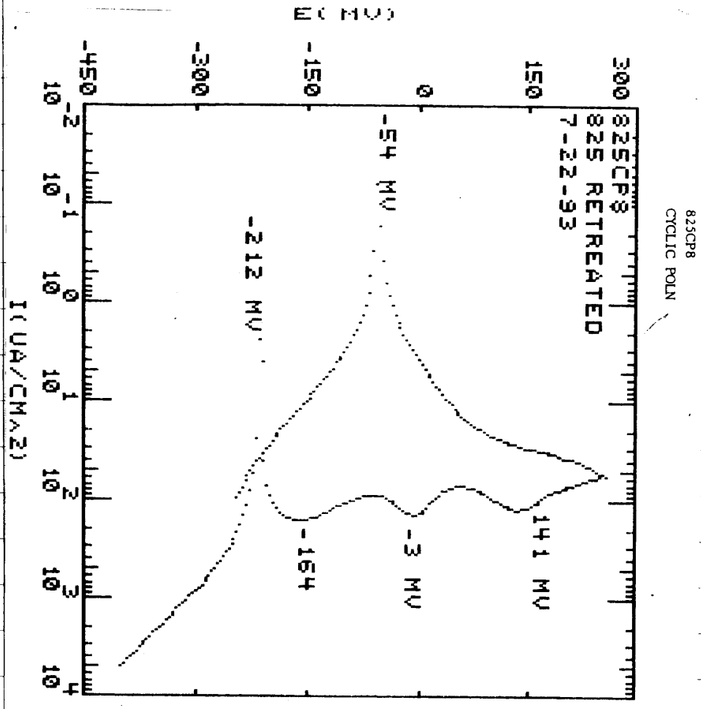
E_{CORR} = -246

Appearance: No change

Remarks: Will try higher temp. Previous samples had no precipitates.
Parameters and Graph on page 152

N. Eliaszadeh
12/1/94

7/22/93



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP8
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-246
MV/PT	4
DATA MAX	157.8
DATA MIN	-5120
ABS MIN	.062
ABS MAX	5120

LEGEND

825CP8
825 SA SAMPLE TREATED @ 750/15HRS
1 SIDE 1 MICRON 4 SIDES 600 GRIT
SOLUTION: 50 % H2SO4
TEMP 30C
7/22/93

7/22/93

7/23/93 825CP9

Sample: 825 HT # HH4391FC

~~CNRW-1K~~ 7/23/93

CNWRA#1

1 side ~3μ 4 sides 600 grit

Solution: 50% H_2SO_4 by weight

230 ml H_2SO_4 Lot # 925400

400 ml 18 MΩ H_2O

T = 100°C Hg Therm 0323008 same as G108 page 70.

Reference: SCE Fisher 13-620-51 SN 0165415

Technique: PCP page 134

Saved As: ~~825~~ 1K 7/23 825CP9

Ecorr: -153 mV

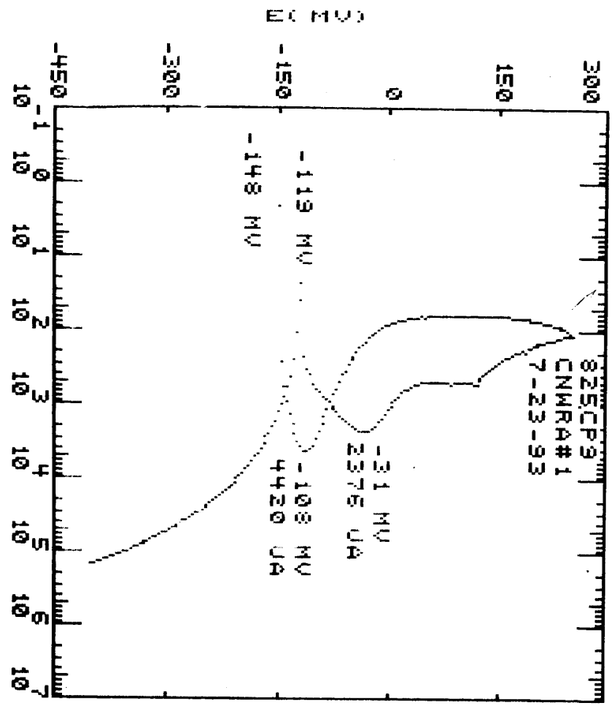
Appearance: No apparent corrosion

Remarks: Some attack.

