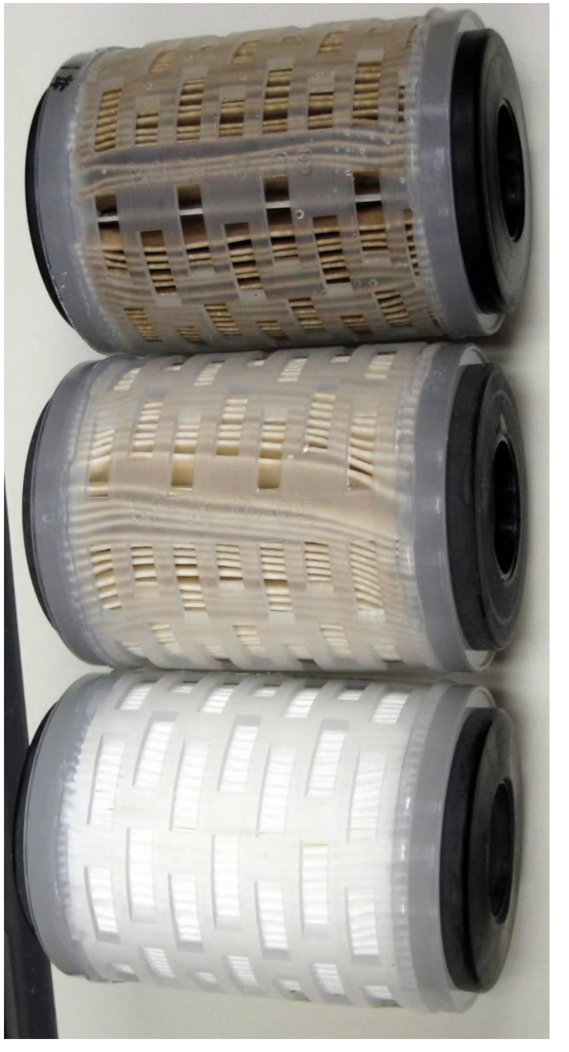
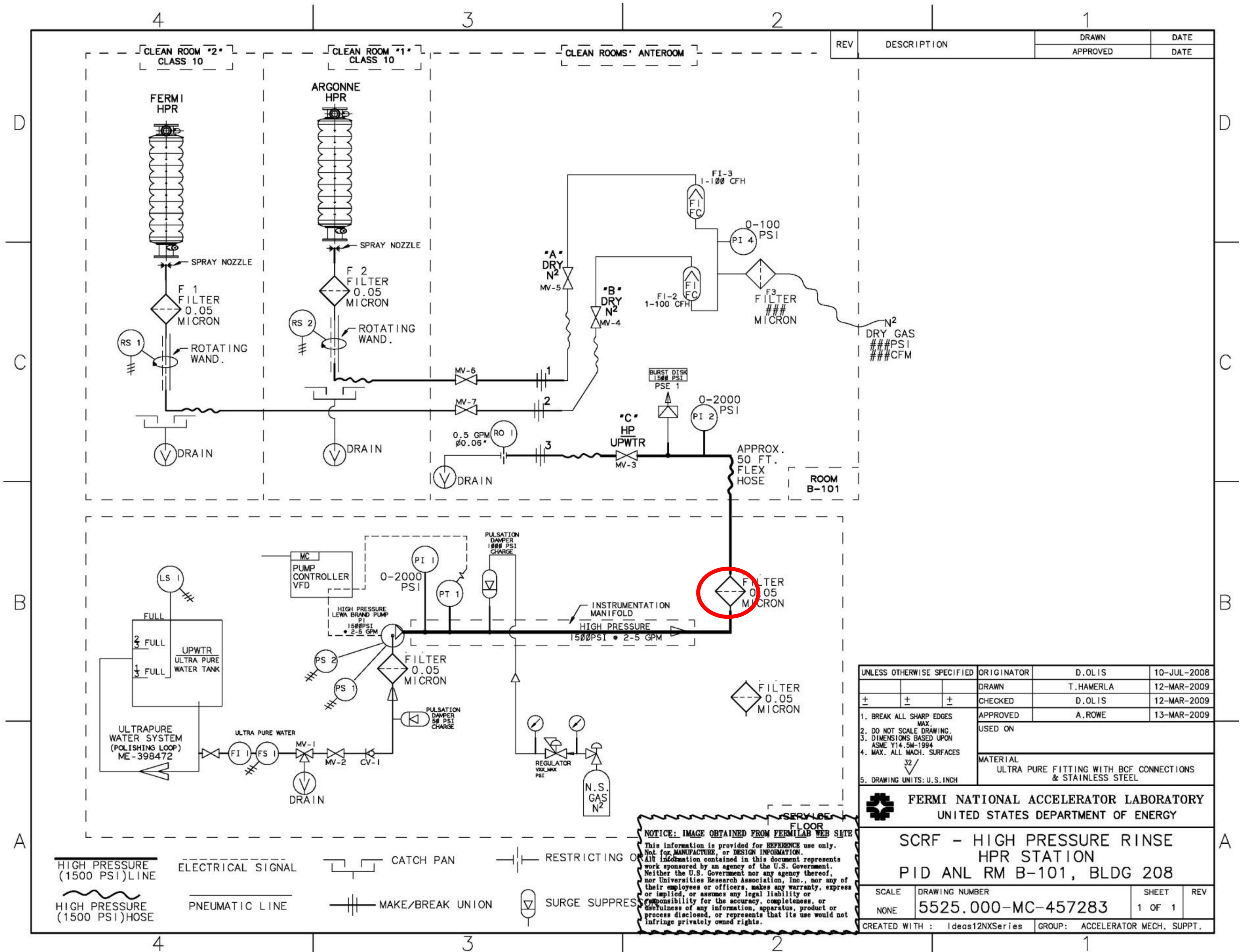
Argonne HPR system Contamination

O.Pronitchev

Problem

- Upon removal of the filter that is at the bottom of the spray nozzle for the Argonne HPR System a *Brown Contaminant* was found
- Additional filter was added after high pressure manifold. New manifolds were manufactured and installed.
- After running of 1500 gallons of DI water through the additional filter in Argonne HPR system with Pump On filter color changed. Filter that is at the bottom of the spray nozzle stays white.





CLEAN ROOM "2" CLASS 10
CLEAN ROOM "1" CLASS 10
CLEAN ROOMS' ANTEROOM
REV
DESCRIPTION
DRAWN
APPROVED
DATE
FERMI HPR
ARGONNE HPR
SPRAY NOZZLE
F 1 FILTER 0.05 MICRON
F 2 FILTER 0.05 MICRON
RS 1
RS 2
ROTATING WAND.
DRAIN
MV-6
MV-7
MV-5
MV-4
MV-3
"A" DRY N2
"B" DRY N2
FI-3 1-100 CFH
FI-2 1-100 CFH
FI FC
0-100 PSI
PI 4
F3 FILTER ### MICRON
N2 DRY GAS ###PSI ###CFM
BURST DISK 1500 PSI
PSE 1
0-2000 PSI
PI 2
"C" HP UPWTR
RO 1
0.5 GPM Ø0.06"
APPROX. 50 FT. FLEX HOSE
ROOM B-101
MC
PUMP CONTROLLER VFD
PI 1
PT 1
0-2000 PSI
PULSATION DAMPER 1000 PSI CHARGE
INSTRUMENTATION MANIFOLD
HIGH PRESSURE 1500PSI • 2-5 GPM
HIGH PRESSURE LEWA BRAND PUMP P1 1500PSI • 2-5 GPM
FILTER 0.05 MICRON
LS 1
FULL
2/3 FULL
1/3 FULL
UPWTR ULTRA PURE WATER TANK
PS 2
PS 1
PULSATION DAMPER 50 PSI CHARGE
ULTRAPURE WATER SYSTEM (POLISHING LOOP) ME-398472
ULTRA PURE WATER
FI 1
FS 1
MV-1
MV-2
CV-1
REGULATOR
N.S. GAS N2
SERVICE FLOOR
HIGH PRESSURE (1500 PSI)LINE
HIGH PRESSURE (1500 PSI)HOSE
ELECTRICAL SIGNAL
PNEUMATIC LINE
CATCH PAN
MAKE/BREAK UNION
RESTRICTING ORIFICE
SURGE SUPPRESSOR
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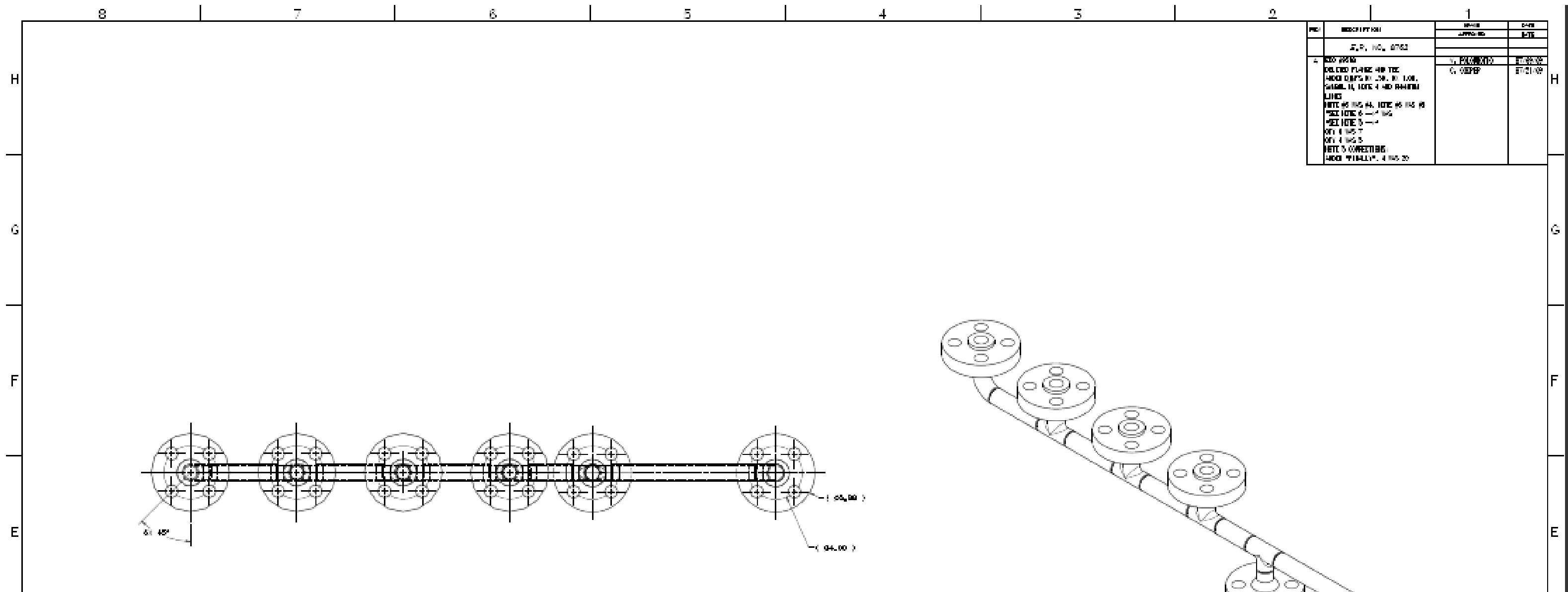
UNLESS OTHERWISE SPECIFIED
ORIGINATOR D.OLIS 10-JUL-2008
DRAWN T.HAMERLA 12-MAR-2009
CHECKED D.OLIS 12-MAR-2009
APPROVED A.ROWE 13-MAR-2009
1. BREAK ALL SHARP EDGES MAX.
2. DO NOT SCALE DRAWING.
3. DIMENSIONS BASED UPON ASME Y14.5M-1994
4. MAX. ALL MACH. SURFACES 32
5. DRAWING UNITS: U.S. INCH
USED ON
MATERIAL ULTRA PURE FITTING WITH BCF CONNECTIONS & STAINLESS STEEL
FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY
SCRF - HIGH PRESSURE RINSE HPR STATION PID ANL RM B-101, BLDG 208
SCALE NONE
DRAWING NUMBER 5525.000-MC-457283
SHEET 1 OF 1
REV
CREATED WITH : Ideas12NXSeries
GROUP: ACCELERATOR MECH. SUPPT.

