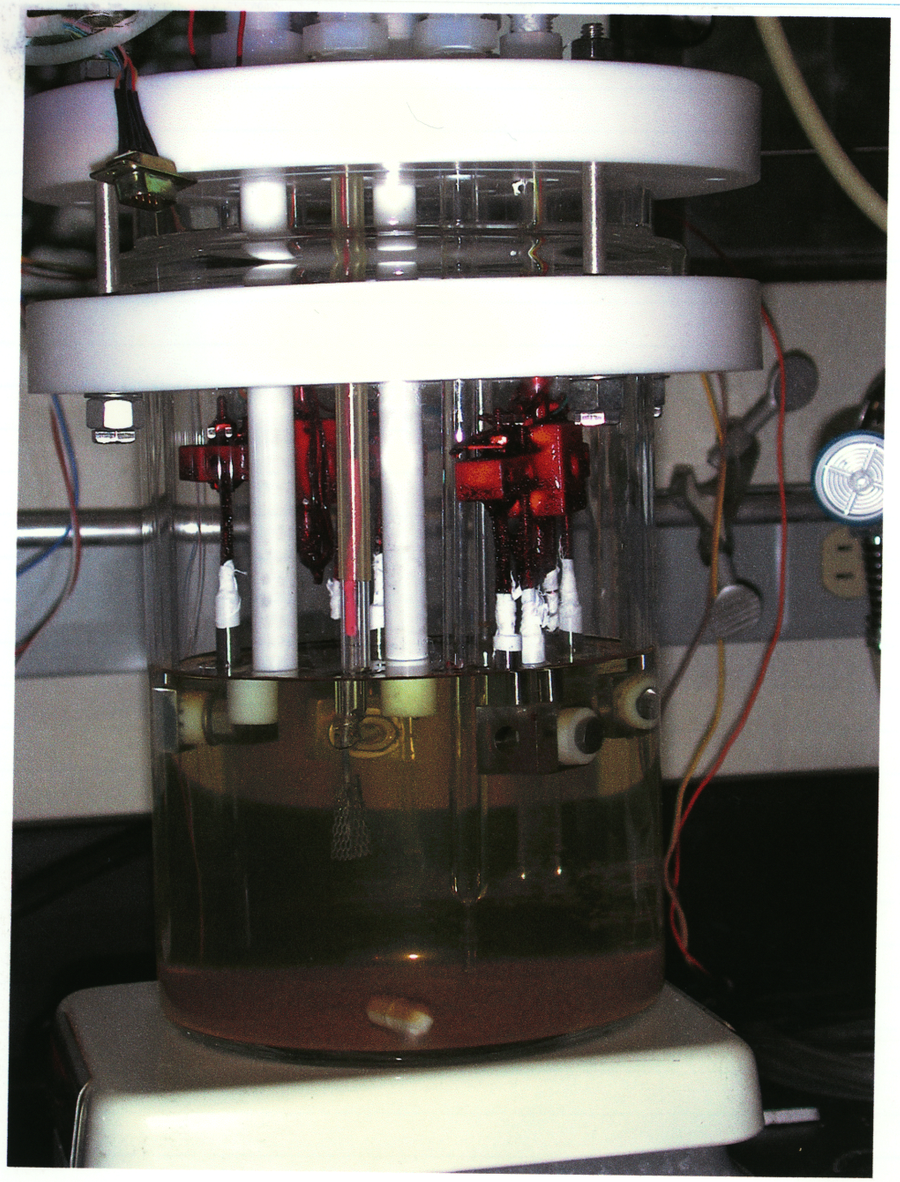
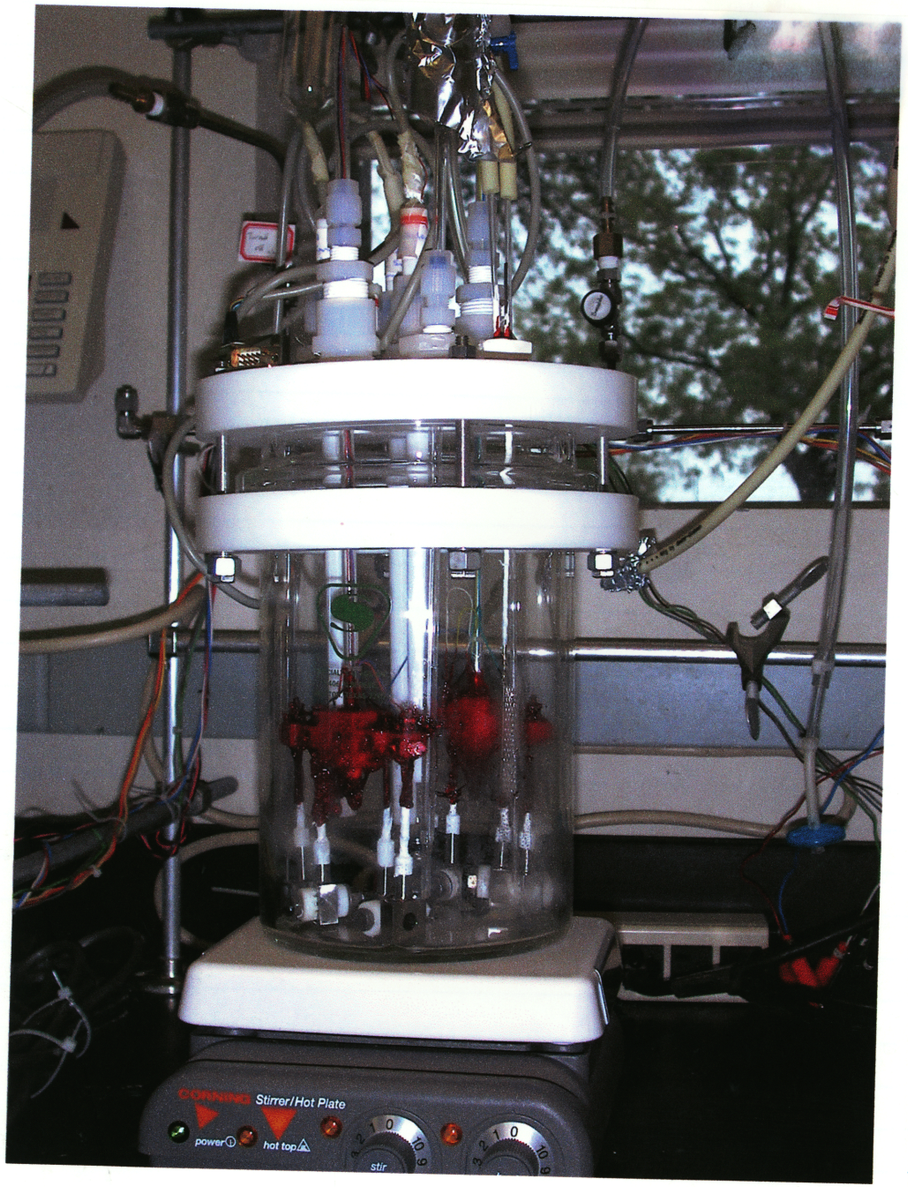


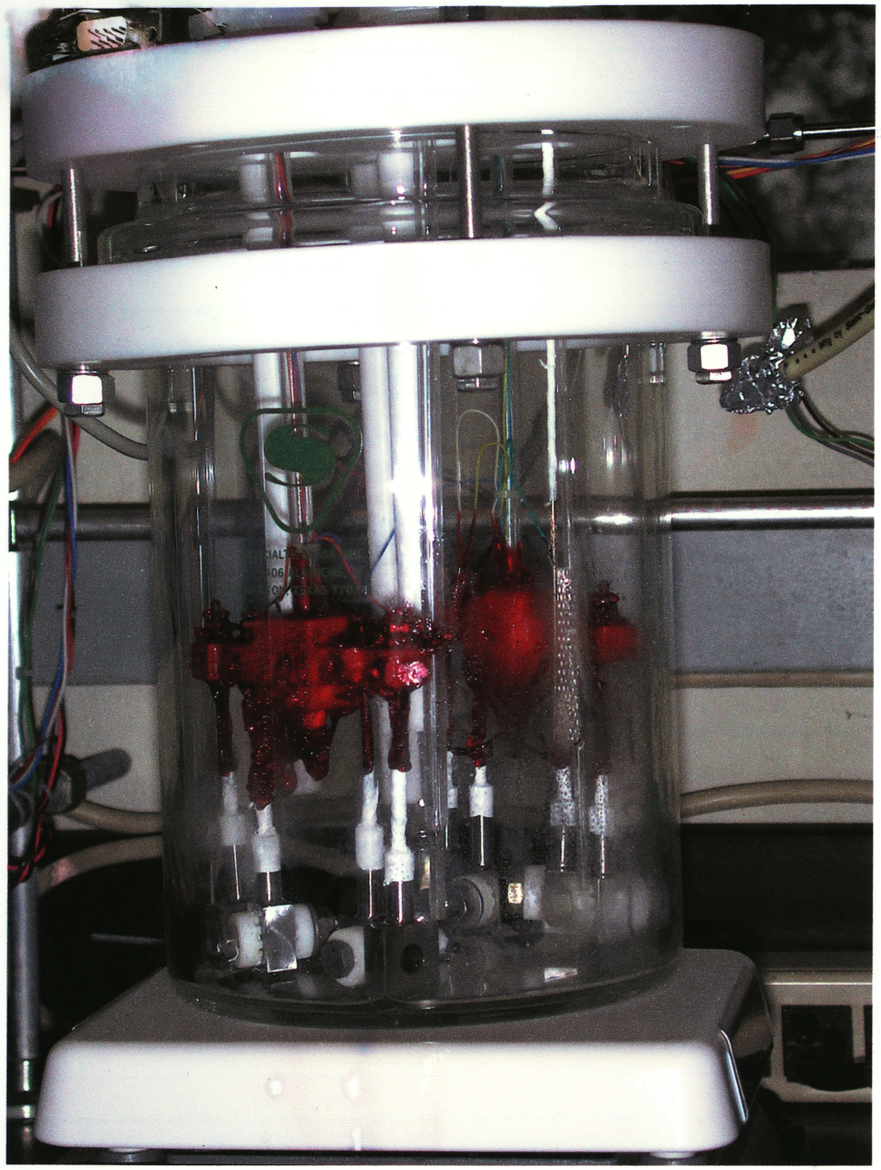
Close-up of Pseudomonas cell taken on 4.26.04