Parameters and Graph on page 154.

7/23/93

825CP9



RUN PARAMETERS

	CYCLIC POLN
TECHNIQUE	825CP9
ORIGINAL NAME	-400 VS R
INITIAL E(MV)	250 VS R
VERTEX E(MV)	0 VS E
FINAL E(MV)	1.67
SCAN RATE(MV/S)	PASS
THRESHOLD I(UA/CM^2)	-400
CONDITION E(MV)	300
CONDITION T(S)	PASS
INIT DELAY(MV/S OR S)	

SAMPLE PARAMETERS

AREA(CMS^2)	)
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-153
MV/PT	4
DATA MAX	4420
DATA MIN	-152200
ABS MIN	2.2
ABS MAX	152200

LEGEND

825CP9
825 RETREATED SAME AS 825CP8
1 SIDE APROX 3 MICRON 4 SIDE 600
SOLUTION: 50% H2SO4 BY WEIGHT
TEMP 100
7/23/93

Jack E. Kuhl Jr. 7/23/93

7/23/93 825CP10

Sample: 825 HT# HA4371FC
CNWRA#1
1 side 1 Micron 4 sides 600 grit.

Solution: Reused from 825CP9, page 153. JS 12/1/94
T = 60°C Hg Therm 0323008 ~~page~~ JK 7/23
SAME AS 6108 page 70

Reference: SCE Fisher 13-620-51 SN 0165415

Technique: PCP page 134

Saved As: 825CP10

Ecorr: -195

Appearance: No corrosion apparent.

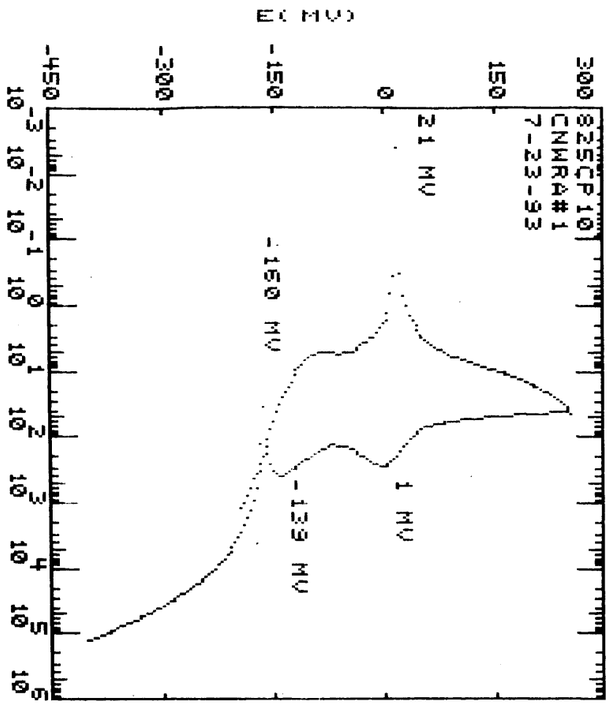
Remarks: will key lower conc. H_2SO_4.

Graph and parameters on page 156.

N. Sridhar
12/1/94

7/23/93

825CP10



RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP10
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-195
MV/PT	4
DATA MAX	384.8
DATA MIN	-129400
ABS MIN	.004
ABS MAX	129400

LEGEND

825CP10
CNWRA#1
1 SIDE 1 MICRON 4 SIDES 600 GRIT
SOLUTION: REUSED FROM 825CP9
TEMP 60C
7/23/93

Jack E. Kuhlman 7/23/93

7/26/93 825CP11

Sample: 825 HH #4371FC
CNWRA #1
1 side 1 micron 4 sides 600 grit

Solution: 20% H_2SO_4 by weight
108.5 ml 96% H_2SO_4 Lot# 925400
800 ml H_2O (18 MΩ)
~~T = 100°C~~ tk 7/26/93 97°C Hg Therm
032300S SAME AS G/108 page 70

Reference: SCE Fisher 13-620-51 SN/0165415
Technique: PCP page 134
Saved as: 825CP11
Ecorr: -216 mV

Appearance: Grain Boundaries visible.