HPR system in Argonne

HPR system in IB4

New versions of manifolds were made in September 2009 by Holland Applied Technologies.



NOTES:

1) FABRICATE PER ASME B31.3, NORMAL SERVICE, 2000PSI OPERATING PRESSURE, 100° F. OPERATING TEMPERATURE. VENDOR'S CERTIFICATION OF CODE COMPLIANCE TO BE DELIVERED WITH ORDER.

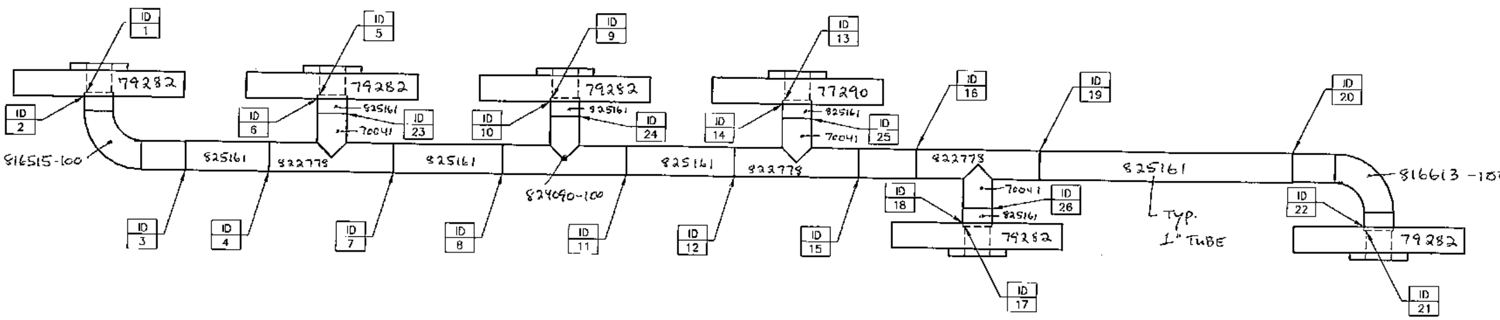
2) WELDING PROCEDURE SPECIFICATIONS (WPS) AND WELDER PERFORMANCE QUALIFICATIONS TO BE SUPPLIED TO FERMILAB PRIOR TO FABRICATION.

3) MATERIAL CERTIFICATIONS ARE REQUIRED AND MUST BE INCLUDED WITH ORDER.

4) INTERNAL ZONE OF EACH WELD MUST BE MECHANICALLY POLISHED TO 20 μ-in Ra INDIVIDUALLY. INSPECTION REPORT IS REQUIRED. A

5) FINALLY ELECTROPOLISH INTERIOR PASSAGES TO 4 μ-in Ra AVERAGE. A

6) PIPE SEGMENTS ARE TO BE CUT TO ACHIEVE NOTED ASSEMBLY FLANGE CENTER DISTANCES.



5525.000-ME-457423 MANIFOLD-HIGH PRESSURE LEWA PUMP		
W.O. #: 32739	QUANTITY: 1	DUE DATE: 09-04-09
MAT'L: T316L	INTERIOR FINISH: 20 RA & ELECTROPOLISH ORB. WELDS AS-IS	EXTERIOR FINISH: 32 Ra (150 GRIT) REMOVE WELD DISCOLOR.
UNLESS OTHERWISE SPECIFIED: ALL DIMENSIONS GIVEN IN INCHES RECORD ALL 316/316L HEAT NUMBERS		
.XXX	.XX	.X
±.005	±.060	+.125

Holland APPLIED TECHNOLOGIES		7050 HIG BURR RIDGE (630) 325-5130 PH. (6 ww
DESIGNED BY: cvassos		DRAWING NUMBER: 9285
DRAWN BY: cvassos		
DATE DRAWN: 8/17/2009		
APPROVED BY:	SCALE: NTS	REVISION

Supplier manufacturing drawing

Holland Applied Technologies

ISOMETRIC WELD LOG

CUSTOMER DATA	
CLIENT	FERMI LAB
PROJECT	MANIFOLD-HIGH PRESS. LEWA
PROJECT NUMBER	
PO NUMBER	
GAS LOT NO / CERT ID/OD	080309-1379
GAS LOT NO / CERT ID/OD	
FILLER WIRE HEAT NUMBER	520432

HAT DATA	
DATE	8/19/2009
JOB ORDER	32739
DRAWING	9285-001
SHEET NUMBER	0
REVISION	A.1
SHEET 1	OF 2

Q/A SIGNATURES
[signature] DAN KOSMOS
WELDER SIGNATURES
[signature] / THOMAS C HUGHES

LOG NO.	DATE	WELD PROCEDURE	MACHINE ID #	WELD ID #	HEAT NUMBER 1	HEAT NUMBER 2	SIZE	WELDER INITIALS	QUALITY CONTROL ACCEPTED	REJECTED	NOTES
1	11SEP09	HAT-A-01	HAT02	23	70041	825161	1.00	TCH	DK		
2	11SEP09	HAT-A-01	HAT02	24	824090-100	825161	1.00	TCH	DK		
3	11SEP09	HAT-A-01	HAT02	25	70041	825161	1.00	TCH	DK		
4	11SEP09	HAT-A-01	HAT02	26	70041	825161	1.00	TCH	DK		
5	11SEP09	HAT-A-01	HAT02	3	816515-100	825161	1.00	TCH	DK		
6	11SEP09	HAT-A-01	HAT02	4	825161	822778	1.00	TCH	DK		
7	11SEP09	HAT-A-01	HAT02	7	822778	825161	1.00	TCH	DK		
8	11SEP09	HAT-A-01	HAT02	8	825161	824090-100	1.00	TCH	DK		
9	11SEP09	HAT-A-01	HAT02	11	824090-100	825161	1.00	TCH	DK		
10	11SEP09	HAT-A-01	HAT02	12	825161	822778	1.00	TCH	DK		
11	11SEP09	HAT-A-01	HAT02	15	822778	825161	1.00	TCH	DK		
12	11SEP09	HAT-A-01	HAT02	16	825161	822778	1.00	TCH	DK		
13	11SEP09	HAT-A-01	HAT02	19	822778	825161	1.00	TCH	DK		
14	11SEP09	HAT-A-01	HAT02	20	825161	816613-100	1.00	TCH	DK		

IST WELD ID NUMBERS PER THE DRAWING. REWELDS, WHERE ALLOWED, ARE LISTED AS THE ORIGINAL NUMBER FOLLOWED BY AN "R," FOR EXAMPLE, "2R." ONLY ONE REWELD IS ALLOWED PER ASME BPE 2002.
EPLACEMENT WELDS WILL BE MARKED WITH WELD NUMBER PLUS LETTER. FOR EXAMPLE: "1A" IS THE REPLACEMENT WELD FOR "1". "1B" IS THE REPLACEMENT WELD FOR "1A".

Weld log with inspection report

(05) **Table MJ-3 Acceptance Criteria for Welds on Tube**

Discontinuities	Product Contact Surfaces	Nonproduct Contact Surfaces
Misalignment (mismatch) [see Note (1)]	Maximum of 15% of nominal wall thickness [see Fig. MJ-1(b)], except that 4 in. tube may have a maximum of 0.015 in. (0.38 mm) misalignment on the OD and 6 in. tube may have a maximum of 0.030 in. (0.76 mm) misalignment on the OD. Figure MJ-1(b) does not apply to 4 in. and 6 in. tube.	Same as product contact surfaces
Concavity [see Note (1)]	Maximum of 10% of the nominal wall thickness [see Figs. MJ-1(c) and MJ-1(d)]. However, OD and ID concavity shall be such that the wall thickness is not reduced below the minimum thickness required in DT-5.	Maximum of 10% of the nominal wall thickness [see Figs. MJ-1(c) and MJ-1(d)] over entire circumference with up to 15% of the nominal wall thickness permitted over a maximum of 25% of the circumference.
Convexity [see Note (1)]	Maximum of 10% of the nominal wall thickness [see Fig. MJ-1(f)]	Maximum of 0.015 in. (0.38 mm) [see Fig. MJ-1(f)]
Cracks	None allowed	None allowed
Lack of fusion	None allowed	None allowed
Undercut	None allowed	See Note (2)
Arc strikes	None allowed	See Note (3)
Incomplete penetration	None [see Fig. MJ-1(e)]	None [see Fig. MJ-1(e)]
Tack welds	Must be fully consumed by final weld bead [see Note (4)]	Same as product contact side [see Note (4)]
Discoloration (weld bead)	None allowed	Discoloration level will be agreed upon between the owner/user and contractor. AWS D18.2 may be used as a reference for this purpose. Postweld conditioning may be allowed to meet discoloration requirements at the discretion of the owner/user.
Discoloration (Heat-affected zone)	Heat-affected zone (HAZ) may be permitted to have light straw to light blue color (for example, AWS D18.2 samples 1 through 3 may be used as a guide). Any discoloration present must be tightly adhering to the surface such that normal operations will not remove it. In any case, the HAZ shall have no evidence of rust, free iron, or sugaring. See Note (5).	Discoloration level will be agreed upon between the owner/user and contractor. AWS D18.2 may be used as a reference for this purpose. Postweld conditioning may be allowed to meet discoloration requirements at the discretion of the owner/user. See Note (5).
Tungsten inclusions	None open to the surface; otherwise, see Note (2).	See Note (2)
Weld bead width	No limit provided that complete joint penetration is achieved on groove welds.	If product contact surface cannot be inspected (such as ID of a tube beyond the reach of remote vision equipment), then the non-product contact surface weld bead shall be straight and uniform around the entire weld circumference [see Fig. MJ-1(g)]. The minimum weld bead width shall not be less than 50% of the maximum weld bead width [see Fig. MJ-1(h)]. The maximum weld bead meander shall be 25% of the weld bead width, measured as a deviation from the weld centerline, as defined in Fig. MJ-1(i).
Porosity	None open to the surface; otherwise, see Note (2).	None open to the surface; otherwise, see Note (2).