Reyjuno
4.26.04



Picture of Consortium cell before initial Gill taken on 4.21.04

Reyjuno
4.26.04



Closeup of the Consortia cell on 4.21.04

Roger T Dybas
4-26-04

4.30.04 Cell A (Consortia)
1215 clear
Cell B (Pseudomonas)
clear
Cell C
SRB & Slime clear

5.2.04 Pseudomonas cell has a fungus growing in it.

1300 Inoculated cells A & C - with aerobic organisms.

5.5.04 Redid Pseudomonas cell.

5-6-04. Using aseptic technique withdraw
2:20 p.m. approximately 10 ml. solution from vessels A & C.
(PB). (Stir bars activated prior to manipulation)
Solution. Culture each sample for
recovery of organisms. Inoculate vessel
A and vessel C with approximately
20 ml SRB. Stir bars turned off.

5.7.04 Cell C 0930
C22 yellow -0.3257 plt slag -0.1601
gray -0.3408
Blue -0.3646
purple -0.3666

SS316 orange -0.3663
purple -0.3780
SS304 blue -0.3540
black -0.3911

Roger T Dybas
5/11/04

5.7.04 Cell A 0915

C22

black	-0.3084	pltn Stg	-0.2655
red	-0.2759		
orange	-0.2881		
purple	-0.3008		

316 : C22

white	-0.2796
yellow	-0.2776
blue	-0.2787
green	-0.2900

5/10/04 12:00 GMT. Both cells A & C with SRB are emitting very distinctive odor. From each vessel approx. 10 ml solution is harvested aseptically. Samples are tested for sulfide, pH and turbidity using Klett spectrophotometer. Ps. halophilaktis and Ps stutzeri are inoculated into vessel B, which is clear today. Approximately 20 ml of each organism is added using aseptic technique.

1432 Started the multi-way system with the set-up of before.

040704-5, C22 2702	I-1	cell A	C22	probe	1KΩ
040704-6, C22 2702	I-2	cell A	C22	probe	1KΩ
040704-2, 316 C22	I-3	cell A	316	probe	1KΩ
040704-3, 1212	I-4	cell B	C22	probe	1 to 10KΩ
040704-1, 316SS	II-1	cell B	316	probe	1 to 10KΩ
040704-4, C22 / 1212	II-2	cell C	C22	probe	1KΩ

Computer File Name: 5_10_4.txt. Report Date 5/11/04

5.10.04

Cells were moved from upstairs lab to lab 113 under the vent hood.

5.11.04 0820

C22 cell A

black	-0.4350	pltn Stg	-0.4328
red	-0.4318		
orange	-0.4333		
purple	-0.4325		

316 : C22

white	-0.4332
yellow	-0.4342
blue	-0.4326
green	-0.4311

C22 cell B

brown	-0.0504	pltn Stg	-0.0552
orange	-0.0470		
white	-0.0556		

316

yellow	-0.1035
red	-0.1070
white	-0.0640

C22 cell C

yellow	-0.4478	pltn Stg	-0.3918
grey	-0.4420		
blue	-0.4498		
purple	-0.4458		

316 : 304

orange	-0.4483
purple	-0.4707
blue	-0.4~~435~~ ~~0.476~~ RTO 5.11.04 0.4363
black	-0.4623

10/3/09

5/11/04 1020. Sampled vessels A & C for MPN — Replaced media volume removed. Aseptic technique utilized throughout.

5.12.04 1530

C22 Cell A

black	-0.4385	pltn flg	-0.4364
red	-0.4361		
orange	-0.4374	temperature	21.0 °C
purple	-0.4354		

SS316 & C22

white	-0.4375
yellow	-0.4352
blue	-0.4353
green	-0.4357

C22 Cell B

brown	-0.0787	pltn flg	-0.0923
orange	-0.0628		
white	-0.0921	temperature	21.4 °C

SS316

yellow	-0.1325
red	-0.1309
white	-0.1291

C22 Cell C

yellow	-0.4661	pltn flg	-0.4069
gray	-0.4546		
blue	-0.4654	temperature	21.5 °C
purple	-0.4633		

SS316 & 304

orange	-0.4606
purple	-0.4729
blue	-0.4533
black	-0.4720

10.3.04

5.13.04 10:30

C22 Cell A

black	-0.4385	pltn flg	-0.4365
red	-0.4365		
orange	-0.4381	temp	20.8 °C
purple	-0.4359		

SS316 & C22

white	~~-0.4355~~ 5.13.04 RED 4380
yellow	-0.4355
blue	-0.4333
green	-0.4354

C22 Cell B

brown	-0.0875	pltn flg	-0.1095
orange	-0.0761		
white	0.0975	temp	20.8 °C

SS316

yellow	-0.1311
red	-0.1317
white	-0.1195

C22 Cell C

yellow	-0.4666		
gray	-0.4567	pltn flg	-0.4669
blue	-0.4678		
purple	-0.4644	temp	20.6

SS316 & 304

orange	-0.4611
purple	-0.4626
blue	-0.4572
black	-0.4645

10.3.04

5.17.04
0900

C22 Cell A
black -0.4426
red -0.4389
orange -0.4423
purple -0.4390

pltn flg - 0.4392
temp 20.4 °C

SS 316 & C22
white -0.4426
yellow -0.4402
blue -0.4384
green -0.4401

C22 Cell B
brown 0.0965
orange 0.0913
white -0.1096
SS316
yellow -0.1155
red -0.1126
white -0.1156

pltn flg -0.1197
temp 20.5 °C

C22 Cell C
yellow -0.4726
gray -0.4575
blue -0.4715
purple -0.4648

pltn flg -0.3812
temp 20.1 °C

SS316 & 304
orange -0.4573
purple -0.4596
blue -0.4503
black -0.4676

10.3.04

5.18.04
0800
1400

Poor output computer stop recording
Now file 5_18_04 00.txt.
Took readings → on EXEL spread sheet
MicTest.xls.

5.19.04
1300

Opened all three cells to identify the coupon configuration. Broke the sampling tube in cell A.

Sampled all 3 cells.