Remarks: Will try sol. annealed.

Graph and parameters on page 158.

N. Finch
12/1/94

825CP11

7/26/93

Room saved for saved for parameters and graph for 825CP11. Printer won't come on line.

[signature] 7/26/93

RUN PARAMETERS

TECHNIQUE	CYCLIC POLN
ORIGINAL NAME	825CP11
INITIAL E(MV)	-400 VS R
VERTEX E(MV)	250 VS R
FINAL E(MV)	0 VS E
SCAN RATE(MV/S)	1.67
THRESHOLD I(UA/CM^2)	PASS
CONDITION E(MV)	-400
CONDITION T(S)	300
INIT DELAY(MV/S OR S)	PASS

SAMPLE PARAMETERS

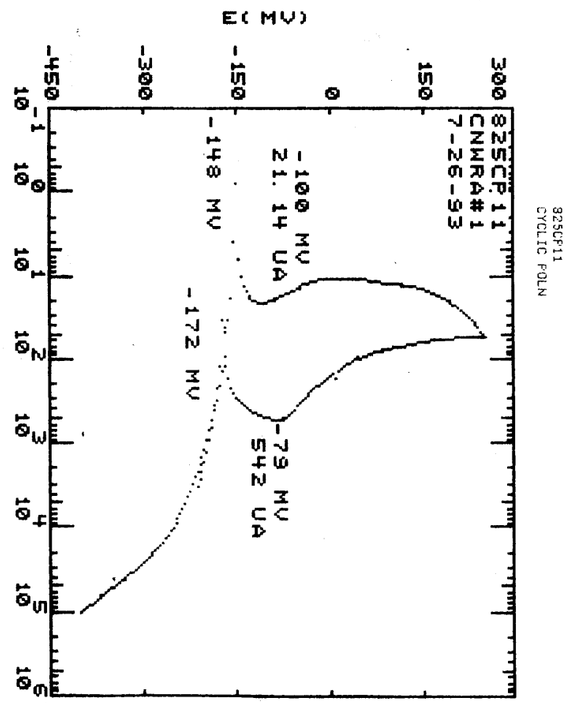
AREA(CMS^2)	5
EQ WT(GM)	PASS
DENSITY(GM/CM^3)	PASS
CATHODIC TAFEL(MV)	PASS
ANODIC TAFEL(MV)	PASS

DATA SCALE

ECORR	-216
MV/PT	4
DATA MAX	542
DATA MIN	-104400
ABS MIN	.82
ABS MAX	104400

LEGEND

825CP11
CNWRA#1
1 SIDE 1 MICRON 4 SIDES 600 GRIT
SOLUTION: 20% H2SO4 BY WEIGHT
TEMP 100C
7/26/93



[signature] 7/26/93

7/26/93 825CP12

Sample: 825 HT# HH 4371FC
: Solution Annealed
1 side 1 micron 4 sides 600 grit

Solution: Reused from 825CP11 page 157.
T = ~~40~~ 7/26/93 97°C Hg Therm
0323008 same as G/08 page 70

