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CORROSION OF CONSTRUCTION MATERIALS

IN 234-5 PROJECT SOLUTIONS (1)

INTRODUCTION

Laboratory corrosion studies in support of the 234-5 Project at the Hanford Works were authorized over an eighteen month period which began in May 1948 and ended in November 1949. Construction materials were to be selected for equipment which might arbitrarily be classified in one of three categories (a) Pre-process equipment, e.g., solution preparation vessels and transfer lines, (b) Process equipment, e.g., vessels, agitators, air spargers, valves and transfer lines, and (c) Laboratory equipment, e.g., hoods, pails, beakers, etc. Such materials as glass and tantalum, both known to be most resistant to the liquid environments under consideration have definite limitations for some applications; glass, of course, has a propensity for breaking and tantalum is quite expensive.

This program was to include metals, alloys and non-metallics of interest to the 234-5 Project Development Group. While the prime objective was to be the selection of corrosion resistant materials and the determination of their corrosion rates in process solutions, a secondary objective, namely the evaluation of the effects of heat treatment and surface preparation on the corrosion resistance of austenitic stainless steels was undertaken in order to establish whether these steels would have limited application in the process.

The laboratory corrosion tests which were employed to carry out this program and the data procured therefrom are contained herein. The original notes are contained in laboratory notebook HW-2371-T.

SUMMARY

According to the data obtained from laboratory corrosion tests which simulated 234-5 Project environments, tantalum is the only metallic material which can be employed under all test conditions. Of the non-metallics, Fluorothene and Teflon showed satisfactory resistance.

Duriron, austenitic stainless steels T-304 ELC and T-316 and Hastelloys B and C and MFP-10 (Plasticized), Saran and Vinylite 1911 and 6461 may have limited use depending upon specific requirements. Havg 41 and 43, Koroseal, Lucite, Neoprene, Polythene and Tygon (S 22-1) failed to exhibit satisfactory resistance in laboratory tests.

(1) Supersedes:

- (a) "234-5 Project Static Corrosion Tests; Plastic and Synthetic Rubber in Hydriodic Acid and/or Process Supernatant Solution," W.W. Koenig, HW-12172, 1-3-49.
- (b) "Corrosion Tests on Tantalum, Hastelloy C and Duriron in 234-5 Project Solutions," W. W. Koenig, HW-12552, 2-25-49.
- (c) "Vinylite and Hydriodic Acid Solutions," W. W. Koenig, HW-13419, 5-18-49.

DETAILS

Actual duplication of process environments for corrosion testing was held to be impractical under existing conditions, therefore the laboratory corrosion tests employed were designed to simulate the most corrosive process conditions which could be anticipated and yet maintain simplicity of test equipment.

Test Environments

The test environments included the following solutions and their vapors: (a) Hydriodic acid, 47% by wt. at room temperatures (2). (b) Synthetic 234-5 Project supernatant at room temperatures and, (c) Synthetic 234-5 Project supernatant at boiling temperatures.

Construction Materials

The following construction materials were tested:

Metals & Alloys

Duriron
Hastelloy B
Hastelloy C
Stainless Steels:
T-304
T-304 ELC
T-316
T-347
T-309 SCb
Carpenter 20
Tantalum

Non-Metallics

Havag 41
Havag 43
Koroseal
Lucite
MFP-10 (Fluoroethene)
Neoprene
Polythene
Saran
Teflon
Tygon S22-1
Vinylite 1911
Vinylite 6461

Specimen Preparation

By and large the shapes of the test specimens were dictated by the samples which were received from the manufacturer for test purposes. In general, the test specimens were rectangular in shape with the ratio of surface to mass large and that of edge area to total area relatively small. The edges of all samples were finished, either by machine in the case of the metallics, or by sanding with No. 00 paper in the case of the non-metallics. Prior to weighing to ± 0.0001 gm. and test exposure, the metallics were degreased, rinsed in alcohol and air dried. The cleaning and degreasing methods employed with the non-metallics varied according to their individual characteristics.

In general the austenitic stainless steels were tested in the "as received" (hot rolled, annealed, pickled), "as welded" and the "welded-annealed-water quenched" conditions. Tantalum and the remaining alloys were tested "as received". Appendix 5, p. 18, "Corrosion Rates Of Metals and Alloys Exposed to 234-5 Project Process Solutions", lists the fabrication for each individual test specimen of the metallic group in addition to the test results.

(2) Tantalum, only, was also tested in 47% HI at boiling temperatures.

The non-metallics were all tested "as received". The data are contained in Appendix 3, p.16, "Test Data For Non-Metallic Exposed To 234-5 Project Process Solutions".

Aeration

All corrosives employed were considered to be initially air saturated. No attempt was made to aerate the test environments during the exposure periods.

Agitation

The room temperature tests were carried out under static conditions. Tests at boiling temperatures were naturally agitated by convection currents and solution bubbling.

Apparatus

For the room temperature tests the apparatus consisted simply of glass jars with covers and glass holders designed to hold the test sample in the desired environment. The apparatus for the boiling temperature tests was essentially the same, except that erlenmeyer flasks and condensers, attached by means of ground glass connections, were used. Heating was accomplished by means of electric hot plates.

Calculations

$$C \text{ mils/yr} = \frac{527,000 W}{DAT}$$

Where:

- C mils/yr = Corrosion rate in mils penetration per year assuming uniform corrosion.
- W = Loss in weight, expressed in grams, of test specimen.
- D = Density of metal or alloy expressed in grams per cubic centimeter.
- A = Area of test piece in square inches.
- T = Exposure time expressed in hours.

Cleaning, Post Exposure

Upon removal from the test environment the test specimens were water washed and brushed with a bristle brush. This was in most instances adequate for the removal of test solution and such corrosion products which might have formed. Some of the alloys, however, were covered or partially covered with a scale-like deposit which was quite adherent. A more detailed investigation would have called for severe cleaning measures, e.g., wire brushing, chipping or electro-chemical cleaning, to

remove this product, however, since these specimens had failed and the prime object of these tests was to determine corrosion resistance, further examination was not thought to be warranted.

Corrosive Media

All corrosives in tests at boiling temperatures were changed daily and those in tests at room temperature at each test period, or weekly, whichever came first. See Appendix 2, Table 1, p. 13, "Composition of Corrosives."