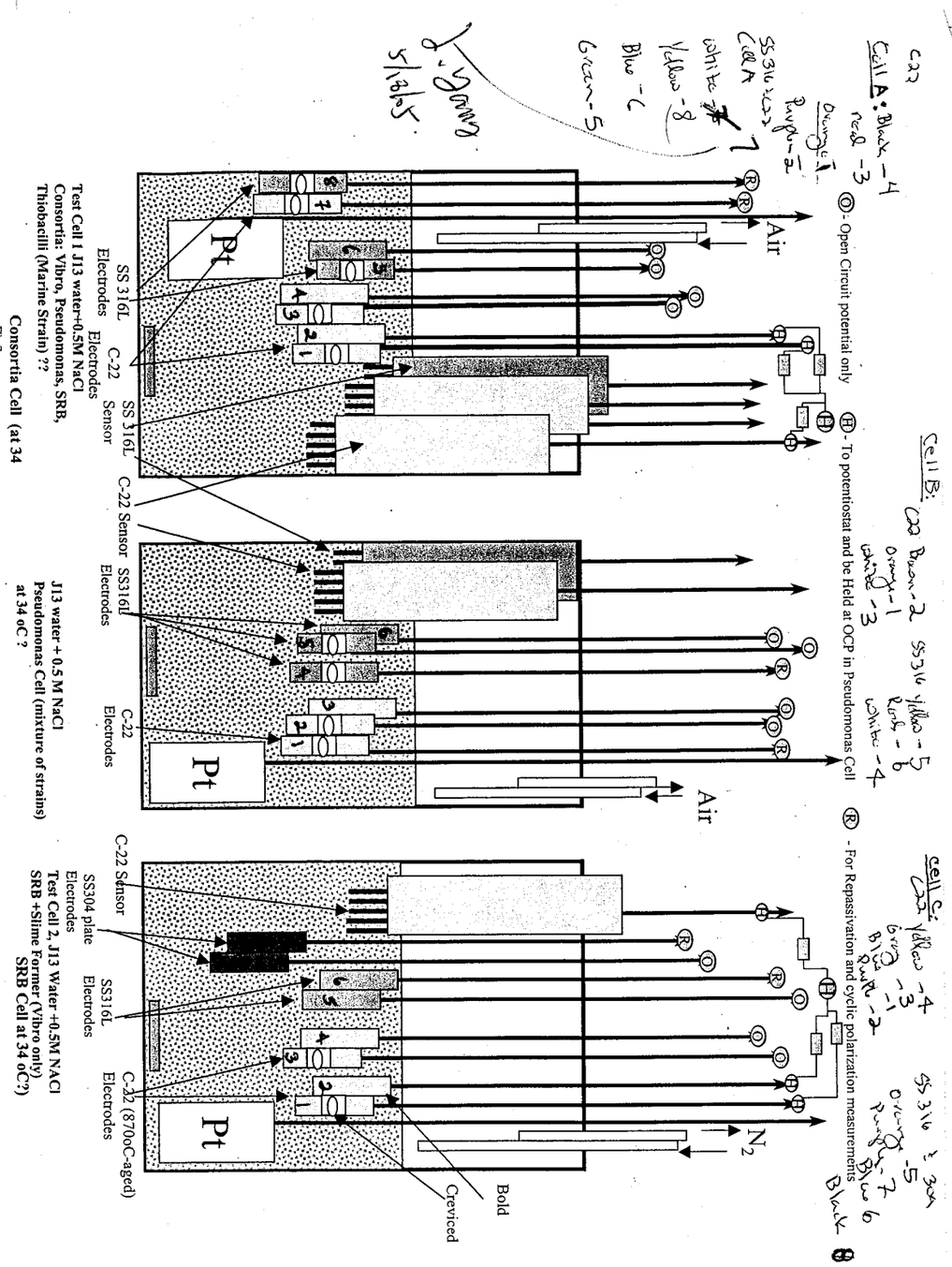
5.20.04
0945

Took readings on EXEL spread sheet.

7/7/2004

Data program restarted. File: 7_7_0400.TXT.

10.3.04



Sulfur media in immersion test.

SPEX CertiPrep

203 Norcross Ave.
Metuchen, NJ 08840
732-549-7144
1-800-522-7739

CRM Fax:
732-603-9647

Sample Prep Fax:
732-906-2492

110174-1

PACKING LIST

Shipping List Number 110174-1

Customer Order	Order Date	Page
DR8533368	11-21-03	1

Ship To: 40409*2566
SOUTHWEST RES INSTITUTE
5704 BUSINESS PARK
BLDG 57,PO:1.20.0754, 51554
ATN: LIETAI YANG
SAN ANTONIO, TX 78218

Bill To: 40409
FISHER SCIENTIFIC COMPANY
P.O.BOX 1768
PITTSBURGH, PA 15230

Ship from: 01 Spex CertiPrep, Inc.

Ordered By: B KING

Ln No	Item Number	Lot Description	Sell UM	Stk UM	Open Quantity	Stock Qty To Ship	Backorder Qty/UM
1	PLS9-2X|01	8-74SX			1 EA	EA 1	
	1000PPM SULFUR ICP STD IN	1000PPM SULFUR ICP STD IN H2O, 500ML					
2	PLS9-3X|01	R8-134SX			1 EA	EA 1	
	10000PPM SULFUR ICP STD I	10000PPM SULFUR ICP STD IN H2O, 500ML					

** Sales Order Comments **
PLEASE REMIT TO:
Spex CertiPrep Inc.
203 Norcross Avenue
Metuchen NJ 08840
****
MEMO: RUSH! SHIP 11/21/03
****
****
MEMO: SEND C OF A WITH CHEMICAL
****

Allocated: 11-21-03
Printed : 11-21-03 14:46:41

$\frac{10}{32} = 0.312$ mol/L

OK B-K

6/14/04

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227
Phone/Fax: (210) 923-5999

PACKING LIST

Invoice

DATE	INVOICE #
5/17/2004	2634

BILL TO	SHIP TO
Southwest Research Institute P.O. Box 28510 San Antonio, TX 78228-0510 Attn: Accounts Payable mail	Southwest Research Institute 6220 Culebra Road, Bldg. 171 San Antonio, TX 78238-5166 Attn: P.O.# 485273S

P.O. NO.	P.O. DATE	TERMS	REP	SHIP DATE	SHIP VIA	FOB
485273S	05/17/2004	Net 30	MMC	6/1/2004	SwRI Pickup	SAT

QTY	STOCK NO.	DESCRIPTION	RATE	AMOUNT
24	S560-304L	Stainless Steel, Type 304L, 1/2"x2"x.06", polished 600 grit.	[illegible]	[illegible]
24	S560-316L	Stainless Steel, Type 316L, 1/2"x2"x.06", polished 600 grit.	[illegible]	[illegible]
24	S560-825	Inconel 825, 1/2"x2"x.06", polished 600 grit.	[illegible]	[illegible]
24	S560-C22	Inconel, C-22, 1/2"x2"x.06", polished 600 grit.	[illegible]	[illegible]
24	S560-G7	Titanium Alloy, Grade 7, 1/2"x2"x.06", polished 600 grit	[illegible]	[illegible]
24	610-G7/Wire	Titanium, Grade 7, wire, 1/8"dia.x 36" long.	[illegible]	[illegible]
	SC	Shipping/Handling Charges	[illegible]	[illegible]
	**	Payments are to be made on a U.S. bank, in U.S. dollars. A service charge of 1.5% per month will be made on overdue accounts. Overdue accounts may be turned over to a collection agency, and a collection fee (up to 33% of your overdue amount) will be charged to your account. Returned checks are subject to a $25 service fee.		
		Sales Tax	[illegible]	[illegible]
			Total	[illegible]

Thank you for your business.

Confirmatory Analysis results see pages 297 – 303.
J.Y. 1/27/06.

PACKING LIST

Certificates see pages 281 – 286. J.Y. 1/27/06

6.16.09
Roger

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227
Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

All 24 of these specimens were heat treated, see page 288.
J-Yang 2/17/06.

Southwest Research
Customer

485273S
Your Purchase Order No.

2634
Our Invoice No.

These samples were cut into 1/2" x 1/2" coupons by Roger Dykstra before use.
SBY 2/14/06

S560-304L
Stock No.

DESCRIPTION:

Stainless Steel, Type 304L, 1/2"x2"x.06", polished 600 grit.

304L

~~**FC7432**~~
~~**Heat Number**~~
Tracking Numb.
J.Y. 1/27/06

Talked to vender (see page 286A). This is not heat number. It is tracking number. The heat number in vendors file not legible.

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

By: _____

Confirmatory Analysis results see page 301
J.Y. 1/27/06.

6.16.09
Roger

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227

Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

Southwest Research
Customer

All 24 pieces of these specimens were heat treated see page 288. J-yang 2/17/06

485273S
Your Purchase Order No.

2634
Our Invoice No.

S560-316L
Stock No.

316L

DESCRIPTION:

These samples were cut into 1/2"x1/2" coupons SBY 2/16/06 →

Stainless Steel, Type 316L, 1/2"x2"x.06", polished 600 grit.

GW0219
~~Heat Number~~ ← This is actualy tracking number, but not heat number (see page 286A).

J.Y. 1/27/06 Tracking number.

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

By: _____

Vender's record for this material is not legible Heat number not known. Confirmatory Analysis done results see page 300.

J.Y. 1/27/06.

6.16.04

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227

Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

The heat treatments were verified see page 67/Book 737 J. Yang

Southwest Research
Customer

185273S
Your Purchase Order No.

2634
Our Invoice No.

All 24 pieces of these specimen were heat treated. see Page 278 J.yang 2/17/06

S560-C22
Stock No.

DESCRIPTION:

Inconel, C-22, 1/2"x2"x .06", polished 600 grit.. ← Samples were cut 1/2"x1/2" coupons. SBY 2/16/06

CM0792
~~Heat Number~~ J.Y. 12/8/05
Tracking number. see page 286A

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

By: _____ Mill test

Heat Number: 2277 13150 see next page (insert 284A).

Confirmatory Analysis J.Y. 12/08/05. done. results see page 298.

J.Y. 1/27/06.

6.16.04

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227

Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

Southwest Research
Customer

485273S
Your Purchase Order No.