Reference: SCE Fisher 13-620-51 SN 0165415

Technique: PCP page 134

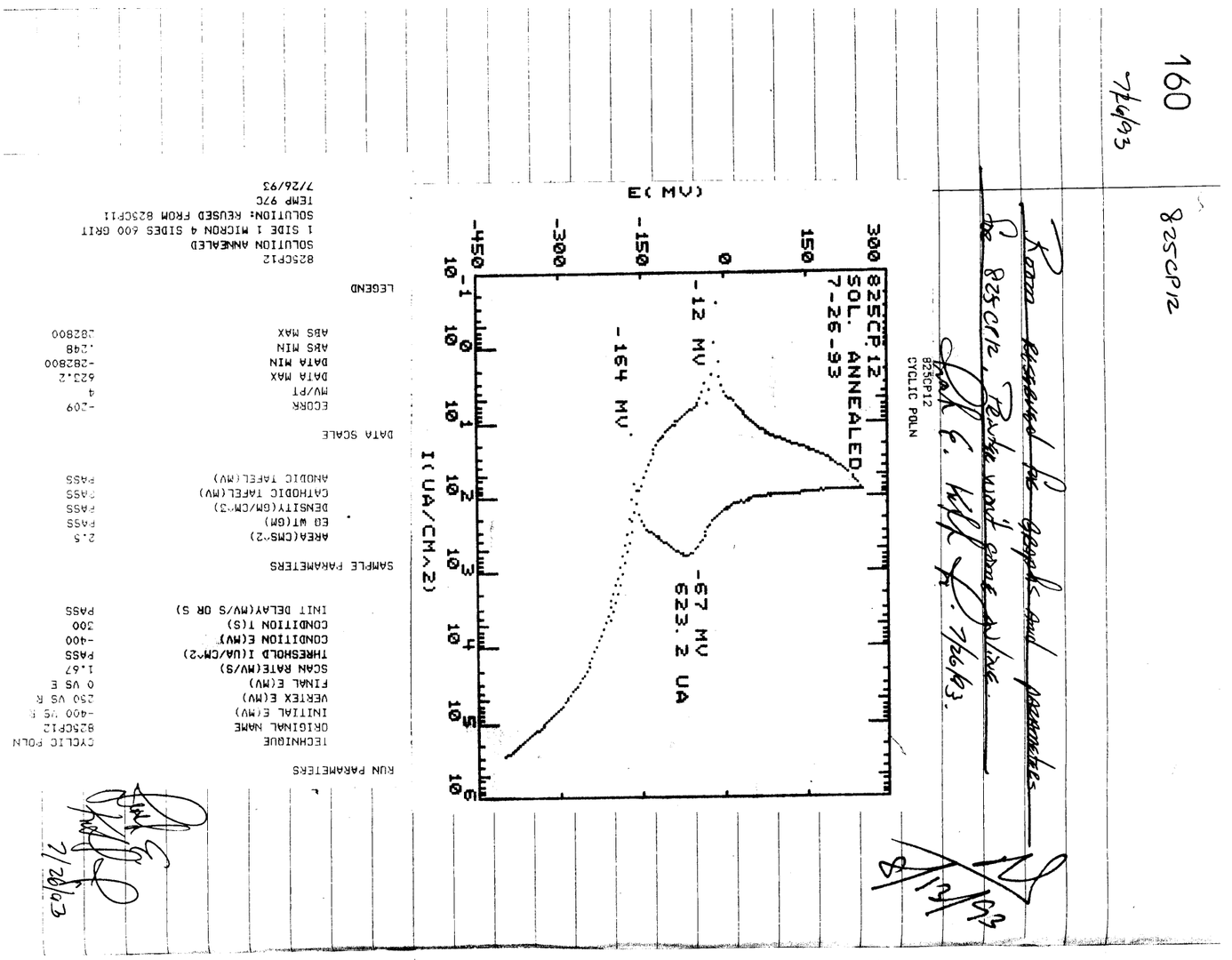
Saved As: 825CP12

Ecorr: -209 mV

Appearance: No attack.

Graph and parameters on page 160.

N. [signature]
12/1/94



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 qualifiied individual could repeat the activity.

N. Sridhar

EM, EBS 1/10/97

1/10/97

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK #: 032

Document Date:	11/30/1994
Availability:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, Texas 78228
Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
Data Sensitivity:	■"Non-Sensitive" □ Sensitive □"Non-Sensitive - Copyright" □ Sensitive - Copyright
Date Generated:	06/26/1993
Operating System: (including version number)	Windows
Application Used: (including version number)	NA
Media Type: (CDs, 3 1/2, 5 1/4 disks, etc.)	2 - 3 ½ disks
File Types: (.exe, .bat, .zip, etc.)	.d; .t
Remarks: (computer runs, etc.)	Media contains: Experiments G108, p. 70 to 825CP12 p. 159.