Duration

The exposure time was largely determined by the resistance of the individual materials tested to the corrosives. Those specimens which evidenced resistance were exposed up to 1.3 months while those which failed were usually taken from the test at the time of failure.

Temperature

These tests were carried out at three temperatures. The room temperature was approximately 22.2°C (72°F), the boiling temperature of the 234-5 process supernatant was 101°C and the temperature of the vapor atmosphere over the boiling supernatant was 100°C.

Specific data for each sample are included in Appendices 3 and 5, pp. 16, 18.

Velocity

Room temperature tests: none
Boiling temperature tests: unknown

EVALUATION OF RESULTS

Tantalum exhibited superior corrosion resistance to both 47% (by wt.) hydriodic acid and the 234-5 Process supernatant solution under all laboratory test conditions which included room and boiling temperatures. In addition to the normal 47% hydriodic acid tests, hydriodic acid which had been stabilized with 1.5% H_3PO_2 was also used.

Duriron exhibited corrosion resistance after becoming passivated in the first 43-hour exposure period during which a grayish film was formed on the test specimens. However, it has disadvantages which are discussed below under the appropriate heading. Hastelloy B and C and several austenitic stainless steels, notably T-316 and T-304 ELC, exhibited limited resistance to individual test solutions under specific conditions, e.g., the 234-5 Project supernatant solution at room temperatures (22.2°C, approximately).

While these materials cannot be recommended without definite limitations, they may find some use as materials for laboratory equipment, or such plant equipment as agitators, air spargers, addition tubes and the like.

Among the plastics, Teflon and Fluorothene exhibited excellent resistance. Saran exhibited good resistance; however, it became somewhat discolored during exposure.

Exposure data are contained in Appendix 4, p. 17. "Construction Materials vs Synthetic 234-5 Project Process Solutions", Appendix 5, pp.18, "Corrosion Rates Of Metals and Alloys Exposed to 234-5 Project Process Solutions", and Appendix 3, pp. 16. "Test Data For Non-Metallics Exposed to 234-5 Project Process Solutions".

Duriron

According to the data collected from complete immersion and vapor suspension tests in 47% (by wt.) hydriodic acid and its vapors at room temperatures, Duriron acquires a grayish film and becomes passivated during the first 48-hours of exposure and the initial high rate of corrosion falls off to a low rate on the order of 1-mil per year or less. Total exposure time was approximately 1.5 months.

However, since Duriron is a cast material, of high silicon content and consequently fabricated with difficulty, it has definite structural limitations. For this reason it was not subjected to further tests. A test program sufficiently broad to include castings of this material may show it to have definite value.

Hastelloy B & C

Hastelloy B in the "as received" condition resisted attack by 47% HI at room temperature under partial immersion conditions during a 4-day test period. A very slight discoloration of the immersed portion was noted along with a corrosion rate of 1.77 mils/yr. In 47% HI at boiling temperatures and in 234-5 Project supernatant solution, however, this material failed, exhibiting general corrosion with definition of grain boundaries and pitting. This material apparently would have limited application under these conditions.

Hastelloy C was tested in the "as cast", "as rolled", and "as welded" conditions. In general it showed rather low corrosion rates and signs of some passivation in 47% (by wt.) HI and 234-5 Project supernatant solution at room temperatures although corrosion products which would contaminate any process stream were formed. These were apparently due to chemical reaction with components of the alloy, notably nickel. In two cases high corrosion rates were observed for this material. A sample of "rolled-welded-sandblasted" material in 47% HI (total immersion test) suffered a corrosion rate of 65.2 mils/year along with the formation of corrosion products, and a sample of "as cast - ground finished" material showed evidence of limited pitting in both environments but no evidence of general corrosion on its ground surfaces. However, each specimen contained a suspension hole which was left in the "as cast" condition and these holes showed evidence of general corrosion and the formation of corrosion products.

In 234-5 Project supernatant solution all samples exhibited high corrosion rates.

While it might be possible to employ Hastelloy C under certain conditions at room temperatures where contamination by foreign ions is not a factor, this material cannot be recommended without reservation.

Stainless Steel, austenitic

Five types of austenitic stainless steel were tested, T-309 SCS, T-304, T-347, T-304 ELC and Carpenter 20. None can be recommended for use in 47% HI or 234-5 Project supernatant solution without reservation. They are definitely unsuited for use in (a) 47% HI solution, in which severe general corrosion was noted, or in its vapors, in which erratic pitting and discoloration were noted or in (b) 234-5 Project supernatant solution or its vapors at boiling temperatures, in which environments, especially the latter, severe corrosion was noted.

In 234-5 Project supernatant solution at room temperatures, however, these steels showed some resistance, although erratic pitting, especially at liquid-vapor interfaces, and discolorations were noted. The T-316 and T-304 ELC types were the most resistant in the order named. Since several of these specimens acquired superficial pits there is no guarantee that the protective oxide film will remain unbroken for any predictable period. However, for such application as agitators, addition tubes, etc., these two stainless steels may well be exposed in plant tests.

Tantalum

Tantalum was exposed to 47% (by wt.) hydriodic acid, 47% HI plus 1.5% H_3PO_2 , 234-5 Project supernatant and 234-5 Project supernatant containing H_3PO_2 , solutions and their vapors at room and boiling temperatures. Exposure periods of 2.5 weeks at room temperature failed to show detectable weight or appearance changes. Six days exposure at boiling temperatures failed to reveal any appearance changes and no corrosion rates $\geq \pm 0.79$ mils.

Fluorothene

See MFP-10

Haveg 41 and 43

Haveg 41 and Haveg 43 were exposed to 234-5 Project supernatant solution and its vapors at room temperatures. After seven days exposure both materials evidenced discoloration and loss of surface compound although weight increases from 0.25% to 1.3% were measured, indicating absorption. Unacceptable.

Koroseal

Koroseal exposed to 234-5 Project supernatant solution and its vapors for 4 days at room temperatures evidenced surface embrittlement in the solution immersion test and swelling and deterioration (the surface became putty-like) in the vapor suspension test, along with weight gains from 18% to 76%. Unacceptable.