2634
Our Invoice No.

S560-G7
Stock No.

Ti-7 plate

DESCRIPTION:

Titanium Alloy, Grade 7,
1/2"x2"x.06", polished 600 grit.

SAI1584
~~Heat Number~~ 2.1.06 12/28/03
Tracking number see page 286A.

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

Heat 453072 see page 284B. 2.1.06 12/28/03

By: _____

Confirmatory analysis done results see page 303.

6.16.04

Page 284A from page 283

Tracking number 2.1.06

Mill Test Reports Furnished by:
CORROSION MATERIALS, INC.
P.O. Box 666 Baker, LA 70714
Phone (504) 775-3675 Fax (504) 774-0514

Invoice No. _____
Customer _____
P.O. Number _____ Item No. _____

HAYNES International

Haynes International
1020 West Park Avenue
P.O. Box 9013
Kokomo, Indiana 46904

PRODUCT DESCRIPTION • DESCRIPTION PRODUIT • MATERIAL BESCHREIBUNG: .062 x 48 x 144 HASTELLOY(R) ALLOY C-22 (TM) SHEET

PACKING NO. / NUMERO DE COLIS / PACKUNGS NR.: 911202009 1573608

PAGE OF PAGES / PAGE DE PAGES / AUSGE. DER SEITEN: 1 1

SOLD TO • CLIENT • BESTELLERANSCHRIFT: 23393- 1- 1-0 00 00 911003 24199 1573608
CORROSION MATERIALS
DIV OF SPECTRUM METALS INC
P.O. BOX 666
BAKER LA 70714

SHIP TO • DESTINATAIRE • LIEFERANSCHRIFT:
CORROSION MATERIALS INC
2262 GROOM RD
BAKER LA 70714

QUANTITY ORDERED / QUANTITE COMMANDEE / BESTELLMENGE: 8 PC

QUANTITY SHIPPED / QUANTITE EXPEDIEE / LIEFERMENGE: 8 PC

SPECIFICATION • SPECIFICATION • SPEZIFIKATION: ASTM-B-575-86, ASME-SB-575-89ED N06022

CHEMICAL ANALYSIS • ANALYSE CHIMIQUE • CHEMISCHE ANALYSE

HEAT NUMBER / NUMERO DE COULEE / CHARGE NR.	HEAT CODE	PCS	Al	B	C	Co	Cr	Cu	Fe	Mn	Mo	Ni	P	S	Si	Ti	V	W
1227713150		8			.003	1.70	21.1		45	35	13.2	BAL	.008	.004			16	29

TENSILE TEST AT ROOM TEMPERATURE • ESSAI DE TRACTION A TEMP. AMBIANTE • ZUGVERSUCH BEI RAUMTEMP.

ULTIMATE	YIELD 0.2% OFFSET	ELONGATION %
PSI 113000	PSI 53000	2IN 57.0

TENSILE TEST AT ELEVATED TEMPERATURE • ESSAI A CHAUD DE TRACTION • WARM ZUGVERSUCH

TEST ESSAI VERSUCH	ULTIMATE	YIELD 0.2% OFFSET	ELONGATION %
TEMP. ANLD			

ANNEALED HARDNESS / DURETE ADOUCIE / HARTE GEGLUEHT

IRB	90

AGED HARDNESS / DURETE TRAITEE / HARTE GEGLUEHT UND GEALTERT

GRAIN / GROSSEUR DE GRAIN / KORNGROESSE	5.0

STRESS RUPTURE • ESSAI A CHARGE DE RUPTURE • ZEITSTANDVERSUCH

TEST ESSAI VERSUCH	STRESS CONTRAINTE SPANNUNG	HOURS HEURES STUNDEN	% ELONG. % ALLONGEM. % DEHNUNG	% RA % RA
TEMP.				

Material was produced in accordance with Haynes Intl's Quality Control System Manual dated 5/31/88 Rev. 6.

CERTIFIED BY • CERTIFIE PAR • BESCHEINIGT DURCH: 12-02-91

2.1.06 2/17/06

Page 284B

MATERIAL CERTIFICATION

(805) 388-2138
Fax: (805) 987-6492

351 Cortez Circle
Camarillo, California 93012

Supra Alloys, Inc.

DATE: May 20, 2004

THIS MATERIAL DID NOT COME INTO CONTACT WITH MERCURY OR ITS COMPOUNDS WHILE AT SUPRA ALLOYS INC.

CUSTOMER: METASPEC CO

SO# M420495 PO# 1584

HT# 453072
(TS-7015)

MATERIAL DESCRIPTION

C. P. TITANIUM SHEET ASTM-B-265-95 GRADE 7 ANLD.

2) 1 PC. .063" X 11.75" X 11.75" 1-1/2# NET WT.

CHEMICAL ANALYSIS:

CARBON:	0.008	OXYGEN:	0.130	YTTRIUM:	
IRON:	0.070	HYDROGEN:	12/22 PPM	PD:	0.150
NITROGEN:	0.006	TITANIUM:	BAL.		

MECHANICAL PROPERTIES:

YIELD KSI	TENSILE KSI	ELONG%	%R/A	BEND
49.3/49.4	71.4/71.7	21/22		2.0 TR
55.3/55.5	70.9/71.4	22/23		2.0 TR

PRODUCT ANNEALED: 1380 F 3 MIN & A/C
SURFACE: CONTAMINATION FREE
GRAIN:
MICRO:

Called Supra Alloys, Inc
They cannot provide more information. No Mill test report
J.G. 2/31/06

MATERIAL CONFORMS TO ALL OTHER TECHNICAL REQUIREMENTS OF THE SPECIFICATION. WE CERTIFY THAT THE CHEMICAL ANALYSIS AND PHYSICAL TEST RESULTS APPLYING ON THE ABOVE ORDER ARE TRUE AND CORRECT .

Howard Van Allen
HOWARD VAN ALLEN
MATERIALS MANAGER

J. Young 2/17/06

1 TUBE 4 GROSS WT
SHIPPED VIA UPS

Issue Date: 7-28-03

Form 7.5_6, Rev(0)

12/7/06

Reg Ta

MATERIAL CERTIFICATION Page 284C

(805) 388-2138
Fax: (805) 987-6492

351 Cortez Circle
Camarillo, California 93012

Supra Alloys, Inc.

DATE: May 20, 2004

CUSTOMER: METASPEC CO

THIS MATERIAL DID NOT COME INTO CONTACT WITH MERCURY OR ITS COMPOUNDS WHILE AT SUPRA ALLOYS INC.

SO# M420495 PO# 1584

HT# R-1652 (TB-7004)

MATERIAL DESCRIPTION

C. P. TITANIUM WIRE ASTM-B-863-99A GRADE 7 ANLD.

1) 30 PCS. .125" DIA X 36"R 2-1/4# NET WT.

CHEMICAL ANALYSIS:

CARBON:	0.010	OXYGEN:	0.160	YTTRIUM:	
IRON:	0.110	HYDROGEN:	17 PPM	PD:	0.240
NITROGEN:	0.010	TITANIUM:	BAL.		

called Supra Alloys, Inc. They do not have the mill test report. They got the composition from their suppliers. Can not provide additional information. 5/31/04 t.g.

MECHANICAL PROPERTIES:

YIELD KSI	TENSILE KSI	ELONG%	%R/A

PRODUCT ANNEALED:
SURFACE:
GRAIN:
MICRO:

MATERIAL CONFORMS TO ALL OTHER TECHNICAL REQUIREMENTS OF THE SPECIFICATION. WE CERTIFY THAT THE CHEMICAL ANALYSIS AND PHYSICAL TEST RESULTS APPLYING ON THE ABOVE ORDER ARE TRUE AND CORRECT .

J. Ryan 2/17/06

Howard Van Allen
HOWARD VAN ALLEN
MATERIALS MANAGER

1 TUBE 4 GROSS WT
SHIPPED VIA UPS

METASPEC Co.

METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS

P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227

Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

Southwest Research
Customer

485273S
Your Purchase Order No.

2634
Our Invoice No.

610-G7/Wire
Stock No.

Ti-7
wire.

DESCRIPTION:

Titanium Alloy, Grade 7,
1/8"dia. x36" long Wire.

SAI1584 J.V. 11/8/05
~~Heat Number~~
Tracking number, see page 286A

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

Heat #: R-1652

By: _____

see page 284C

Confirmatory Analysis done. Results see Page 302.

J.V. 11/08/05

J.V. 1/27/06

6.16.04
Reg Ta

METASPEC Co.
METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS
P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227
Phone/Fax: (210) 923-5999

CERTIFICATE OF COMPLIANCE

June 09, 2004
Date

Southwest Research
Customer

485273S
Your Purchase Order No.

2634
Our Invoice No.

S560-825
Stock No.