GENERAL NOTE: All repairs shall comply with ASME B31.3.

NOTES:
(1) In the case of two different wall thicknesses, any acceptance criteria listed in terms of nominal wall thickness shall be based on the nominal wall thickness of the thinner tube.
(2) The limits of ASME B31.3, paras. 341.3.2 through 341.3.4 and Table 341.3.2, along with the criterion value notes for Table 341.3.2, will apply.
(3) Arc strikes on the non-product contact surface may be removed by mechanical polishing as long as the minimum design wall thickness is not compromised.
(4) Any welds which show unconsumed tack welds on the non-product contact surface must be inspected on the product contact surface; otherwise they are rejected. If the weld cannot be inspected on the product contact surface, rewelding per para. MJ-6.4.1 is not allowed. Rewelding per para. MJ-6.4.1 is allowed if the weld can be inspected on the product contact surface after rewelding.
(5) Welds on tubing that has been in service may require unique criteria.

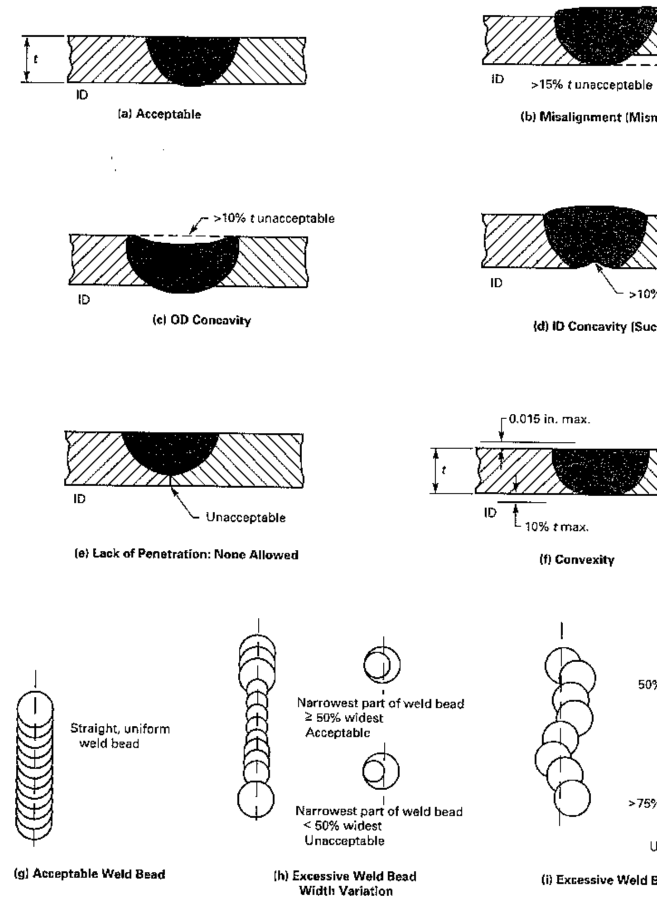


Fig. MJ-1 Acceptable and Unacceptable Weld Profiles for Tube Welds

Weld acceptance / rejection criteria

ASME BPE-2005, Bioprocessing equipment

SPX Waukesha Cherry-Burrell LIGHTNIN BRAN-LUEBBE WCB - Flow Products

MTR REPORT DATE PRINTED : 09/23/09

The material producer has certified that this material has been manufactured, sampled, tested, and inspected in accordance with the specification, including year date and supplementary requirements, and that the results meet the requirements of this specification.
MATERIAL IS FREE OF MERCURY CONTAMINATION!

Signature on file
Paul F. Nehlen
General Manager

Sold To :
FERMI LAB

Ship To :

5525.000-ME-457423 HAT JOB 32739

Sales Order No.: 328211

Customer Part No.:

Customer PO No.: 587683

Quantity:

Heat I.D: 824090-100

1.0 INCH 316L / ASTM A-269/270/ASME SA-249

	CHEMICAL REQUIREMENTS																
LIMITS	C	Mn	P	S	Si	Cr	Ni	Mo	Cu	Co	N	Cb	Ti	Fe	Sn	Bi	Fer
Actuals	0.015	1.420	0.028	0.013	0.420	16.300	10.100	2.110	0.330	0.560	0.040						4.120

	MECHANICAL REQUIREMENTS					
LIMITS	Tensile Min (psi)	Yield Min (psi)	Elongation Min %	Hardness Max	Red. Area Min %	Grain Size
Actuals	89000	58200	58.000	RB 89		

Material certificates

ABLE® Electropolishing
Advanced Metal Improvement Technologies

September 22, 2009

Holland Applied Technologies
7050 High Grove Blvd
Burr Ridge, IL 60527

This is to certify that the following parts were processed according to standard process and your purchase order specifications:

PART NO.	Various
PART DESCRIPTION	SUB-5525.000-ME-457423
PURCHASE ORDER NO.	S03892
QUANTITY SHIPPED	1 PCS.
OPERATION PERFORMED	Passivate
PACKING LIST NO.	361434-00
LOT NUMBER	
SPEC NUMBER	
REMARKS	JOB #32739

CERT DESCRIPTION	Passivate Per ASTM A967-05e1

ABLE ELECTROPOLISHING COMPANY

John S. Glass
President

Marcia

Phone: 1.888.868.2900 • Fax: 773.277.1655 • www.ableelectropolishing.com
CHICAGO Corporate Headquarters Production Facility: 2001 S. Kilbourn Ave. • Chicago, IL 60623

Manifolds were electropolished and passivated by ABLE Electropolishing

CERTIFICATE OF CONFORMANCE

CUSTOMER: **LEWA, INC.**

CUSTOMER P.O. # : 19380

PART OR DWG. # LDE2/M9/46 PUMP
4 VALVE BODIES / 2 DIAPHRM BODIES / 4 VALVE SEATS /
4 VALVE GUIDES / 4 VALVE PLATES / 4 SPRINGS

AL-REF#: FERMILAB 22620

SURFACE TREATMENT ID: MECHANICAL POLISH, EP & ULTRASONIC PASSIVATE

SURFACE TREATMENT OD: MECHANICAL POLISH, EP & ULTRASONIC PASSIVATE

ID SURFACE FINISH IS LESS THAN OR EQUAL TO: 20 RA

MATERIAL USED: CUSTOMER SUPPLIED

OLYMPIC SYSTEMS CORPORATION HEREBY CERTIFIES THAT ABOVE SURFACE TREATMENT PROCESS AND SURFACE FINISHES CONFORM TO CUSTOMER REQUIREMENTS.

DATE: 1/29/10

QUALITY CONTROL INSPECTOR: [signature]

OLYMPIC SYSTEMS CORPORATION. 15 LOWELL AVENUE, WINCHESTER, MA. 01890
781-721-2740 FAX: 781-729-4831

REV. A

LEWA pumps + systems

WERKSZEUGNIS
TEST REPORT
RELEVÉ DE CONTRÔLE
EN 10204 - 2.2

Besteller/Purchaser/Commettant:	**Bestell-Nr.**/Order no./Numéro de commande:	**Positions-Nr.**/Item no.:
LEWA, Inc.	**PO 18889 / SO 22620** **Fermilab PO 588993**	
LEWA-Auftrags-Nr./Commission no./Référence: **E12-522790**	**Erzeugnis** / Product / Produit: **Metering pump**	**Typ** / Type / Type: **LDE2 M911S Gr. 46**

Für die fluidberührten Teile wurden nachstehend spezifizierte Werkstoffe verwendet:
For the wetted parts the materials specified below have been used:
Les matériaux définis ci-dessous ont été utilisés pour les piéces en contact avec le fluide:

Teil / part / Pièce	**Element / element / Élément**	**Werkstoffe / materials / matériaux** a	b	c	d	e
Pumpenkörper / pump body / Corps de pompe		-	-			
Membranpumpenkörper / diaphragm body / Corps de pompe à diaphr.		1.4571	1.4571			
Tauchkolben / plunger / Piston plongeur		-	-			
Membrane / diaphragm / Diaphragme		PTFE	PTFE			
Faltenbalg / bellows / Soufflet		-	-			
Ventilsitz / valve seat / Siège de soupape		1.4571	1.4571			
Ventilführung / valve guide / Guide de soupape		1.4571	1.4571			
Ventilkugel / Kegel / Platte / valve ball / cone / plate / Bille / Cône / Disque		1.4571	1.4571			
Ventilfeder / valve spring / Ressort de soupape		1.4571-FH	1.4571-FH			
Ventilkörper / valve body / Corps de soupape		1.4571	1.4571			
Flansch / flange / Bride		-	-			