Lucite

Lucite (plain and cemented sheets) were exposed to both 47% hydriodic acid and 234-5 Project supernatant solution at room temperatures for 14 days. Weight gains, due to absorption, from 12.7% to 31.7% were measured and discoloration and swelling of the edges of this material were observed. Unacceptable.

MFP-10 (Fluoroethene)

MFP-10 was exposed to 234-5 Project supernatant solution and its vapors at room temperatures for 42-days without undergoing any detectable chemical or physical changes, except for a 0.012% to 0.021% wt. loss. Acceptable.

MFP-10. Plasticized

Plasticized MFP-10 was exposed to both 234-5 Project supernatant solution and 47% hydriodic acid and their vapors at room temperatures. In the former, a 20-day exposure period produced an amber discoloration and weight gain of 0.139% in the solution and 0.021% in its vapors. In the 47% environment a weight loss of 0.216% was measured for the sample exposed to the solution after a 35-day period and a weight loss of 0.242% for the sample exposed to the vapors after a like period. A possible loss in pliability was noted in both cases. Questionable.

Neoprene

Neoprene exposed for 10-days to 234-5 Project supernatant solution and its vapors at room temperatures showed high absorption with weight gains of 46.3% and 23.9% respectively. Unacceptable.

Polythene

Polythene exposed for 10-days to 234-5 Project supernatant solution and its vapors showed discoloration and absorption as evidenced by weight gains of 2.47% and 2.37% respectively. Unacceptable.

Saran

Saran exposed for 20-days to 234-5 Project supernatant solution and its vapors at room temperatures showed slight discolorations and weight gains of 0.104% from solution exposure and 0.059% from vapor exposure. Limited application.

Teflon

Teflon exposed to 234-5 Project supernatant and its vapors at room temperature appeared normal after 42-days exposure. Weight gains of only 0.013% and 0.019% were recorded for the solution immersion and vapor suspension samples respectively. Acceptable.

Tygon (S 22-1)

Tygon (S 22-1) showed absorption of liquid (4.21% by wt.) and vapor (2.02% by wt.) upon 10-days exposure to 234-5 Project supernatant solution. Unacceptable.

Vinylite 1911 and 6461

Vinylite formulations 1911 and 6461 were exposed for 16-days at room temperatures in 49% (by wt.) HI and 234-5 Project supernatant solutions and their vapors. Weight gains, attributable to absorption, which varied from 0.058% to 0.67% with an average of 0.366%, were recorded. Both vinylite

types acquired an olive-drab discoloration but retained their original semi-glossy (6461) and glossy (1911) textures and exhibited no dimensional changes. Questionable.

WV Koenig:eg

APPENDIX 1

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"Corrosion Handbook," H.H. Uhlig, John Wiley & Sons, Inc. 1948.

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Company, Inc., 1949.

APPENDIX IITABLE ICOMPOSITION OF CORROSIVES

1. 234-5 Project Process Supernatant Solution (Synthetic):

Fe (NO ₃) ₃ ·9H ₂ O	1.616	mg/liter
Ce (NO ₃) ₃ ·xH ₂ O	0.362	"
NiSO ₄ ·6 H ₂ O	0.184	"
KHSO ₄	8.17	"
KH ₂ PO ₄	0.272	"
KNO ₃	36.4	"
HI (Anhydrous basis)	103.7	"
I ₂	33.0	"
HO ₂ C·CO ₂ H	27.7	"

2. Hydriodic Acid: Merck reagent, Sp. Gr. 1.7:

Assay, HI	55-58%
Maximum impurities:	
Non-volatile	0.010%
Chlorine, bromine (as Cl)	0.050%
Phosphorus	0.003%
Sulfate (SO ₄)	0.005%
Heavy Metals (as Pb)	0.001%
Iron (Fe)	0.001%
Mol. Wt.	127.93

3. Hydriodic Acid (Stabilized): Baker's Reagent, Sp. Gr. 1.7:

Assay, HI (min)	56%
Maximum impurities:	
Chlorine and bromine (as Cl)	0.05%
Sulfate (SO ₄)	0.005%
Iron (Fe)	0.001%
Heavy Metals (as Pb)	0.001%
H ₃ PO ₂ (Preservative) approx.	3.0%

TABLE II
PLASTICS DATA

<u>Trade Name</u>	<u>Type Of Plastic</u>
Haveg	Phenol-formaldehyde moulding compounds
Haveg 41	Phenolic-asbestos filler
Haveg 43	Phenolic-graphite filler
Koroseal	Polyvinyl chloride elastomer
Lucite	Acrylate or methyl methacrylate resin
MFP-10*	Polymer of trifluoromonochloropolyethylene
Neoprene	Polymers of chloroprene
Polythene	Polyethylene - polymer of ethylene
Saran	A polyvinylidene chloride
Teflon	Polymer of tetrafluoroethylene
Tygon F	Furfural resin
Tygon T (S 22-1)	Modified vinyl derivative plastic
Vinylite	Vinyl chloride-acetate resins
1911	
6461	

* Fluorothenes - was originally a classified material with the code name of MFP-10; also KEL-F. In these tests fluorothenes-A was employed.