All 24 pieces of these specimens were heat treated see page 288 J. Yang 2/17/06

SBY 2/16/06

DESCRIPTION:

Inconel 825, 1/2"x2"x.06", polished 600 grit. → were cut into 1/2" x 1/2" coupons J. Yang 12/08/05

~~PS10096~~ ACI 2764
~~Heat Number~~
Tracking number see page 286A

This is to certify that all of the articles in the quantities as called for in the purchase order number listed hereon are in conformance with the requirements, specifications and drawings listed on that order. Tests to substantiate this have been performed in our plant and/or by our suppliers and reports are available upon request from us and/or our suppliers.

Heat #: 1474 see page 286B (insert). J. Yang 12/5/05

By: _____

Confirmatory analysis done.

results see page 299.
J. Yang 1/27/06

6.16.09 ~~6.6.09~~ RSD 6.16.09

Insert 286A

METASPEC Co.
METAL TEST SPECIMEN, COUPONS, PANELS, RODS, FIXTURES, RACKS AND HOLDERS
P.O. Box 27707 ☐ SAN ANTONIO, TEXAS 78227
Phone/Fax: (210) 923-5999

May 20, 2005

Dear Leitai,

Following is the corrected Cert. of Compliance for the Inconel 825. The PS10096 is incorrect and you were correct to question the connection(it is for us, but not for our customers). The correct number is ACI2764. I have also omitted "Heat" and replaced with "Track". If you wish for me to do the same on the others please do not hesitate to contact me.

As for the C-22, if eligiable on your copy, located at the bottom of the test report shows "P.O. Number". There you should see 0792. That is the connection for the Cert. of Comp. and the test report.

As per our conversation the "Heat" number is actually an inhouse tracking number.

Please accept my apologies for any inconvenience we may have caused you. I hope the above information rectifies your predicament.

Best Regards,

J. Yang 2/17/06

Michele Cline
210-923-5999(phone/fax)
metaspec@earthlink.net

J. Yang 2/17/06

JESSOP STEEL COMPANY

Washington, Pennsylvania 15301

CERTIFICATE OF TEST

OUR ORDER NO. PP4 563680
YOUR ORDER NO. 5658
MEMO NO. 17292
DATE 07730/84
Saleman no. 099

AUTHORIZED SIGNATURE

DECLARED TO UNDER OATH BEFORE ME

THIS _____ DAY OF _____

JESSOP STEEL COMPANY

Bill 2 Ship to:

JESSOP UNS N08825 ALLOY HRAP
ASTM B 423-82

Heat	Slip	Size	Pcs	Weight
14174	29717	.2500 x 84.0000 x 248.0000	1	SOLD:
33256	29709	.3750 x 84.0000 x 298.0000	1	SOLD:

Heat	C	MN	P	S	SI	NI	CR	MO	CO	CU	TI	CB	N	AL	FE
4174	.043	.36	.015	.001	.23	40.75	21.58	3.48	.07	2.03	.90	.00	.006	.15	4.10
3256	.047	.16	.011	.003	.14	41.00	21.75	3.11	.05	2.04	.99	.08	.003	.10	3.75

eat	Gauge	Yield Strength	Tensile Strength	Elong	Red. of Area	Hardness	Bend	Corrosion	Grain Size
4174	.2500	65.4 KSI	127.6 KSI	52.0	50.0	BHN229	OK		7
3256	.3750	69.7 KSI	131.9 KSI.	47.0	45.0	BHN229	OK		7

~~B = CBITA~~

got to be 0.250" because ¼ x 6 x 10 2y. 12/5/07.

Certifies that this is a true copy of Mill Certificate of Test Data of Material used to fill your order.

ACII 1

WALTER KILIMNIK
Q.C. MGR.

Signed _____
Customer Metaspec Co
PO. # 2764
Size 1/4 x 6 x 10 Quantity _____
Date Shipped _____ Invoice # 5299
Date Shipped _____ Invoice # _____

DEC 2 1994

90 1/2 lbs

Insert: 2262B

-----Original Message-----
From: Lietai Yang [mailto:ltyang@cnwra.swri.edu]
Sent: Wednesday, July 07, 2004 1:01 PM
To: 'rdykstra@swri.edu'; 'STUARTB424@aol.com'; 'rbecker5@satx.rr.com'
Cc: Gustavo Cragnolino
Subject: RE: immersion test

All,

Based on the discussion we had last week and after the discussion with Gustavo, we have decided to do the total immersion test as outlined in the enclosed file. Please review the file and let me know if there is any error.

Please order all needed bottles and media for the tests. We do not have the Welded Coupons yet. We need to talk with Darrell and see if he can let us to use his sample. For the time being, let's assume we have all the samples for the tests and plan every thing.

Roger,

Please consider starting heat treatment (see enclosed file for the conditions) of the the samples and have them cut into 0.5"x0.5" pieces. We talked about getting at least 72 pieces (3 pieces from each sample you have) for each alloy. We also need at least another 12 pieces for the control test. We plan use the left over pieces (the 4th pieces) from each sample) for the control tests.

Many thanks to Geri for the neat idea to use the "small bottles" for the tests.

-Lietai

Page 287

J. Yang 2/17/06

Page 286 C
added 2/17/06
J. Yang

2/17/06

These 13 pieces specimens were re-treated to 870°C, 30 min. see page 288. J. Yang 2/17/06.
R. Dykstra 2/17/06

287

6.16.04
1515 Thermo-aged C22 specimens (13 total) 280
Heat # ~~[illegible]~~ 22771350, see pages 283,
870°C for 5 min, rapid H_2O Quench. J.Y. 2/14/06

Total Immersion Test matrix, July 07, 2004

No	Microorganism Systems	Coupons of each alloy
	Test Systems	
1	Consortia [SRB (2 mixed strains)+Pseudomonas (2 mixed strains) + Thiobacilas +Vibrio(Slimeformer)]	12
2	Pseudomonas (2 mixed strains)	12
3	SRB (2 mixed strains)	12
4	Acidophilium (Strong Acid producer)	12
5	Thermophile (SRB, Stuart to verify this), active at 70 oC	12
6	Clostridium (strong acid producer, reported as a YM bacteria)	12
sum		72
	Negative Control Systems, No Bugs, Nutrients Only	
1B	Consortia [SRB (2 mixed strains)+Pseudomonas (2 mixed strains) + Thiobacilas +Vibrio(Slimeformer)]	2
2B	Pseudomonas (2 mixed strains)	2
3B	SRB (2 mixed strains)	2
4b	Acidophilium (Strong Acid producer)	2
5B	Thermophile (SRB, Stuart to verify this), active at 70 oC	2
6B	Clostridium (strong acid producer, reported as a YM bacteria)	2
sum		12
Total		84

Notes:

Alloy types:

1 304L (annealed, 1100 oC, 10 min, water quenching)
2 316 (annealed, 1100 oC, 10 Min , water quenching)
3 625 (annealed, 1177 oC, 10 Min , water quenching)
4 825 (annealed, 954 oC, 10 Min, , water quenching
5 22(Thermally aged 870 oC, 30 min, water quenching)
6 22 Welded specimen (to be considered later)

Coupons Size: 0.5x0.5" squares for those used in the test systems; can be smaller for samples used in the cotrol systems
Coupon Finish: 600 grit

10.3.04

7.9.04 Thermo-aged 24 C22 specimens 870°C 30 min, water Quenched — see pages 280 & 283 and 286.

Thermo-aged 24 825 specimens 954°C 10 min, water Quenched — see pages 280 and 286.

Thermo-aged 24 316L specimens 1100°C, 10 min, water Quenched — see pages 280 and 282.

Thermo-aged 24 304L specimens 1100°C, 10 min, water Quenched — see page 280 and 281.

Jiyong 2/14/06

8/5/04. 8:37. program restarted, has been too slow. new File: 8_5_04a.

8/10/04 Noted that several electrode (Bold) in cell C dipped too much in liquid. the lead-connections touched liquid!

8/10/04 13:10 More SRB introduced to C cell solution level increased too. All electrodes raised.

8/18/04

8/26/04 9:34. Quit the program. and restarted it.