Werkstoff-Nr.: material no.: Matériau no.:	Bezeichnung designation Designation	Analyse [%] / analysis [%] / Composition du matériau [%] C	Si	Mn	Cr	Mo	Ni	Sonstiges Autres	Rm [N/mm²]	Rp0,2% [N/mm²]	Härte hartness Dureté
1.3541 H	X 45 Cr 13	042-0,50	≤1	≤1	12,5-14,5	---	≤1	P≤0,040 S≤0,03	---	---	57-62 HRC
1.4122	X 35 CrMo 17	0,33-0,43	≤1	≤1	15,5-17,5	0,9-1,3	(≤1)	P≤0,045 S≤0,03	---	600	235-285 HB
1.4301	X 5 CrNi 18 10	≤0,07	≤1	≤2	17-19	---	8,5-10,5	P≤0,045 S≤0,03	500-700	195	130-180 HB
1.4401 (K)	X 5 CrNiMo 17 12 2	≤0,07	≤1	≤2	16,5-18,5	2,0-2,5	10-13	P≤0,045 S≤0,03	500-700	205	130-180 HB
1.4435	X 2 CrNiMo18-14-3	≤0,03	≤1	≤2	17-19	2,5-3	12,5-15	P≤0,045 N≤0,11	500-700	200	≤ 215HB
1.4528	X 105 CRCoMo 18 2	1.00-1.10	≤1	≤1	16,5-18,5	1,0-1,5	---	Co 1,3-1,8	≤900	---	---
1.4539	X 1NiCrMoCu 25-20-5	≤ 0,02	0,7	≤2	19-21	4-5	24-26	P≤0,03 S≤0,01	530-730	230	≤ 230HB
1.4571 (FH)	X 6 CrNiMoTi 17 12 2	≤0,08	≤1	≤2	16,5-18,5	2,0-2,5	10,5-13,5	Ti>5x%C	500-750	225	130-190 HB
1.4581	G X5 CrNiMoNb 19-11-2	≤0,07	≤1,5	≤1,5	18,0-20,0	2,0-2,5	9,0-12,0	Nb>8x%C	440-650	185	130-200 HB
2.4602 (FH)	NiCr21Mo 14 W	≤0,01	≤0,08	≤0,5	20-22,5	12,5-14,5	Rest/Bal.	Co/Fe/W	690-950	310	≤ 205 HB
2.4610	NiMo 16 Cr 16 Ti	≤0,015	≤0,08	≤1	14,0-18,0	14-17	Rest/Bal.	Ti 0,05-0.7	700-900	230-305	≤ 240 HB
2.4819	NiMo 16 Cr 15 W	≤0,01	≤0,08	≤1	14,5-16,5	15-17	Rest/Bal.	Co / Fe / W	700-950	280	≤ 240 HB
316L	ASTM A 479 316L	≤0,03	≤1	≤2	16-18	2-3	10-14	P≤0,045	500-700	200	≤ 215HB
Oxidkeramik	OK 1	AL_2O_3	99,7%	Rest	Si O_2	MgO	Ca O	Ti_2O_3	Fe_2O_3		≈ 2300HV
Hartmetall	H 2			WC	97		Co	3			≈ 1500 HV
hard metal	H 3			WC	94		Co	6			≈ 1500 HV
Métal dun	H 12			WC	90,5		Ni Cr	9,5			≈ 1500 HV

Wir bestätigen, dass die unter oben genannter LEWA-Auftragsnr. gelieferten Erzeugnisse, insbesondere die fluidberührten Teile, den in der Bestellung vereinbarten Werkstoffen entsprechen. Die Analyse sowie die mechanischen Eigenschaften sind der Tabelle zu entnehmen. Die entsprechenden Werkszeugnisse nach EN 10204/2.2 bzw. Abnahmeprüfzeugnisse nach EN 10204/3.1 B liegen dem Hersteller vor.

We certify that the goods supplied under above mentioned LEWA order no., especially the wetted parts, are according to the materials agreed upon in the order. The analysis as well as the mechanical properties of the materials used are slated on the above table enclosed. The appropriate material certificates acc. to EN 10204/2.2 respectively acceptance inspection certificates acc. to EN 10204/3.1 B are available at the manufacturer.

Nous confirmons que les produits fournis sous la référence LEWA susmentionnée,notamment les pièces étant en contact avec le fluide correspondent aux matériaux convenus d'après la commande. L'analyse ainsi que les caractéristiques mécaniques sont représentées dans le tableau. Les relevés de contrôle suivant la norme allemande EN 10204/2.2 ou bien les certificats de réception suivant EN 10204/3.1B afférents sont présent chez le fabricant.

geprüft
approved
comprobado

Datum: 27.11.2009 Date: Date:	**Der Prüfbeauftragte: H.Reger** Nominated inspector: Inspecteur mandaté:

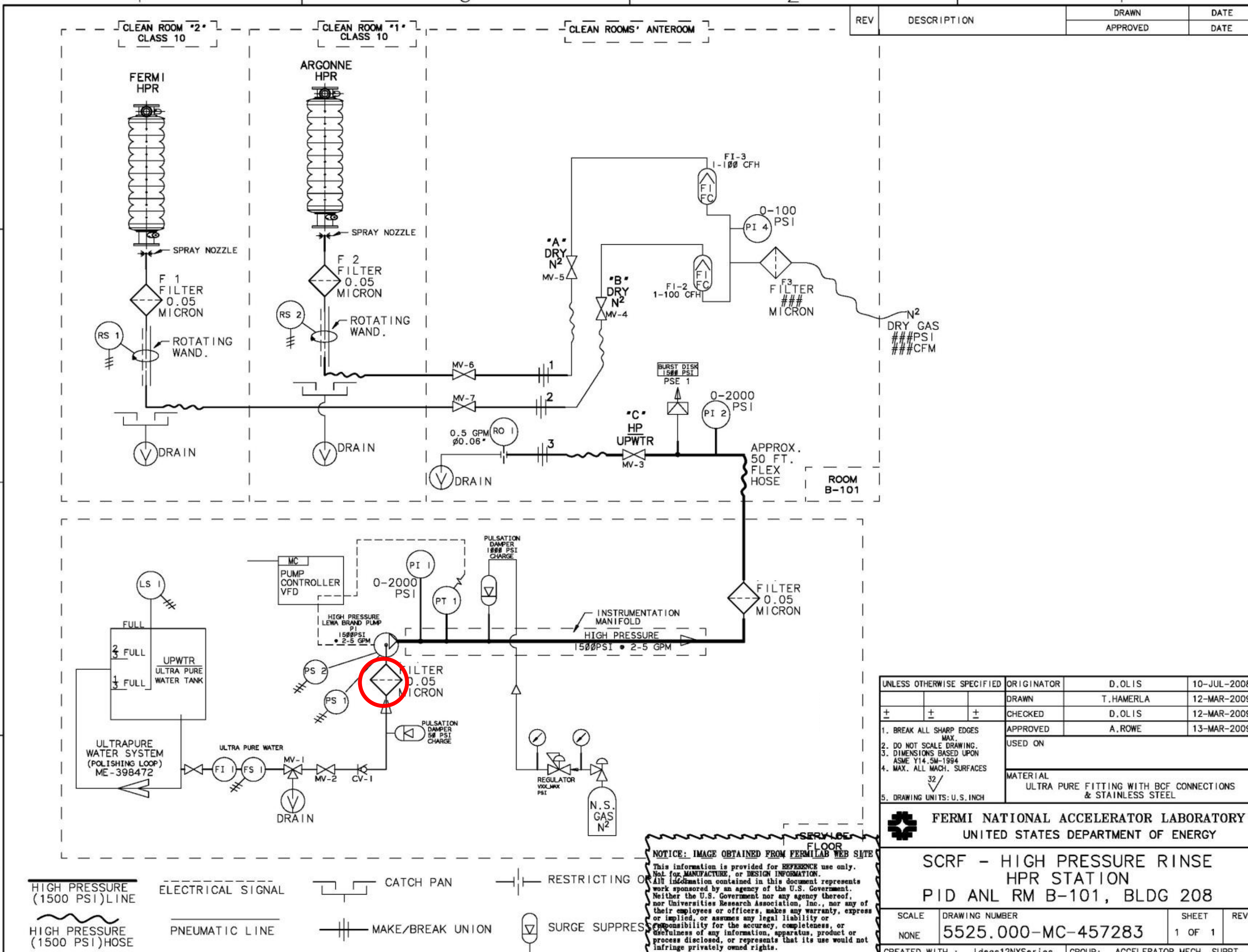
Pump certificates

ASTM A 380-06 Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

ASTM A 967 Chemical Passivation Treatments for Stainless Steel Parts

ASTM A380 covers recommendations and precautions for cleaning descaling, and passivating of new stainless steel parts, assemblies and installed systems. More in “Surface Cleaning, Finishing, and Coating” *ASM Metals Handbook*.

- Design
- Precleaning
- Descaling
- Cleaning/Passivation
- Inspection



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UNLESS OTHERWISE SPECIFIED			
ORIGINATOR	D.OLIS	10-JUL-2008	
DRAWN	T.HAMERLA	12-MAR-2009	
CHECKED	D.OLIS	12-MAR-2009	
APPROVED	A.ROWE	13-MAR-2009	

1. BREAK ALL SHARP EDGES MAX.
2. DO NOT SCALE DRAWING.
3. DIMENSIONS BASED UPON ASME Y14.5M-1994
4. MAX. ALL MACH. SURFACES 32
5. DRAWING UNITS: U.S. INCH

USED ON

MATERIAL
ULTRA PURE FITTING WITH BCF CONNECTIONS & STAINLESS STEEL

FERMI NATIONAL ACCELERATOR LABORATORY
UNITED STATES DEPARTMENT OF ENERGY

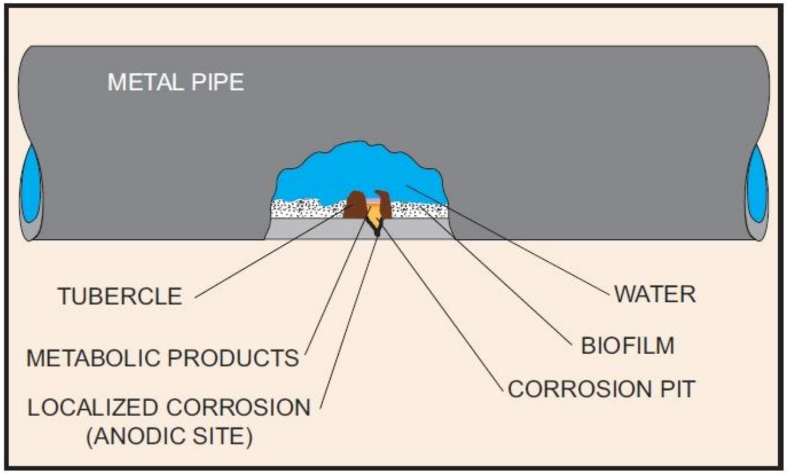
SCRF - HIGH PRESSURE RINSE HPR STATION PID ANL RM B-101, BLDG 208

SCALE	DRAWING NUMBER	SHEET	REV
NONE	5525.000-MC-457283	1 OF 1	

CREATED WITH : Ideas12NXSeries | GROUP: ACCELERATOR MECH. SUPPT.