TABLE III
METAL AND ALLOY DATA

<u>Metal Or Alloy</u>	<u>Nominal Composition</u>		<u>Special Characteristics</u>								
Duroiron - (High Silicon Iron)	Silicon	14.50%	Very hard Machined by grinding Available in cast form Relatively inexpensive								
	Carbon	0.85%									
	Manganese	0.50%									
	Sulfur	0.80%									
	Phosphorus	0.20%									
	Iron	Balance									
Hastelloy B - (Nickel-Molybdenum- Iron Alloy)	Nickel	62.5-66.5%	Readily weldable and machinable, it can be fabricated into almost any type of chemical processing equipment. Corrosion resistance to boiling hydrochloric acid and wet hydrochloric acid gas and has good resistance to phosphoric acid.								
	Molybdenum	26-30									
	Carbon	0.02-0.12%									
	Iron	4-6%									
Stainless Steels -	C	Mn	P	S	Si	Ni	Cr	Other	The chromium-nickel austenitic stainless steels, as a class, exhibit a high order of resistance to corrosion and tarnishing in many media, maintenance of strength properties and resistance to oxidation at elevated temperatures, superior forming characteristics, and the ability to develop high mechanical strength when suitably processed.		
	Max.	Max.	Max.	Max.	Max.	%	%	%			
	T-304	0.08	2.0	0.04	0.03	1.0	8-10	8-20		Bal. Fe	
	T-304 ELC	0.03	2.0	0.04	0.03	1.0	8-10	8-20		Bal. Fe	
	T-316	0.10	2.0	0.04	0.03	1.0	10-14	16-18		Mo 1.75-2.75 Bal. Fe	
	T-347	0.10	2.0	0.04	0.03	1.0	9-12	17-19		Cb 10xC Min Bal. Fe	
	T-309 SCb (Dupont) 820-B	0.07	1.25-2.5	0.035	0.03	0.75	12 Min	22 Min		Cb 10xC Min 1.0 Max. Bal. Fe	
	Carpenter 20	0.07	0.75			1.0	29	20		Mo 2.0 Min Cu. 3.0 Min, Bal Fe	
	Tantalum	Tantalum	99.96%	Corrosion resistant metal used in heat - transfer area in acid-proof chemical equipment. It oxidizes in air above 300°C (570°F), is soluble in hydrofluoric acid and in solutions that contain free sulfur trioxide. In general, it is corrosion resistant except when subject to galvanic couple action. Tantalum can be spot and seam resistance welded.							
		Chromium	0.03%								
	Iron	0.01%									

APPENDIX

TEST DATA FOR NON-METALLICS EXPOSED TO 234-5 PROJECT PROCESS SOLUTIONS

TEST CONDITIONS: TEMPERATURE - ROOM (APPROX. 22.2°C, 72°F).

EXPOSURE - LIQUID IMMERSION AND VAPOR SUSPENSION, SEE BELOW.

AGITATION - NONE.

AERATION - NONE. TEST SOLUTIONS WERE ASSUMED TO BE INITIALLY AIR-SATURATED.

NON-METALLIC	TEST SOLUTION	TYPE EXPOSURE	DURATION (DAYS)	PER CENT WT. CHANGE	TEST	REMARKS
MAVCO 41	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	7	+ 1.3	HC-55	SOME DISCOLORATION ALONG SAVED EDGES AND ON SURFACES. LOSS OF SURFACE COMPOUND.
	"	VAPOR	7	+ 1.2	HC-56	"
MAVCO 43	"	IMMERSION	7	+ 0.38	HC-57	SOME DISCOLORATION AND LOSS OF SURFACE COMPOUND.
	"	VAPOR	7	+ 0.25	HC-58	"
KOROSAL	"	IMMERSION	4	+76.3	HC-43	SURFACE BRITTLENESS.
	"	VAPOR	4	+18.6	HC-44	SWELLING AT EDGES AND SURFACES PUTTY-LIKE.
LUCITE	47% HI	IMMERSION	14	+31.7	HC-29	SWELLING AT EDGES AND DISCOLORATION.
	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	14	+15.9	HC-30	"
LUCITE (CEMENTED SHEET)	47% HI	IMMERSION	14	+18.4	HC-31	UNION SATISFACTORY.
	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	14	+12.7	HC-32	"
MPP-10	"	IMMERSION	42	- 0.012	HC-45	APPEARED NORMAL.
	"	VAPOR	42	- 0.027	HC-46	"
MPP-10 (PLASTICIZED)	"	IMMERSION	20	+ 0.139	HC-39	AMBER DISCOLORATION, STILL TRANSLUCENT, HOWEVER.
	"	VAPOR	20	+ 0.021	HC-40	"
	47% HI (1.5% H ₂ FO ₂)	IMMERSION	35	- 0.216	HC-58	NO DISCOLORATION, POSSIBLE REDUCTION OF RELIABILITY.
	"	VAPOR	35	- 0.242	HC-54	"
NEOPRENE	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	10	+46.3	HC-35	ABSORPTION.
	"	VAPOR	10	+23.9	HC-36	"
POLYTHENE	"	IMMERSION	10	+ 2.47	HC-33	DISCOLORATION.
	"	VAPOR	10	+ 2.37	HC-34	"
SARAN	"	IMMERSION	20	+ 0.104	HC-41	(SLIGHT).
	"	VAPOR	20	+ 0.059	HC-42	"
TEFLON	"	IMMERSION	42	+ 0.013	HC-47	APPEARED NORMAL.
	"	VAPOR	42	+ 0.019	HC-48	"
TYGON (822-1)	"	IMMERSION	10	+ 4.21	HC-37	ABSORPTION.
	"	VAPOR	10	+ 2.02	HC-38	"
VINYLLITE 1911	47% HI	IMMERSION	18	+ 0.167	1	OLIVE DRAB DISCOLORATION; NO DIMENSIONAL CHANGES; RETAINED GLOSS AND FLEXIBILITY; MOISTURE ABSORPTION.
	"	VAPOR	18	+ 0.058	2	"
	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	18	+ 0.427	3	"
	"	VAPOR	18	+ 0.308	4	"
VINYLLITE 6461	47% HI	IMMERSION	18	+ 0.413	5	OLIVE DRAB DISCOLORATION; NO DIMENSIONAL CHANGES; RETAINED SEMI-GLOSS AND FLEXIBILITY; MOISTURE ABSORPTION.
	"	VAPOR	18	+ 0.350	6	"
	234-5 PROJECT SUPERNATANT, SYNTHETIC	IMMERSION	18	+ 0.670	7	"
	"	VAPOR	18	+ 0.536	8	"

APPENDIX 5

CORROSION RATES OF METALS AND ALLOYS EXPOSED TO 234-5 PROJECT PROCESS SOLUTIONS

- NOTES: 1. CORROSION RATES ARE EXPRESSED IN MILS PENETRATION/YEAR, ARE RECORDED TO NEAREST 0.01 MIL, AND ASSUME UNIFORM CORROSION FOR ALL SPECIMENS INCLUDING THOSE PARTIALLY IMMERSSED. THIS GIVES A LOW CORROSION RATE FOR THESE SPECIMENS AND DOES NOT INDICATE THE MAXIMUM PIT DEPTH WHERE PITTING OCCURRED. A PLUS (+) SIGN INDICATES A WEIGHT GAIN. CORROSION RATES <0.01 MIL ARE RECORDED AS "NIL."
 2. IN THIS TABLE AN "X" INDICATES NO DATA FOR THE TEST PERIOD IN QUESTION AND "-" INDICATES THAT THE TEST PERIOD IN QUESTION WAS OMITTED.
 3. TEST CONDITIONS:
 AERATION: NONE, CORROSIVES INITIALLY AIR SATURATED.
 AGITATION: NONE WITH ROOM TEMP. TESTS; CONVECTION CURRENTS WITH BOILING TEMP. TESTS.
 TEMPERATURE: AS INDICATED BELOW.
 4. THE 234-5 PROJECT SUPERNATANT SOLUTION REFERRED TO HEREIN IS SYNTHETIC.