13:20 Program restarted. 8_26_04a01.txt

Jiyong 10/6/04

Go to page 294. Jiyong

MICROBIALLY INFLUENCED CORROSION STUDIES OF ENGINEERED BARRIER SYSTEM MATERIALS

Report Data Files

TABLE 4-C1 4-4
1.5% NaCl NUTRIENT BROTH

Chemicals	Amount
Beef Extract	3.0 gm
Peptone	5.0 gm
Sodium Chloride	15.0 gm
Distilled Water	1000 mL
Final pH @ 25° C	7.0 ± 0.3

— See Page 64

TABLE 4-C2 4-5
MODIFIED BAAR'S BROTH MEDIUM

Chemicals	Amount
Sodium Chloride	5 gram
Sodium Citrate	5 gram
Magnesium sulfate	2 gram
Ammonium Chloride	1 gram
Calcium Sulfate	1 gram
Potassium Phosphate (Dibasic)	0.5 gram
Sodium Lactate (60 %wt)	3.5 mL
Yeast Extract	1 gram
Ferrous Ammonium Sulfate	1 gram
Distilled Water	1,000 mL
Final pH at 25 °C	6.5 ± 0.3

See Page 69

TABLE 3 4-6
CHEMICAL COMPOSITIONS (%WT) OF THE SS MATERIALS USED IN THE EXPERIMENT

Metals	UNS #	Ni	Cr	Fe	Mo	Mn	Si	Cu	P	S	C
304 SS	S30400	9.16	18.5	Bal*	0.38	1.10	0.33	0.27	0.019	0.006	0.030
304L SS	S30403	8.29	18.3	Bal	0.4	1.36	0.43	0.26	0.03	0.01	0.02

*Bal: Balance

— see Page 69

Table 4 -C4 Ringas media A (Ringas and Robinson, 1988a). 4-7

Sodium lactate	7.0 g
Beef extract	1.0 g
Peptone	2.0 g
$MgSO_4 \cdot 7H_2O$	2.0 g
Na_2SO_4	1.5 g
K_2HPO_4	0.5 g
$CaCl_2$	0.1 g
NaCl	29.22 g
Distilled water	1.0 L

Thoroughly mix above ingredients; autoclave for 15 min at 120 C.

Sodium ascorbate	2.10 g/100 mL
Ammonium sulfate	2.64 g/100 mL

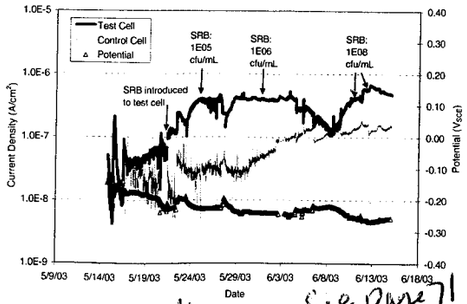
Above ingredients are prepared separately by dissolving in 100 mL distilled water and filter sterilized.

Media preparation: Prior to inoculation, aseptically add 5.0 mL/L of the sodium ascorbate and the ammonium sulfate.

See Reference in the report.

Jiyong 2/13/04

File: Mic_03_May09_Aug08 /Tab: Cpn_Current_SRB



4-5 See Page 71 Same File Name

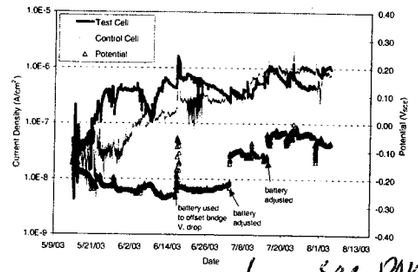
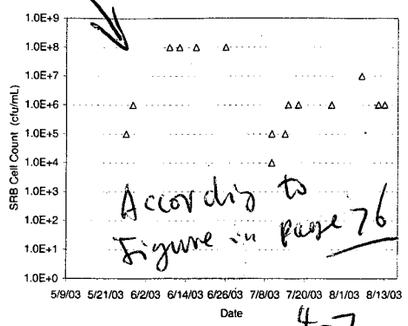


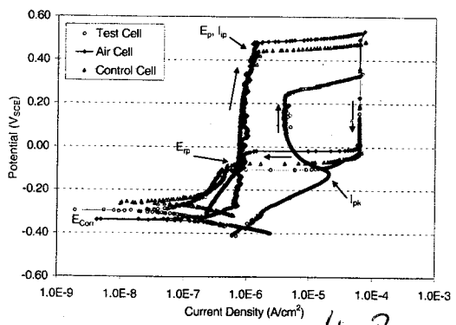
Figure 4-C4

4-6 See page 75



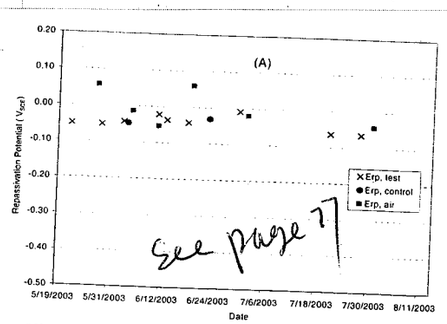
According to Figure in page 76

4-7

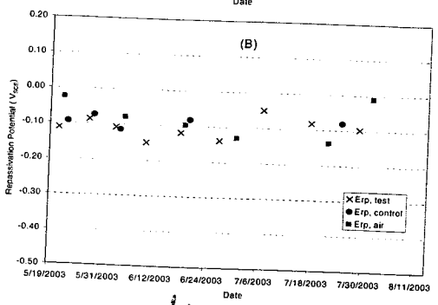


See page 76

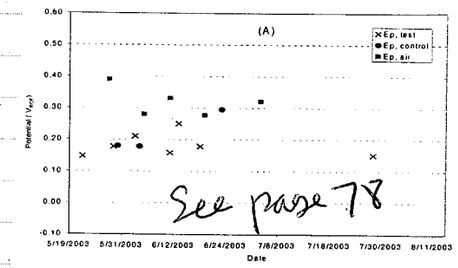
4-8



See page 77



4-9



See page 78

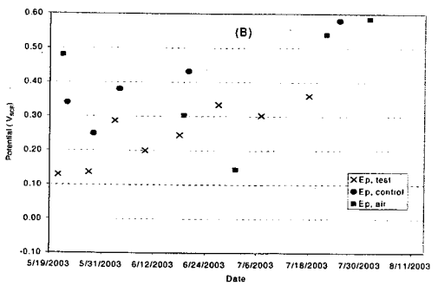
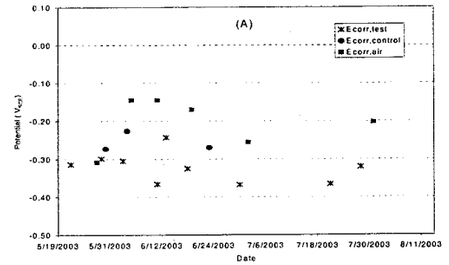


Figure 11 Pit Initiation Potential ....

4-10



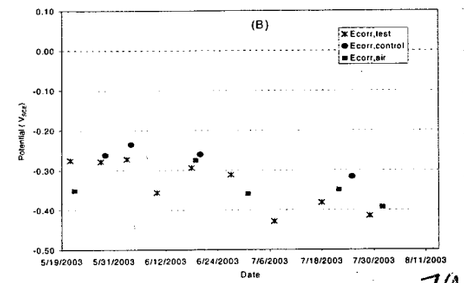
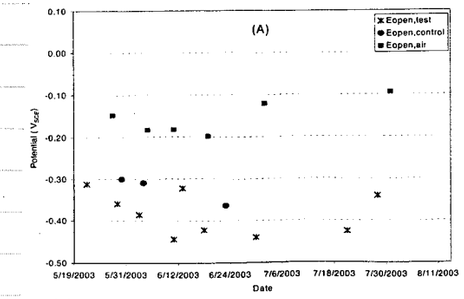
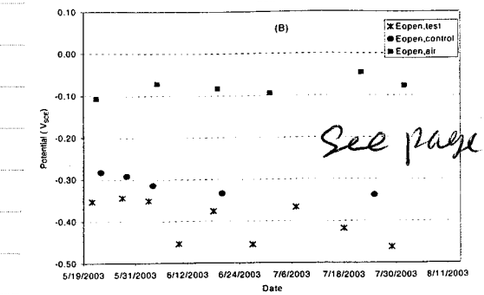


Figure 4-12 Corrosion Potential...

See page 79

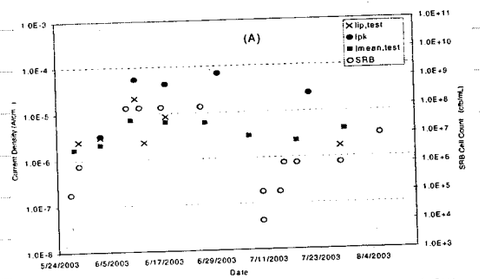
4-11





See page 80

13 Open Circuit Potential



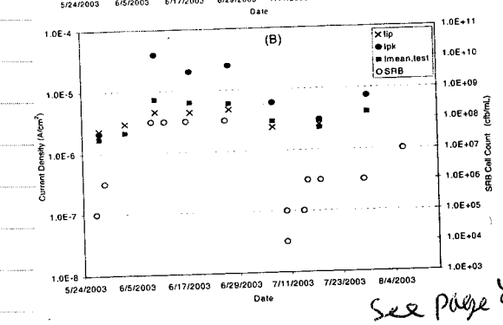
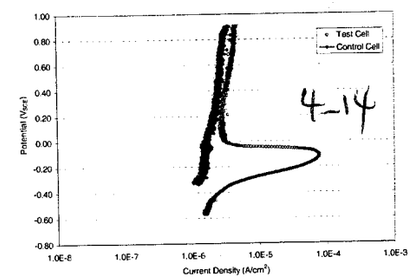


Figure 4-14 Anodic Polarization ....