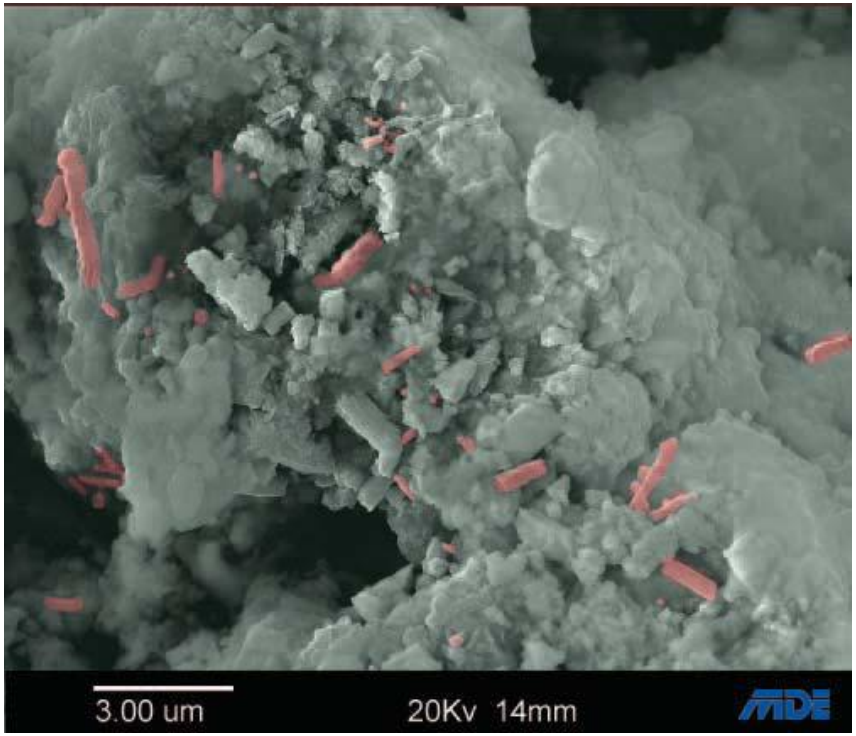
Additional filter was installed before low pressure manifold. No filter discoloration after 95 hours of HPR at 2.5 g/min (14250 gallons at 1350 psi) .

Suspected Contaminant Source - Microbiologically Influenced Corrosion



Simplified diagram showing MIC corrosion site

Microbiologically Influenced Corrosion is a is corrosion caused or promoted by microorganisms. It can apply to both metals and non-metallic materials.



Iron-related bacteria

Sulfate Reducing Bacteria

MIC-related bacterial growth typically occurs in systems within specific temperature ranges, depending on the type of bacteria; an “ideal” range is often reported as 4° to 49°C. Bacterial growth typically hibernates below 4°C. Some types of bacteria favor other temperature ranges; for example, most common strains of SRB grow best at 25° to 35°C. A few thermophillic types of SRB grow more efficiently at more than 60°C, and one type is capable of growing at more than 100°C. While MIC more favorably grows in their typical temperature ranges, growth in other temperature ranges should not be discounted. MIC has been found in extremely cold environments such as freezers or piping systems of Alaskan villages north of the Arctic Circle.

Environmental Microbiology Lab test

We have send contaminated and clean filter to EMSL lab for detection of bacteria known to cause or accelerate corrosion in stainless steel.

- Sulfate Reducing Bacteria chemically reduce sulfates to sulfides, producing compounds such as hydrogen sulfide (H_2S), or iron sulfide (Fe_2S) in the case of ferrous metals.
- Iron-related bacteria are bacteria that derive the energy they need to live and multiply by oxidizing dissolved ferrous iron.
- Slime-Forming Bacteria is the name given to bacteria that are able to produce copious amounts of slime. These are commonly seen as condensed cloudy/plate-like growths suspended in the liquid medium, gel-like rings (around the ball) or globular/swirl forms of slime in the basal cone.

Bacteria detection test results

EMSL Analytical, Inc.

200 Route 130 North, Cinnaminson, NJ 08077 (856) 858-4800

Detection of Iron-Related Bacteria in Bulk Samples with the IRB-BART™ System (EMSL Method: M121)

Lab Sample Number	Client Sample ID	Sample Location	Amount Analyzed	Iron-related Bacteria (Present/Absent)	Potential Population Size (CFU/g)	Identification of Dominant Organism
4135-1	1	Contaminated filter	15mL	Absent		
4135-2	2	Clean filter	15mL	Absent		

Detection of Sulfate-Reducing Bacteria in Bulk Samples with the SRB-BART™ System (EMSL Method: M122)

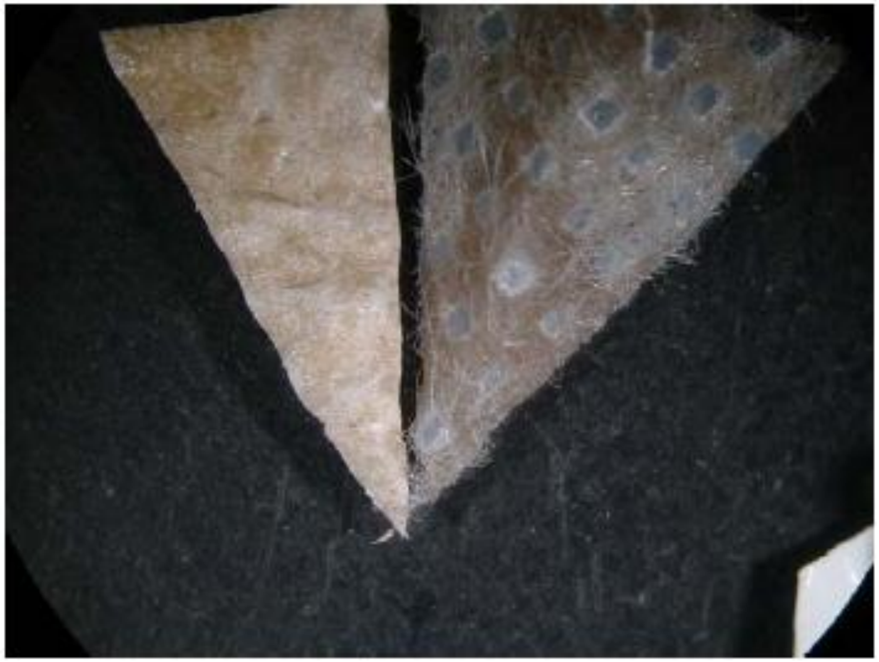
Lab Sample Number	Client Sample ID	Sample Location	Amount Analyzed	Sulfate-reducing Bacteria (Present/Absent)	Potential Population Size (CFU/g)	Identification of Dominant Organism
4135-1	1	Contaminated filter	15mL	Absent		
4135-2	2	Clean filter	15mL	Absent		

Detection of Slime-Forming Bacteria in Bulk Samples with the SLYM-BART™ System (EMSL Method: M123)

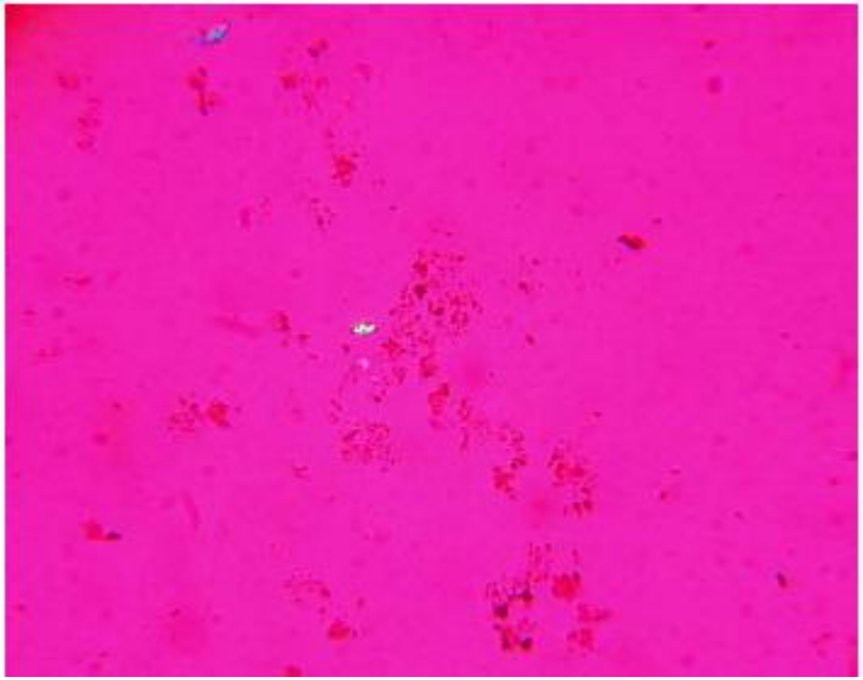
Lab Sample Number	Client Sample ID	Sample Location	Amount Analyzed	Slime-forming Bacteria (Present/Absent)	Potential Population Size (CFU/g)	Identification of Dominant Organism
4135-1	1	Contaminated filter	15mL	Absent		
4135-2	2	Clean filter	15mL	Absent		

EMSL Analytical, Inc.

Basic Material ID Anallyses



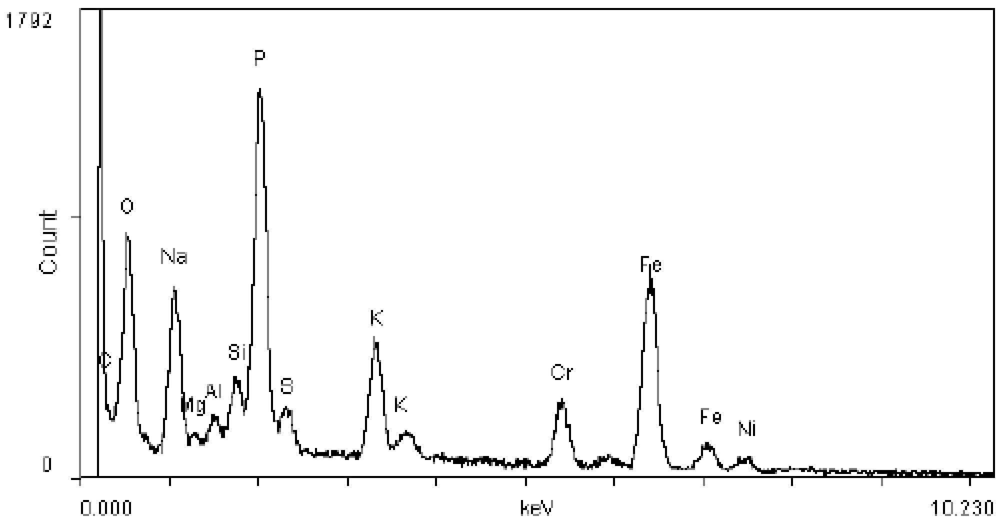
Stereomicroscope image (10x)



PLM image (150x) of the material from the contaminated filter sample showing color and morphology

EMSL Analytical, Inc.