MATERIAL	ENVIRONMENT	TEST	SPECIMEN PREPARATION	I.D. NO.	CORROSION / TEST PERIOD					CORR. RATE	REMARKS		
					1st 48 HRS	2nd 48 HRS	3rd 72 HRS	4th 1 WK	5th 1 WK			6th 1 MO	
T-3093CD	47% HI, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS RECEIVED	S-25	46.81	4.53	0.24	0.09	31.70	16.86	16.27	GENERAL CORROSION OF IMMERSSED PORTION, PITS 18 MILS.	
			AS WELDED	S-35	56.04	73.37	-	-	-	-	64.56		GENERAL CORROSION OF IMMERSSED PORTION.
		STATIC, TOTAL IMMERSION	WELDED, ANNEALED AND QUENCHED	S-45	57.99	178.18	-	-	-	-	-	118.09	GENERAL CORROSION OF IMMERSSED PORTION. LONGITUDINAL WELD CRACKS AND WELD POROSITY.
			AS RECEIVED AND 4-F FINISHED	S-15	55.40	96.69	-	-	-	-	-	75.05	
		STATIC, PARTIAL IMMERSION	AS WELDED AND 4-F FINISHED	S-5	50.11	128.13	-	-	-	-	-	89.12	GENERAL CORROSION OF IMMERSSED PORTION. LONGITUDINAL WELD CRACK AND PITTING.
				S-56	42.49	2.67	0.59	0.10	25.90	16.43	15.04	GENERAL CORROSION OF IMMERSSED PORTION. LONGITUDINAL WELD CRACKS AND WELD POROSITY.	
		VAPOR SUSPENSION	AS RECEIVED	S-26	0.56	24.15	0.73	0.19	0.35	0.55	1.32	SOME ERRATIC ATTACK AND BROWN DISCOLORATION.	
				S-36	2.49	66.97	NIL	1.78	0.52	0.80	3.28		
		VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED	S-46	2.52	197.83	-	-	-	-	100.18	GENERAL CORROSION, WELD MACHS ETCHED.	
				S-16	0.36	2.68	2.27	0.03	1.03	1.03	0.99		SOME ERRATIC, SHALLOW PITTING AND BROWN STAINING.
	VAPOR SUSPENSION	AS RECEIVED AND 4-F FINISHED	S-6	NIL	0.77	NIL	0.16	X	1.04	1.02	SOME ERRATIC, SUPERFICIAL PITTING - FAIR APPEARANCE.		
			S-55	14.43	4.92	0.57	0.08	0.32	0.82	1.16			
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS RECEIVED	S-21	NIL	-	0.50	0.59	1.33	0.10	0.67	ERRATIC ETCHING OF IMMERSSED PORTION AND PHASE LINE - FAIR APPEARANCE.	
			AS WELDED	S-31	0.41	-	0.41	0.12	3.99	0.84	1.15		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED, AND QUENCHED	S-41	3.76	X	1.75	0.30	0.01	NIL	0.31	SLIGHT ERRATIC ETCHING OF IMMERSSED PORTION AND PHASE LINE - FAIR APPEARANCE.	
				S-11	0.38	X	0.06	X	0.11	0.06	0.06		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS RECEIVED AND 4-F FINISHED	S-1	NIL	0.30	X	0.06	0.46	0.07	0.13	ONE SUPERFICIAL PIT - GOOD APPEARANCE.	
				S-51	0.09	X	4.25	0.90	0.13	0.01	0.47		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-2	0.95	X	0.43	1.45	2.30	0.10	0.67	FEW SUPERFICIAL PITS AT ONE END - FAIR APPEARANCE.	
				S-22	0.95	X	0.43	1.45	2.30	0.10	0.67		
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS RECEIVED	S-2	0.95	X	0.43	1.45	2.30	0.10	0.67	ERRATIC ETCHING.		
			S-32	1.10	X	0.81	X	5.54	0.85	1.42			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS WELDED	S-42	6.67	X	1.14	0.73	0.61	2.89	2.26	ERRATIC ETCHING. WELD CRACK AND POROSITY PRESENT PRIOR TO EXPOSURE.		
			S-12	0.36	X	0.18	*(0.10)	X	0.03	0.30			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS RECEIVED AND 4-F FINISHED	S-2	0.38	2.40	X	NIL	1.38	0.85	0.37	FEW SUPERFICIAL PITS, FAIR APPEARANCE.		
			S-2	0.38	2.40	X	NIL	1.38	0.85	0.37			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	TOTAL IMMERSION	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-52	0.15	X	1.84	0.29	0.74	0.97	0.92	SOME ERRATIC, SUPERFICIAL PITTING.		
			S-23	1.07	28.45	1.63	33.37	-	-	12.80			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	TOTAL IMMERSION	AS RECEIVED	S-33	8.18	20.98	5.45	8.77	-	-	11.23	ETCHING, SLIGHT ERRATIC PITTING.		
			S-43	56.78	4.89	3.50	3.56	-	-	21.58			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	TOTAL IMMERSION	WELDED, ANNEALED AND QUENCHED	S-13	2.70	454.58	1.39	-	-	-	152.89	GENERAL CORROSION, PITTING, ESP. TOWARD BOTTOM EDGES.		
			S-3	20.33	11.35	8.71	-	-	-	14.83			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	TOTAL IMMERSION	AS WELDED AND 4-F FINISHED	S-53	0.59	63.21	43.92	8.62	-	-	33.16	ERRATIC PITTING.		
			S-24	0.06	1397.27	-	-	-	-	931.53			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS RECEIVED	S-34	10.37	1202.52	-	-	-	-	805.14	GENERAL CORROSION AND PITTING.		
			S-44	X	384.29	-	-	-	-	256.19			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	WELDED, ANNEALED, AND QUENCHED	S-14	0.30	X	241.68	-	-	-	172.67	GENERAL CORROSION, PITTING, ESP. TOWARD BOTTOM EDGES.		
			S-4	1055.30	-	-	-	-	-	1055.30			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS WELDED AND 4-F FINISHED	S-54	2360.65	-	-	-	-	-	2360.65	ERRATIC PITTING.		
			S-54	2360.65	-	-	-	-	-	2360.65			
T-304	47% HI, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS RECEIVED	S-104	48.24	-	-	-	-	-	48.24	GENERAL CORROSION OF IMMERSSED PORTION, VAPOR PORTION STAINED.	
			AS WELDED	X	NO SAMPLE.	-	-	-	-	-	-		
		STATIC, PARTIAL IMMERSION	WELDED, ANNEALED, AND QUENCHED	S-84	77.25	-	-	-	-	-	-	77.25	GENERAL CORROSION OF IMMERSSED PORTION, VAPOR PORTION STAINED, & SEVERAL PITS IN WELD ZONE.
			AS RECEIVED AND 4-F FINISHED	S-94	70.44	-	-	-	-	-	-	70.44	
		STATIC, PARTIAL IMMERSION	AS WELDED AND 4-F FINISHED	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-74	43.29	-	-	-	-	-	43.29	ETCHING - GOOD APPEARANCE.
	AS RECEIVED AND 4-F FINISHED			S-105	1.60	3.05	X	0.78	1.26	X	1.25		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS RECEIVED	S-85	2.22	2.52	X	1.08	1.58	X	1.57	GENERAL CORROSION OF IMMERSSED PORTION, VAPOR PORTION STAINED, & SEVERAL PITS IN WELD ZONE.	
				S-95	3.05	1.16	X	1.30	1.61	X	1.61		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	VAPOR SUSPENSION	AS RECEIVED AND 4-F FINISHED	S-75	2.57	3.70	X	1.96	-	0.23	1.59	ETCHING, WELD POROSITY REVEALED - APPEARANCE GENERALLY GOOD.	
				S-100	1.98	0.95	-	NIL	NIL	0.56	0.18		
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-75	2.57	3.70	X	1.96	-	0.23	1.59	ETCHING - GOOD APPEARANCE. HOWEVER, PITS REVEALED AT 36X.		
			S-100	1.98	0.95	-	NIL	NIL	0.56	0.18			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS RECEIVED	S-75	2.57	3.70	X	1.96	-	0.23	1.59	ONE SUPERFICIAL PIT, SOME APPEARANCE.		
			S-100	1.98	0.95	-	NIL	NIL	0.56	0.18			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS WELDED	S-80	15.02	-	-	-	-	-	15.02	SLIGHT ETCH.		
			S-90	10.25	-	-	-	-	-	10.25			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED AND QUENCHED	S-80	15.02	-	-	-	-	-	15.02	FITTING ATTACK AT LIQUID-VAPOR INTERFACE.		
			S-90	10.25	-	-	-	-	-	10.25			
234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS RECEIVED AND 4-F FINISHED	S-80	15.02	-	-	-	-	-	15.02	FITTING ATTACK AT LIQUID-VAPOR INTERFACE.		
			S-90	10.25	-	-	-	-	-	10.25			