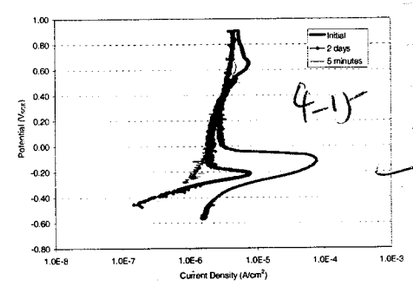
See page 81

4-13



4-14

See Page 82



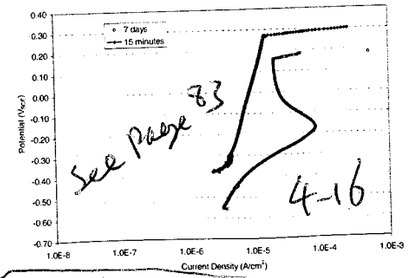
4-15

See page 82

7/23/04

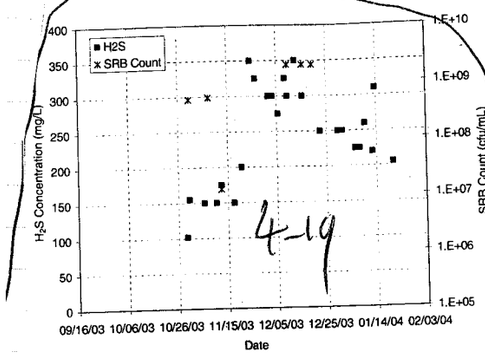
7/23/04

File: Test resultsA/ Tab: Cha



See page 83

4-16



4-19

File:Test results_H2S_pH /Tab: ChartA_2

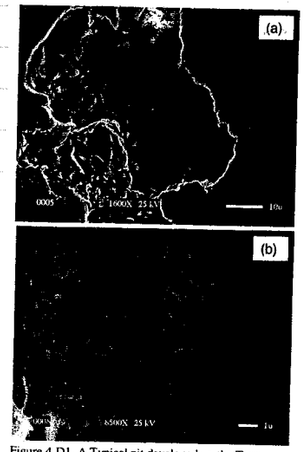
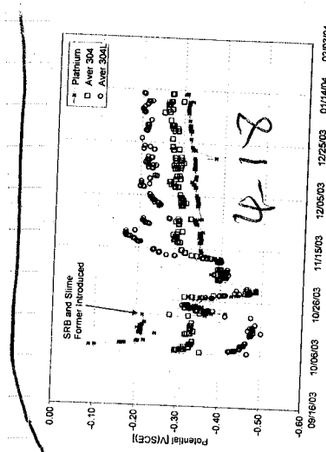


Figure 4-D1. A Typical pit developed on the Type 304L stainless steel specimen surface157 days after the exposure in a 0.5 M NaCl solution inoculated with sulfate-reducing bacteria and a slime former (a), and a closeup view at the pit center area showing bacteria cells clearly visible (b).

4-17

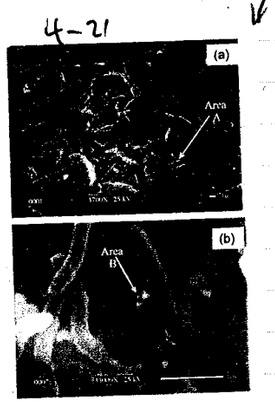
See page 286



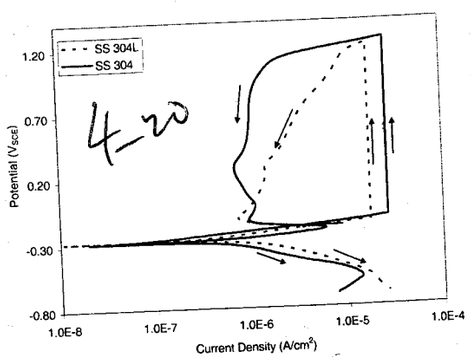
4-18

File: SEM_pictures.ppt

4-21



See page 286.



4-20

File: SS_SRB_Solution / Tab: E_I_Cart

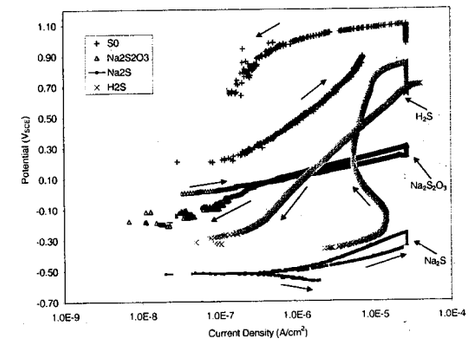


Figure4-D7 Polarization behavior of platinum electrodes in solutions containing pure sulfur element and sulfur-containing species. Ambient air may be present in the tests with H_2S and element sulfur.

4-22

File: Pt_S_Containing /Tab: E_I_Cart

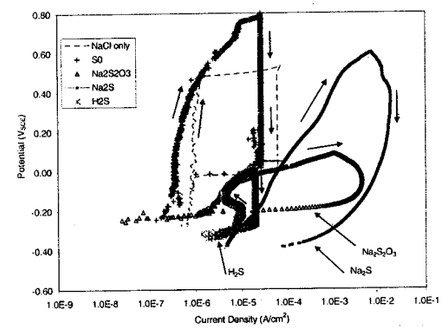
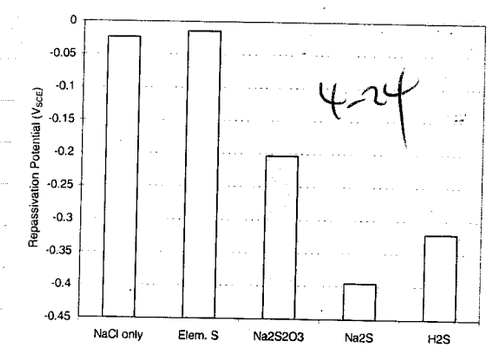


Figure 4-D8 Polarization behaviors of stainless steel specimens in solutions containing pure sulfur element and sulfur-containing species. Note, the curves for $Na_2S_2O_3$ and Na_2S were obtained in a preliminary study using cyclic potential dynamic method [Jain, 2003].

4-23

File: SS_S_Containing_Solution /Tab: E_I_Cart



4-24

Figure 4-D9 Repassivation potentials of stainless steel in different solutions

File: SS_S_Containing_Solution /Tab: ChartE

7/24/04

8/26/04 From page 288 J. Yang 10/6/04

Verification of Keithley

7001 and 2182 (S/N: 0772682)

~~S/N:~~ J.Y. 08/26/04

(S/N: 0796137)

Calibrated Equipment: Keithley 614

(S/N 0555368), Cal. Mar 19, 04

by SwRI Cal Lab.

Voltage source: Thermocouple.

Channel #33

7001 and 2182 Connected to therm-couple. 614 also connected to same Thermocouple. 4.763 mV → by 2182

4.78 mV → by 614

$$\text{Differen. } \% = \frac{4.763 - 4.78}{4.78} * 100\% = -0.356\%$$

Acceptable.

Connect Thermocouple to ch. 35 of 7001 and 2182, and 614

4.730 mV → by 2182

J.Y. 8/26/04

4.74 mV by 614

$$\text{Difference } \% = \frac{4.730 - 4.74}{4.74} * 100 =$$

$= -0.211\%$ Acceptable.

Measurements Witnessed By: MLS
SwRI QA 8/26/04

Also: The above measurement varified the correctness of the switching mechanism and the program. The connection was to 35, The reading on computer screen for channel 35 was for 35 indeed.

J. Y. 8/26/04

9/2/04 16:49. chan: I-1, II-1 disconnect from probes.

9/3/04 poweroff computer, restarted the program

File: 09_03_04a

9/7/04. 8:46. Safety Shutdown Unit #1.

Unexpected data header: -178,0 ?!

8:51. other three units stopped (not user request)

Files copied. This is for sensor tests.

should be in Book # 552.

9/8/04 polarization test on MASS test stopped.

I-1, II-1 reconnected to the MIC probes

File 09_08_04a started.

Go to page 1, Notebook # 675

J. Yang 10/7/04

10.3.04

 From page 280.