Basic Material ID Analyses



Elements:	Weight %	Atomic %
O	30.04	32.93
Na	7.69	5.87
Mg	0.05	0.04
Al	0.27	0.18
Si	0.86	0.54
P	7.32	4.14
S	0.29	0.16
K	2.54	1.14
Cr	2.9	0.98
Fe	13.09	4.11
Ni	0.96	0.29
C	34	49.65

SEM/EDX elemental analysis of the material from the sample filter. The combination of iron (Fe), nickel (Ni) and chromium (Cr) is indicative of stainless steel oxides. The combination of phosphorous (P), sulfur (S), potassium (K), sodium (Na) and Magnesium (Mg) are indicative of salts and other minerals. The combination of aluminum (Al) and silicon (Si) and oxygen (O) may indicate clays or grinding/polishing compounds. The high percentage of carbon (C) may me from a biological source such as bacteria, mold, or algae.

Sample	Description	Analyte	Relative Concentration
1	Contaminated Filter	Inorganic material Salts Stainless steel oxides Organic/biological Unidentified	Major Major Secondary Secondary Trace

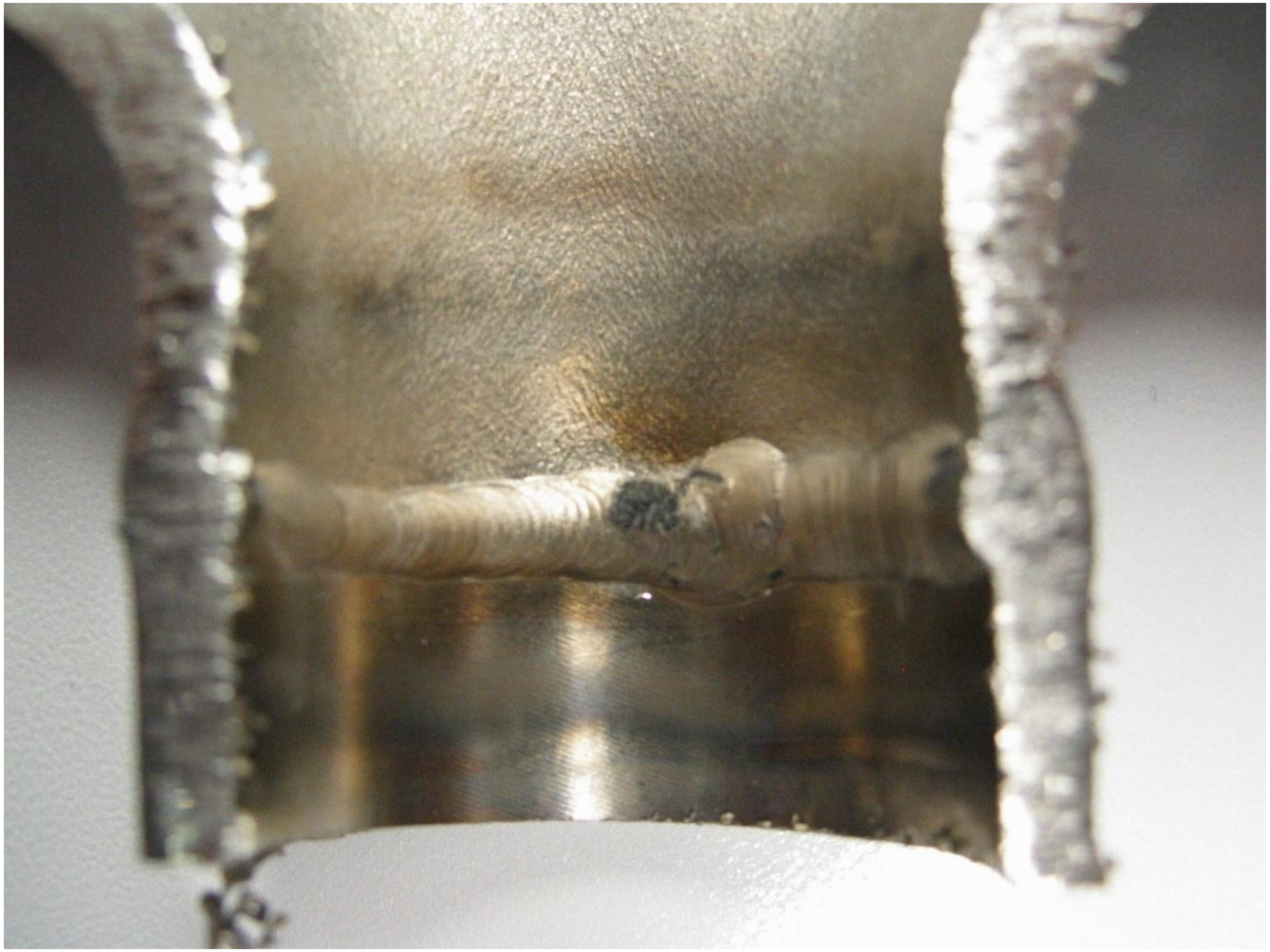
Stainless steel residual contaminations

Table 2. Examples of cleaning procedures

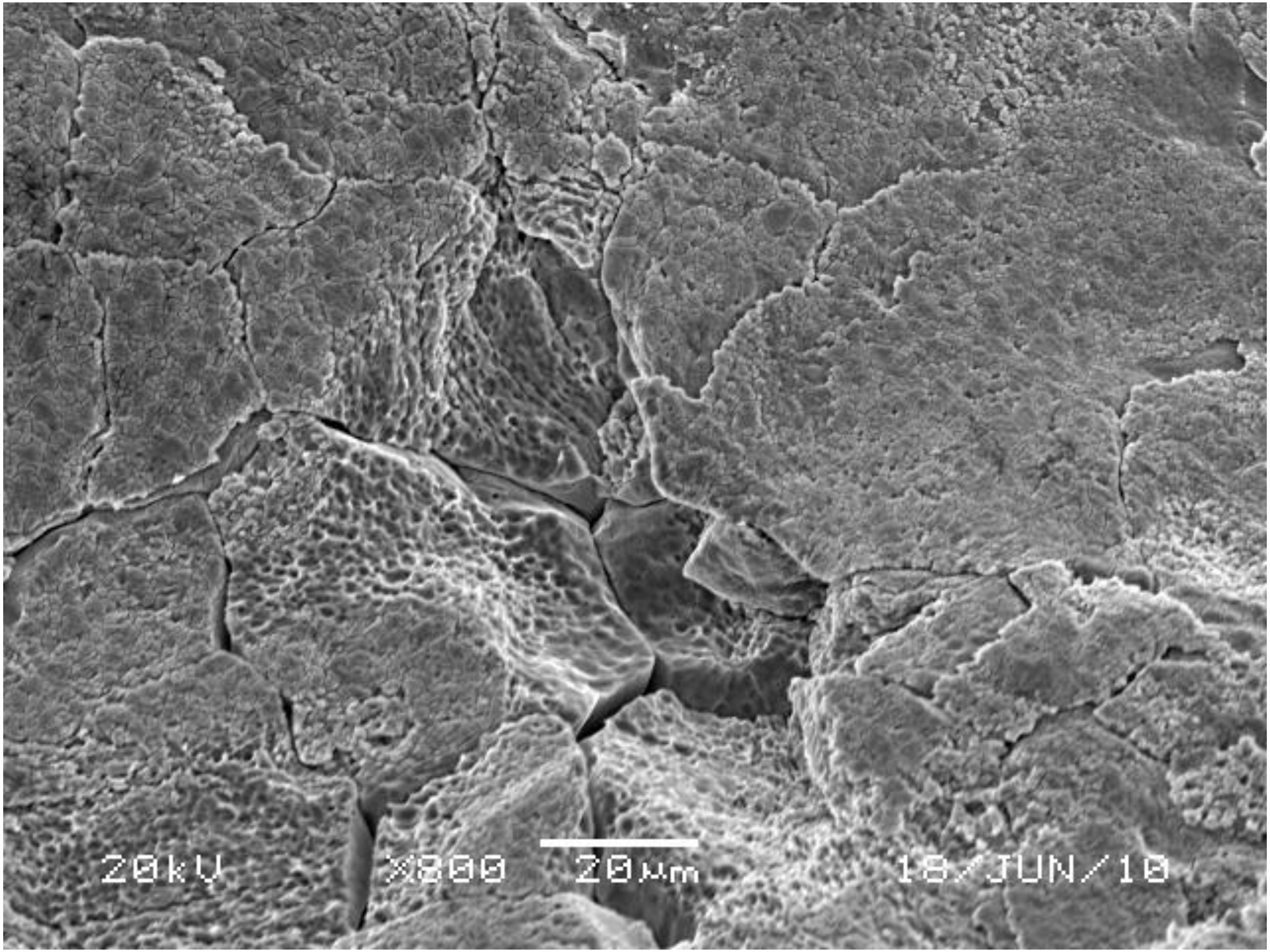
Contamination	**Cleaning methods** Characterised by medium, temperature, contact time, rinsing pressure, etc.	**Extent of residual contamination** (Examples)
Polishing compound coverage	Alkaline compound removal through heating HC 500	< 0.5 mg/dm^2 Residual compound coverage on refined steel surface
Punching compound coverage	Alkaline compound removal through heating HC 500	< 0.5 mg/dm^2 Residual compound coverage on refined steel surface
Drawing compound coverage	Alkaline compound removal through heating HC 500 + Electrochemical polishing HE 111 (Electrochemical removal 5 µm)	< 0.5 mg/dm^2 Residual compound coverage on refined steel surface (CFOS application)
Grinding particle	Electrochemical polishing HE 111 (Electrochemical removal 5 µm)	< 10 particles > 1 µm per dm^2 Refined steel surface
Residual chlorides	Chemical rinsing HC 1100	< 10 ppm Cl^-, or < 0.1 mg Cl^-/m^2
Fe-oxides	Chemical rinsing HC 700	< 1 ppm Fe
Fe-oxides as red layer	Chemical rinsing HC 1106	< 1 ppm Fe
Fe-sulphates	Chemical rinsing HC 1106/HC 1100	< 1 ppb S