APPENDIX 5 (CONTINUED)

SERIAL	ENVIRONMENT	TEST	SPECIMEN PREPARATION	I.D. NO.	CORROSION / TEST PERIOD						COMPL. LATIVE	REMARKS	
					1st 48 HRS	2nd 48 HRS	3rd 72 HRS	4th 1 WK	5th 1 WK	6th 1 MO			
306	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS WELDED AND 4-F FINISHED	I	NO SAMPLE.								
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-70	44.36	-	-	-	-	44.36	FITTING ATTACK AT LIQUID-VAPOR INTERFACE AND VAPOR PORTION.		
		VAPOR SUSPENSION	AS RECEIVED	S-101	3.58	1.01	-	0.36	-	1.95	0.93	ETCHING AND A FEW SUPERFICIAL PITS - GOOD APPEARANCE.	
			AS WELDED	I	NO SAMPLE.								
			WELDED, ANNEALED AND QUENCHED	S-81	10.49	5.42	-	5.41	8.21 (2 WKS)	-	7.48	GENERAL CORROSION AND FITTING.	
			AS RECEIVED AND 4-F FINISHED	S-91	2.99	1.54	-	0.04	-	0.72	0.70	SOME SUPERFICIAL FITTING.	
			AS WELDED AND 4-F FINISHED	I	NO SAMPLE.								
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-71	9.75	0.59	-	13.72	10.44 (2 WKS)	-	10.50	FITTING.	
			TOTAL IMMERSION	AS RECEIVED	S-102	186.90	89.61 (24 HRS)	-	-	-	-	352.03	GENERAL ATTACK AND PIN-POINT PITS.
				AS WELDED	I	NO SAMPLE.							
307	47% HI, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED	S-86	560.19	-	-	-	-	560.19	GENERAL ATTACK AND PIN-POINT PITS - FAIR APPEARANCE, HOWEVER.		
			AS RECEIVED AND 4-F FINISHED	S-92	47.83	35.80 (24 HRS)	-	-	-	43.82			
		VAPOR SUSPENSION	AS WELDED AND 4-F FINISHED	I	NO SAMPLE.								
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-72	2451.12	-	-	-	-	-	2451.12	FITTING.	
			AS RECEIVED	S-103	1777.80	-	-	-	-	-	1777.80	GENERAL CORROSION AND FITTING.	
			AS WELDED	I	NO SAMPLE.								
			WELDED, ANNEALED & QUENCHED	S-57	2256.73	-	-	-	-	-	2256.73		
			AS RECEIVED AND 4-F FINISHED	S-93	421.15	749.01 (24 HRS)	-	-	-	-	530.44		
			AS WELDED AND 4-F FINISHED	I	NO SAMPLE.								
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-73	793.37	-	-	-	-	-	793.37		
307	47% HI, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	AS RECEIVED	S-114	134.92	-	-	-	-	134.92	GENERAL CORROSION OF IMMERSED PORTION.		
			AS WELDED	S-134	106.06	-	-	-	-	106.06	GENERAL CORROSION OF IMMERSED PORTION AND SIGNS OF FITTING AT INTERFACE.		
		VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED	S-164	100.46	-	-	-	-	-	100.46	GENERAL CORROSION OF IMMERSED PORTION, STAINS VAPOR PORTION.	
			AS RECEIVED AND 4-F FINISHED	S-124	116.99	-	-	-	-	-	116.99		
			AS WELDED AND 4-F FINISHED	S-154	84.28	-	-	-	-	-	84.28		
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-116	99.42	-	-	-	-	-	99.42		
			AS RECEIVED	I	NO SAMPLE.								
			AS WELDED	S-135	1.16	0.47	-	0.56	-	1.40	1.05	SUPERFICIAL FITTING; SOME STAINING.	
			WELDED, ANNEALED & QUENCHED	S-165	1.33	-	-	-	-	-	1.33	SUPERFICIAL FITTING; STAINING.	
			AS RECEIVED AND 4-F FINISHED	S-125	0.12	0.92	-	1.48	-	0.94	1.01		
AS WELDED & 4-F FINISHED	S-155	X	0.41	-	8.20	-	-	5.74					
308	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-115	0.53	1.04	-	0.80	-	1.49	1.28		
			AS RECEIVED	I	NO SAMPLE.								
		VAPOR SUSPENSION	AS WELDED	S-130	0.38	2.37	-	0.73	-	0.63	0.20	NO VISUAL CHANGE - GOOD APPEARANCE.	