Requisition # 05024278 **Date:** 6/6/2005 **Status:** PO Generated

Requisitioner: Yang,Lietai **Buyer:** Luna, Cynthia R

Target Place Date: 6/9/2005 **Date Entered:** 6/6/2005 11:37:49 AM

Purchase Order # 575916J **Vendor:** STAVELEY SERVICES NORTH AMERICA INC

Order Date: 06/08/05 **Due Date:** 06/10/05

LN NO	ORD QTY	REC QTY	ACC QTY	REC DATE	SHIP VIA	TOT AMT	DESCRIPTION
1	6.0000	0	0		UPS BLUE	$480.00	Chemical Analysis for Metal Specimens with Atomic Absorption

Total $480.00

See Pages

CNWRA *A center of excellence in earth sciences and engineering*

6220 Culebra Road · San Antonio · Texas, U.S.A. 78228-5166

Lietai Yang
Southwest Research Institute
Building 57
6220 Culebra Rd
San Antonio, TX 78238
210-522-2483
210-522-5184 - fax
E-mail LTyang@swri.org

requisition_detail 2nd P.O. for re-Analysis. Page 1 of 1

Requisition # 05031450 **Date:** 8/10/2005 **Status:** PO Generated

Requisitioner: Yang,Lietai **Buyer:** Eury, Sarah E

Target Place Date: 8/12/2005 **Date Entered:** 8/10/2005 1:37:53 PM

Purchase Order # 575887PR **Vendor:** STAVELEY SERVICES NORTH AMERICA INC

Order Date: 08/11/05

LN NO	ORD QTY	REC QTY	ACC QTY	DUE DATE	REC DATE	SHIP VIA	TOT AMT	DESCRIPTION
1	3.0000	0	0	8/19/2005		BEST WAY	$240.00	SERVICE PURCHASE ORDER

Total $240.00

NOTES: CHANGE ORDER NO. 2 ISSUED TO REINSTATE PURCHASE ORDER NO. 575887PR. CHANGE ORDER NO. 1 ISSUED TO CANCEL PURCHASE ORDER IN IT'S ENTIRETY, WORK WAS NOT COMPLETED.

FOOTNOTES: P8 P12 Q20

Resent: Three samples (ACI 2764, R-1652, SAI 1584)

All results See Pages 298 to 303

J. Yang 1/27/06

Dear Mr Mccoy,

Enclosed are 6 types of specimens we obtained under our PO# 485273S. Please do the chemical analysis as specified in P.O. #575916J sent to you by our purchasing department. These six types of specimens are:

Note book page#	Materials	ID*	
283	Nickel Based Alloy	CM0792	C-22
286	Nickel Based Alloy	~~PS10096~~ ~~Alloy 625~~	
282	Stainless Steel	GW 0219	316L
281	Stainless Steel	FC7432	304L
285	Titanium Alloy	R-1652	Ti, Grd 7 Rod
284	Titanium Alloy	SAI 1584	Ti, Grd 7 Rod, Sheet

Heat Number

Should be ACI 2764 vender mistake, see Page 286 J. Yang 1/27/06

J. Yang 1/27/06

Please contact me if you have any questions.

Lietai Yang J. Yang
6/14/2005

* ID are tracking numbers from Metaspec. except R-1652 which is the heat number.

ACCREDITED
Certificate # 286.01
Certificate # 286.02

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TEST REPORT

SOUTHWEST RESEARCH INST. 7010
6220 CULEBRA RD
P.O. DRAWER 28510
SAN ANTONIO TX 78284
BYRON CHAPA

P.O.# 485273S

DESCR

REPORT DATE: 06/22/2005

LAB NO: 0615-029 / 01 RECEIVED DATE: 06/15/2005 JOB NO: 06/17 #112

CM0792

Alloy 22
HT: 2772 / 3150

CHEMICAL ANALYSIS

Si	.06	Mn	.34	C	.09
P	.020	S	.001	Ni	REM
Cr	20.18 ✓	Mo	12.36 ✓	Cu	.10
Al	.56	B	.0040	Ti	<.01
Fe	4.68 ✓	Cb	.04		

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-03 ; ASTM E-354-93(2000)e1* ; ICP* ;

Compared with ASTM B575-04 (C-22)
Results are acceptable. see also pages 280-286.

J. W. 1/27/06. Bill Sego
QA INSPECTOR

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SAMPLE RESULTS RELATE ONLY TO THE SAMPLE TESTED
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TEST REPORT

Alloy 825

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LIETAI YANG

P.O.# 485273S, 575887PR

DESCR RECEIVED 06-15-05

REPORT DATE: 01/18/2006

LAB NO: 0615-029 / 02 RECEIVED DATE: 06/15/2006 JOB NO: 06/17 I13

~~PS10096~~ ACI-2764
Should be ACI 2764
HT# 14174 See Page 286
J.Y. 1/24/06

typo confirmed by Joe Hansen.
Should be 2015.
J.Y. 1/24/06

CHEMICAL ANALYSIS

Si	.12	Mn	.38	C	.030
P	.026	S	.004	Ni	43.04
Cr	21.85	Mo	3.20	Cu	2.08
Al	.06	B	.0076	Ti	.99
Fe	REMAINDER	Cb	.16		

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-03 ; ASTM E-354-93(2000)e1* ; ICP* ;

AMENDED 01/17/06 TI FROM 2ND SAMPLE RECEIVED SEPT 2005

Compared with ASTM SB-424 (for Alloy 825)
results are acceptable. see also pages 280-286
J. Y. 1/27/06.

Joe Hansen
Q.A. INSPECTOR

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J.Y. 2/17/06

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DESCR

REPORT DATE: 06/22/2005

LAB NO: 0615-029 / 03 RECEIVED DATE: 06/15/2005 JOB NO: 6/16 V9

GW0219

316L Tracking #

CHEMICAL ANALYSIS

Si	.54	Mn	1.59	C	.028
P	.027	S	.007	Ni	10.38
Cr	16.90	Mo	2.14	Cu	.25
Al	.01	Ti	.03	Cb	.01

TEST METHODS: ASTM E-1019-03 ; ASTM E-1086-94(2000) ;

Compared with ASTM SA-240, Results are acceptable as S.S. 316L.

See also pages 280-286

1/27/06.

Bill Singo
QA INSPECTOR

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10-3-04 2-Yang 2/17/06

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P.O.# 485273S

DESCR

REPORT DATE: 07/19/2005

LAB NO: 0615-029 / 04 RECEIVED DATE: 06/15/2005 JOB NO: 6/16 V10

FC7432 SS304L

Tracking #

CHEMICAL ANALYSIS

Si	.32	Mn	1.79	C	.020
P	.023	S	.008	Ni	8.37
Cr	18.29	Mo	.12	Cu	.23
Al	<.01	Ti	<.01	Cb	.01

TEST METHODS: ASTM E-1019-03 ; ASTM E-1086-94(2000) ;

All Good.

Compared with ASTM SA-240, results are acceptible as S.S. 304L.

See also pages 280-286

1/27/06

Bill Singo
QA INSPECTOR

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10-3-04 2-Yang 2/17/06

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TEST REPORT

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LIETAI YANG

P.O.# 485273S, 575887PR

DESCR RECEIVED 06-15-05

REPORT DATE: 01/18/2006

LAB NO: 0615-029 / 05 RECEIVED DATE: 06/15/2006 JOB NO:

HT: R1652

Ti-7. rod.

Typo confirmed by Joe Hansen should be 2005 J.Y. 1/24/2006

CHEMICAL ANALYSIS

C	.04	Ni	.02	Cr	<.01
Mo	<.005	Al	.02	V	<.01
Ti	BASE	Fe	.32	Y	<.005
Pd	.13				

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-03* ;

AMENDED 01/17/06 PD FROM 2ND SAMPLE RECIEVED SEPT 2005

~~SB-424~~ SB-348 J.Y. 1/27/06

Compared with ASTM ~~26~~, results are acceptable as Ti Grade 7 bar.

See also pages 280-286

J.Y. 1/27/06

Joe Hansen
QA INSPECTOR

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J.Y. 2/17/06

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LIETAI YANG

P.O.# 485273S, 575887PR

DESCR RECEIVED 06-15-05

REPORT DATE: 01/18/2006

LAB NO: 0615-029 / 06 RECEIVED DATE: 06/15/2006 JOB NO:

SAI1584

Ti-7 plate

HT# 453072.

Typo confirmed by Joe Hansen Should be 2005 J.Y. 1/24/06

CHEMICAL ANALYSIS

C	.023	Ni	.03	Cr	<.01
Mo	<.005	Al	<.01	V	<.01
Ti	BASE	Fe	.27	Y	<.005
Pd	.13				

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-03* ;

AMENDED 01/17/06 PD FROM 2ND SAMPLE RECEIVED SEPT 2005

Compared with ASTM SB-265, results are acceptable as Ti, Grade 7. plate.

See also pages 280-286.

J.Y. 1/27/06

Joe Hansen
QA INSPECTOR

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J.Y. 2/17/06

Pages 3X to 304
copied for QA
record. J. Yang
10/4/04

10-3-04

The following paper and report were published based on the work in this scientific notebook (#604):

Lietai Yang and Gustavo A. Cragnolino, Studies on The Corrosion Behavior of Stainless Steels in Chloride Solutions in the Presence of Sulfate Reducing Bacteria, CORROSION/2004, paper no. 04598, Houston, TX: NACE International, 2004.

L. Yang, S. Birnbaum, and G. Cragnolino, " Microbially Influenced Corrosion Studies on Engineered Barrier System Materials", Oct, 2004. CNWRA report, CNWRA 2005-01.

J. Yang
4/25/06

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

4/25/06