HENKEL
Pickling and Electropolishing

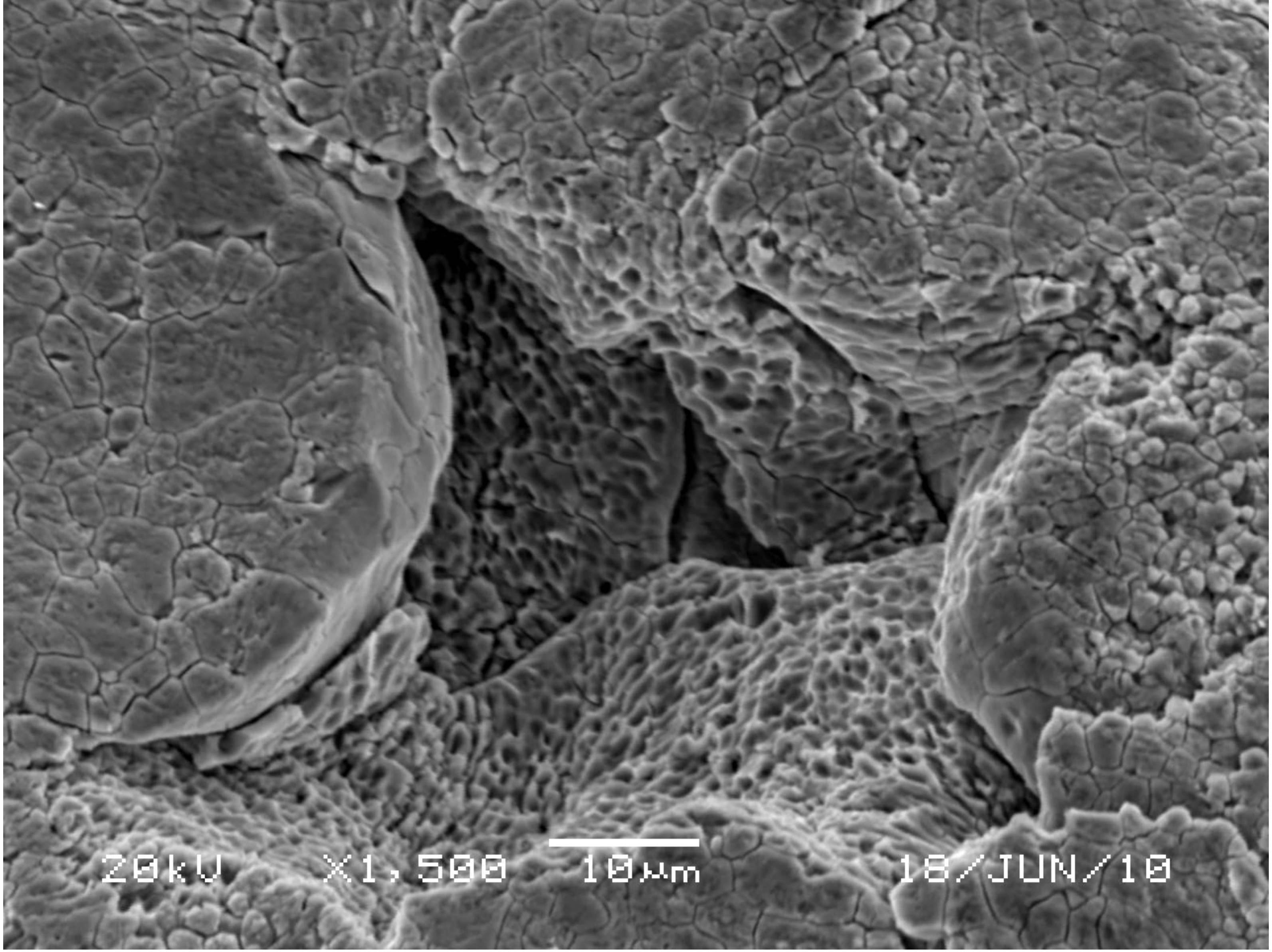
Old manifolds internal surface inspection



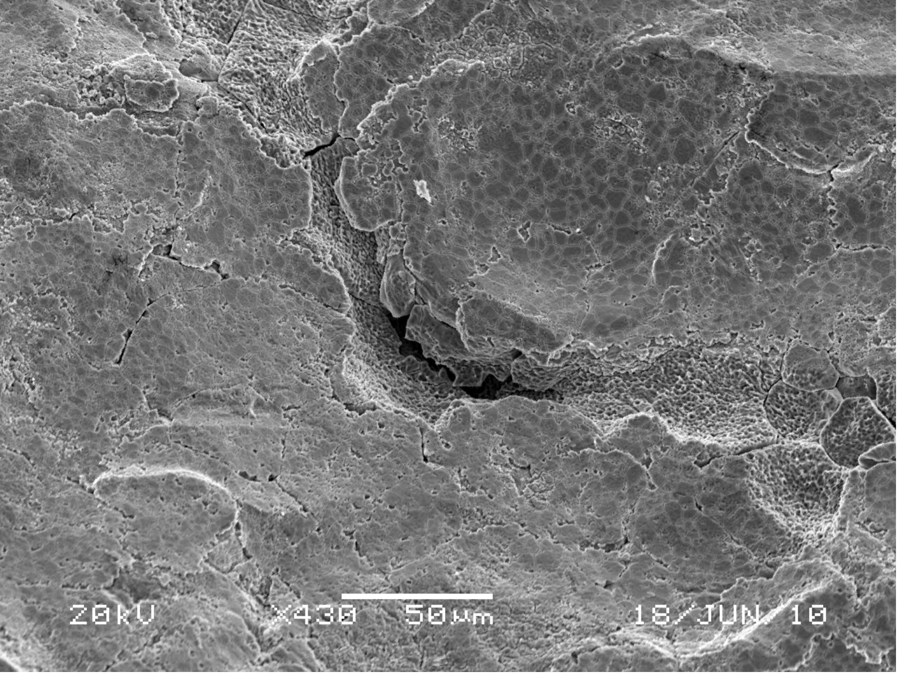
Weld quality not acceptable, pits, Heat tint, rough surface.



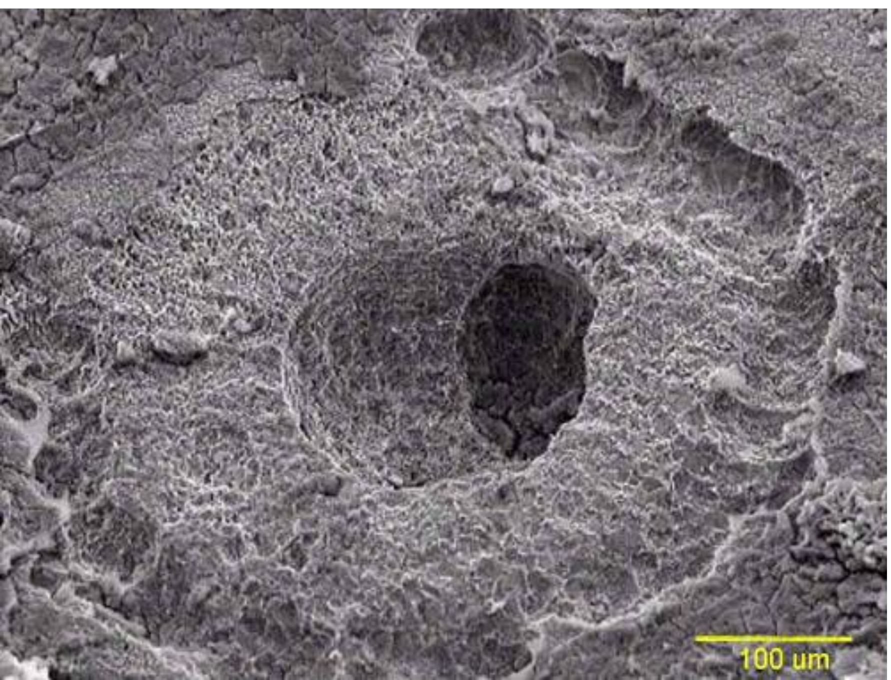
Pitting corrosion or Weld Metal Defect
(C.Cooper)



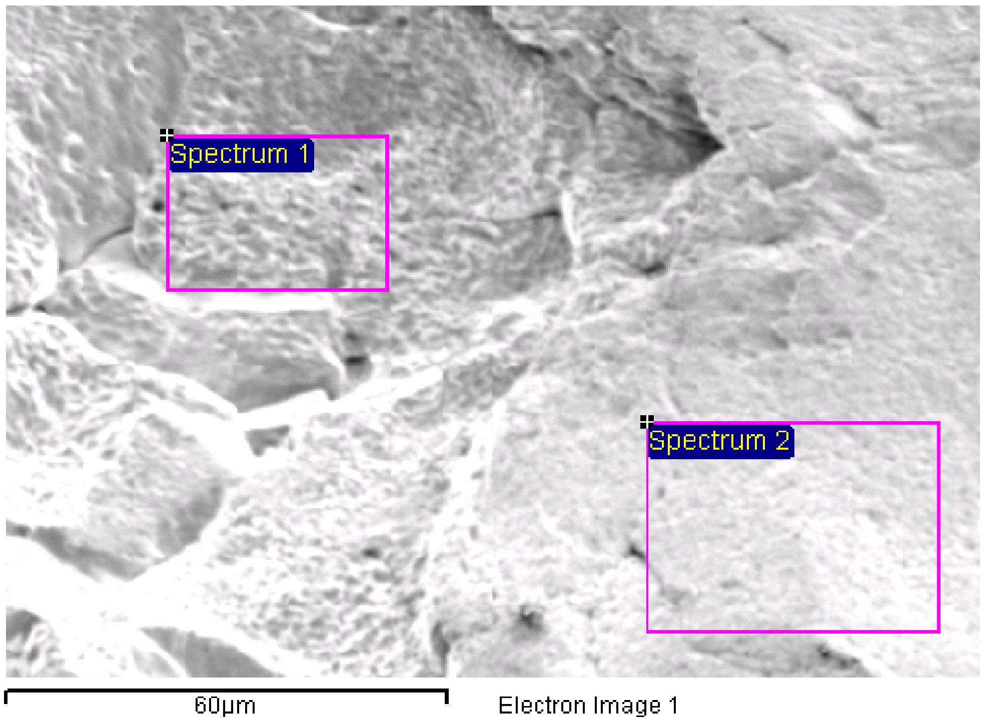
Pitting corrosion or Weld Metal Defect
(C.Cooper)