			WELDED, ANNEALED & QUENCHED	S-160	1.54	0.98	-	X	-	0.10	0.20		
			AS RECEIVED AND 4-F FINISHED	S-120	2.93	-	-	-	-	-	2.93	ERRATIC FITTING ALONG LIQUID-VAPOR INTERFACE AND SUBMERSED PORTION.	
			AS WELDED AND 4-F FINISHED	S-150	0.24	1.25	-	3.52	-	-	2.67		
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-110	3.02	5.54	-	-	-	-	4.28		
			AS RECEIVED	I	NO SAMPLE.								
			AS WELDED	S-131	2.13	1.04	-	0.03	-	1.10	0.93	ERRATIC FITTING.	
			WELDED, ANNEALED AND QUENCHED	S-161	111	1.98	-	36.67	-	-	21.18	GENERAL CORROSION AND SOME ERRATIC FITTING.	
AS RECEIVED AND 4-F FINISHED	S-121	4.89	-	-	-	-	-	4.89	ERRATIC FIN-POINT FITTING.				
309	234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	COMPLETE IMMERSION	AS WELDED & 4-F FINISHED	S-151	-	2.58	-	9.20	-	-	2.21	ERRATIC FITTING.	
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-111	3.57	5.24	-	-	-	-	4.40	ERRATIC FIN-POINT FITTING.	
		VAPOR SUSPENSION	AS RECEIVED	I	NO SAMPLE.								
			AS WELDED	S-132	149.94	-	-	-	-	-	149.94	ERRATIC FITTING AND GREENISH CORROSION PRODUCTS ON SPECIMEN.	
			WELDED, ANNEALED & QUENCHED	S-163	48.98	-	-	-	-	-	48.98		
			AS RECEIVED & 4-F FINISHED	S-122	586.47	-	-	-	-	-	586.47		
			AS WELDED & 4-F FINISHED	S-153	331.36	-	-	-	-	-	331.36		
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-112	1554.24	-	-	-	-	-	1554.24		
			AS RECEIVED	I	NO SAMPLE.								
			AS WELDED	S-133	1808.64	-	-	-	-	-	1808.64	GENERAL CORROSION AND FITTING.	
WELDED, ANNEALED & QUENCHED	S-162	1472.60	-	-	-	-	-	1472.60					
310	47% HI, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS RECEIVED AND 4-F FINISHED	S-123	1330.24	-	-	-	-	1330.24			
			AS WELDED & 4-F FINISHED	S-152	1672.33	-	-	-	-	1672.33			
		VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-113	956.83	-	-	-	-	-	956.83		
			AS RECEIVED	I	NO SAMPLE.								
			AS WELDED	S-170	302.44	31.50	-	22.48	28.03	9.58	26.59	GENERAL CORROSION.	
			AS WELDED	S-180	165.06	248.98	-	17.80	20.26	-	58.05		
			WELDED, ANNEALED & QUENCHED	S-190	23.77	47.26	-	30.38	16.32	10.78	14.64	GENERAL CORROSION & PIT IN WELD. WELD CRACK FROM FABRICATION.	
			AS RECEIVED & 4-F FINISHED	S-200	273.22	41.93	-	-	-	-	157.58	GENERAL CORROSION.	
			AS WELDED & 4-F FINISHED	S-210	154.33	261.72	-	-	-	-	207.77		
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-220	25.99	40.42	-	21.61	14.58	10.75	14.68		
AS RECEIVED	S-171	1.39	0.74	-	0.88	0.41	0.63	0.66	SUPERFICIAL FITTING AND BROWNISH DISCOLORATION.				
311	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS WELDED	S-181	0.12	2.37	-	5.43	0.23	1.06	1.43		
			WELDED, ANNEALED & QUENCHED	S-191	0.62	0.27	-	0.27	0.53	0.30	0.17		
		VAPOR SUSPENSION	AS RECEIVED AND 4-F FINISHED	S-201	2.07	0.56	-	0.72	0.91	0.79	0.84		
			AS WELDED & 4-F FINISHED	S-211	0.65	1.22	-	0.75	0.41	9.99	6.51	SPECIMEN ACCIDENTALLY IMMERSED DURING TEST PERIOD.	
			WELDED, ANNEALED & QUENCHED, & 4-F FINISHED	S-221	0.83	0.36	-	0.05	0.31	0.50	0.41	SUPERFICIAL FITTING AND BROWNISH DISCOLORATION.	
			AS RECEIVED	S-172	0.21	111	-	0.04	111	111	0.01	NO VISUAL CHANGE - RECALIB.	
			AS WELDED	S-182	2.13	0.44	-	0.06	0.04	0.03	0.13		

APPENDIX 5 (CONTINUED)