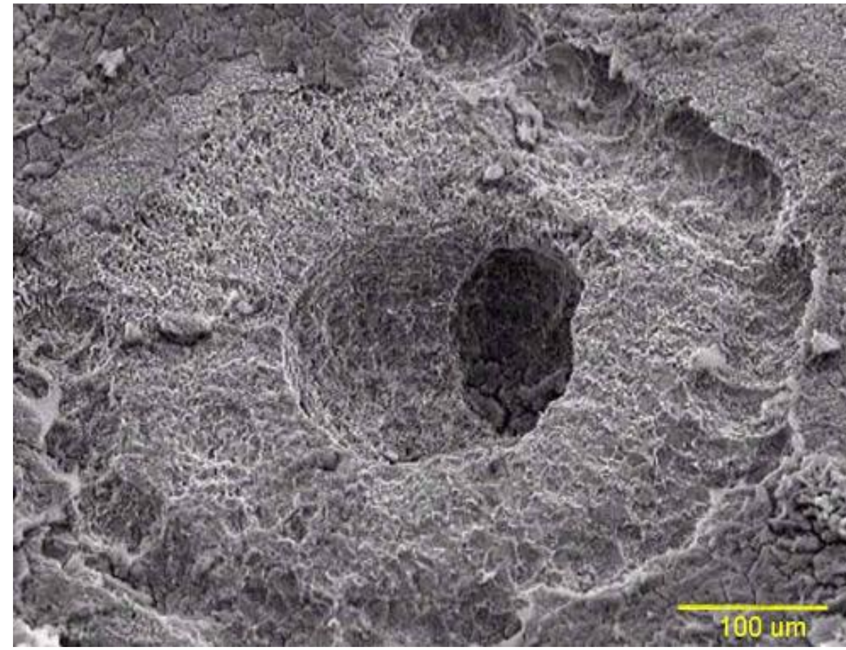


Pitting corrosion or Weld Metal Defect (C.Cooper)



SEM Image of Stainless Steel Corrosion Pit from PMET's Materials Characterization Laboratory





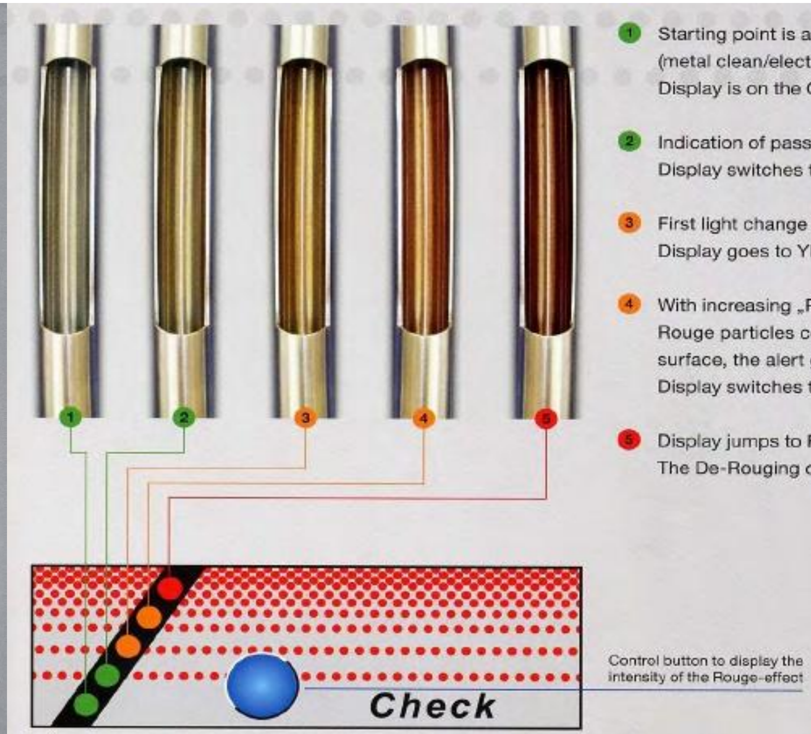
Spectrum	In stats.	C	O	Cr	Fe	Ni	Mo	Total
Spectrum 1	Yes	2.51	1.4	20.2	63.2	10.5	2.3	100
Spectrum 2	Yes	4.22	3.2	19.2	62.9	10.5		100
Max.		4.22	3.2	20.2	63.2	10.5	2.3	
Min.		2.51	1.4	19.2	62.9	10.5	0	

S	Cl	Cr	Fe	Zn
3.80%	1.10%	3.40%	89.50%	2.10%

EDX Analysis of Corrosion Pit from PMET's Materials Characterization Laboratory

EDS Analyses of Argonne manifold defect done by C.Cooper

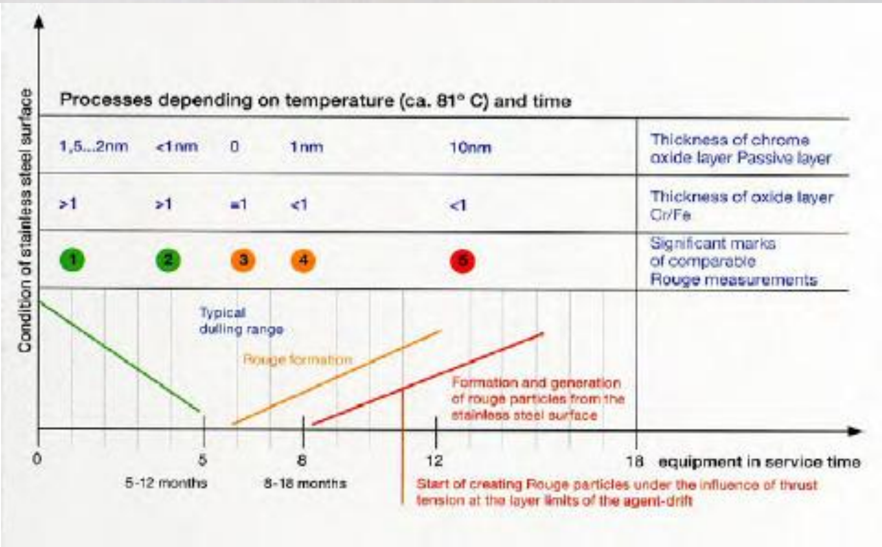
Control of passive layer
Renewable contamination source



1. Starting point is a bright virgin (metal clean/electrochemically polished) pipe surface. Display is on the GREEN.
2. Indication of passive layer reduction. Display switches to GREEN 2.
3. First light change in surface colour – ROUGE – starts. Display goes to YELLOW.
4. With increasing „Rouge"-effect and the risk of Rouge particles coming off from the stainless steel surface, the alert grade is increasing, as well. Display switches to YELLOW 2.
5. Display jumps to RED. The De-Rouging operation must be planned in Time.

Change / Mutation of the passive layer:

The well known problem of the mutation of an ideal corrosion resistant passive layer (chrome oxide primary layer) in conjunction with medias as in WFI systems (austenite stainless steel 316L, or similar stainless steel alloys) into an increasingly metal oxident secundary layer expressed in the socalled „Rouge-Effect" with forming of heavy-metal-oxide particles which detach from the surface by occurring flow effects.



High Purity Systems
Cleaning and Passivation

SUMMARY:

- Rig system and fill with high purity water;
- Establish circulation and inspect for system integrity;
- Formulate cleaning chemistry;
- Circulate cleaning chemistry at temperature;
- Adjust pH of cleaning chemistry;
- Drain and rinse system with high purity water;
- Fill system with high purity water and formulate passivation chemistry;
- Circulate passivation chemistry at temperature;
- Adjust pH of passivation chemistry;
- Drain and rinse system with high purity water to achieve conductivity parity;
- Perform final inspection and return system to starting configuration.

Benefits of Passivation

Average composition of 316L stainless steel

ELEMENT:	CONCENTRATION:
IRON	67.0% - 69.0%
CHROMIUM	16.0% - 18.0%
NICKEL	10.0% - 14.0%
MOLYBDENUM	2.0% - 3.0%
MANGANESE	2.0% maximum
SILICON	1.0% maximum
PHOSPHORUS	0.04% maximum
SULFUR	0.03% maximum
CARBON	0.03% maximum

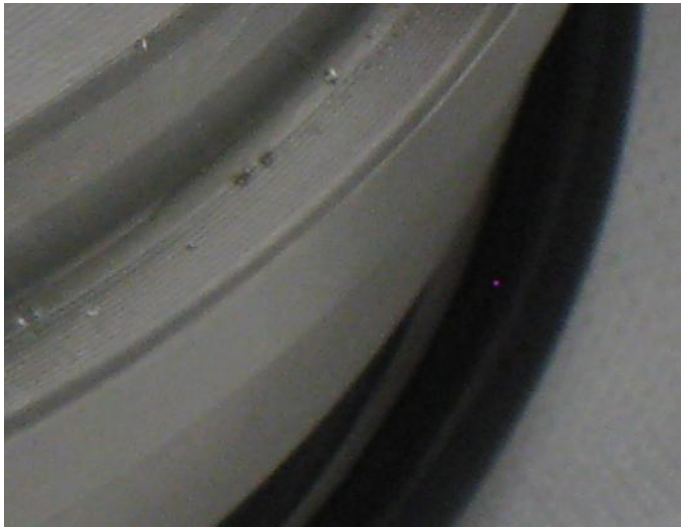
Ratio of chrome to iron in the base metal is 0.24. By chemically treating the surface of the stainless steel, such that iron is removed, then the ratio of chrome to iron is increased.

With a good passivation procedure, elemental chrome to iron ratios in the range of 0.75 to 2.0 can be attained.

Reducing iron content at the surface, while leaving chrome, results in a "chromium rich“ surface, which is less likely to form corrosion products. The "chromium rich" or passive layer is found to be extremely thin - not more than 50 angstroms in depth.

Stainless steel corrosion in High Purity Water Systems

Stainless steel corrosion in Argonne HPR system



Current maintenance procedure:

1. Sanitize with 1 – 2% Minncare solution every 12 month
2. Replace first filter every month, second filter every 6 month.
3. Rinse with DI water

MINNCARE® COLD STERILANT (EPA Reg. No. 52252-4)

Component	CAS #	Amount (percentage by Weight)	PEL
Hydrogen Peroxide	7722-84-1	22.0%	1 ppm
Peracetic Acid	79-21-0	4.5%	NE
Acetic Acid	64-19-7	-	10 ppm
Water	7732-18-5	-	NE

Next steps

- Inspect internal surfaces of pump heads and manifolds at Argonne for signs of corrosion or surface contamination.
- Clean and passivate both manifolds and High Pressure pump heads on-site or off-site if needed.
- Coat internal surfaces with Tantaline solution (surface alloy technology that create an extremely rugged, uniform, inert and corrosion resistant tantalum surface).*

*No indication that HPR system is degrading cavity performance.