MATERIAL	ENVIRONMENT	TEST	SPECIMEN PREPARATION	I.D. NO.	CORROSION / TEST PERIOD						REMARKS		
					1st 48 HRS	2nd 48 HRS	3rd 72 HRS	4th 1 WK	5th 1 WK	6th 1 MO		CUMULATIVE	
T-316	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED	S-192	2.70	0.68	-	0.40	0.16	0.07	0.26	SLIGHT FORMATION OF "CRUD" ALONG LIQUID-VAPOR PHASE LINE. NO VISUAL CHANGE - EXCELLENT APPEARANCE.	
			AS RECEIVED & L-P FINISHED	S-202	0.44	NIL	-	NIL	0.07	0.01	0.02		
		VAPOR SUSPENSION	AS WELDED & L-P FINISHED	S-212	4.24	1.66	-	0.01	NIL	NIL	NIL	0.24	SUPERFICIAL PITS - GOOD APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE.
			WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-222	0.80	0.33	-	0.06	0.11	0.08	0.12		
			AS RECEIVED	S-171	3.26	0.15	-	NIL	NIL	NIL	0.13		
			AS WELDED	S-181	2.85	0.41	-	0.09	0.43	0.02	0.22		
			WELDED, ANNEALED & QUENCHED	S-191	6.28	2.01	-	2.43	0.28	1.55	1.71		
			AS RECEIVED & L-P FINISHED	S-201	4.15	0.15	-	0.09	0.01	NIL	0.10		
			AS WELDED & L-P FINISHED	S-211	0.27	2.37	-	0.22	0.10	0.02	0.14		
			WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-221	4.27	0.30	-	2.01	0.07	0.46	0.77		
	234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	TOTAL IMMERSION	AS RECEIVED	S-174	84.99	-	-	-	-	-	84.99	ERRATIC PIN-POINT PITS. SUPERFICIAL PITS - GOOD APPEARANCE. SUPERFICIAL PITS - FAIR APPEARANCE.	
			AS WELDED	S-184	21.84	3.30	-	3.96	-	-	8.08		
		VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED	S-194	18.85	4.09	-	-	-	-	-	10.59	PIN-POINT PITS ON SIDES - GOOD APPEARANCE. TEST SOLUTION BOILED DRY & SAMPLE WAS ATTACKED. PIN-POINT, ESPECIALLY IN SIDES - FAIR APPEARANCE. PIN-POINT PITS, ESPECIALLY IN WELD ZONE. PIN-POINT PITS, ESPECIALLY IN SIDES & WELD ZONE. GENERAL CORROSION AND FITTING.
			AS RECEIVED & L-P FINISHED	S-204	17.04	2.75	-	1.87	2.99	0.53	-	3.78	
			AS WELDED & L-P FINISHED	S-214	31.14	110.00	-	5.48	-	-	-	36.65	
			WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-224	17.04	3.76	-	-	-	-	-	10.39	
			AS RECEIVED	S-175	1527.54	-	-	-	-	-	-	1527.54	
			AS WELDED	S-185	163.28	-	-	-	-	-	-	163.28	
			WELDED, ANNEALED & QUENCHED	S-195	52.33	810.56	-	-	-	-	-	431.45	
			AS RECEIVED & L-P FINISHED	S-205	69.58	0.12	-	2.90	26.40	0.15	-	13.26	
T-304SLC 47% NI, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS RECEIVED	S-230	73.76	49.31	-	25.07	-	-	16.20	21.87	GENERAL CORROSION. GENERAL CORROSION IMMERSED PORTION, BROWNISH DISCOLORATION VAPOR PORTION.	
		AS WELDED	S-261	42.55	40.60	-	21.15	-	-	14.59	18.25		
	STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED	S-277	36.66	40.24	-	20.63	-	-	15.47	15.69	GENERAL CORROSION. GENERAL CORROSION IMMERSED PORTION, BROWNISH DISCOLORATION VAPOR PORTION.	
		AS RECEIVED & L-P FINISHED	S-250	69.73	48.51	-	26.48	-	-	16.21	21.87		
	VAPOR SUSPENSION	AS WELDED & L-P FINISHED	S-260	47.92	33.93	-	21.66	-	-	17.64	20.46	GENERAL CORROSION IMMERSED PORTION, BROWNISH DISCOLORATION VAPOR PORTION. LITTLE SUPERFICIAL FITTING. PITS AT CONTACT POINTS WITH GLASS HOLDER, BROWNISH DISCOLORATION. FEW SUPERFICIAL PITS, SOME BROWNISH DISCOLORATION - GOOD APPEARANCE. SOME BROWNISH DISCOLORATION - GOOD APPEARANCE. SUPERFICIAL FITTING, BROWNISH DISCOLORATION - FAIR APPEARANCE.	
		WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-287	42.29	5.24	-	31.44	-	-	14.67	18.33		
	234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION	AS RECEIVED	S-231	1.27	6.22	-	0.25	-	-	0.67	0.89	NO VISUAL CHANGE - EXCELLENT APPEARANCE. SLIGHT SUPERFICIAL FITTING, PITS IN SIDES - GOOD APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. WELD POROSITY PRIOR TO EXPOSURE. ERRATIC FITTING, BROAD & PIN-POINT ESPECIALLY TOWARD LOWER HALF. NO VISUAL CHANGE - EXCELLENT APPEARANCE. FEW PITS IN SIDES - GOOD APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. FEW SUPERFICIAL PITS AND PITS IN SIDES - GOOD APPEARANCE.
			AS WELDED	S-260	0.89	0.44	-	0.50	-	-	0.44	0.47	
		STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED	S-271	NIL	0.35	-	0.47	-	-	0.44	0.41	
			AS RECEIVED & L-P FINISHED	S-251	1.07	5.66	-	2.23	-	-	0.92	1.36	
VAPOR SUSPENSION		AS WELDED & L-P FINISHED	S-241	1.19	1.84	-	0.58	-	-	0.51	0.64		
		WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-288	NIL	0.33	-	0.67	-	-	0.48	0.48		
234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)		STATIC, TOTAL IMMERSION	AS RECEIVED	S-232	4.18	0.21	-	NIL	-	-	NIL	0.07	NO VISUAL CHANGE - EXCELLENT APPEARANCE. SLIGHT SUPERFICIAL FITTING, PITS IN SIDES - GOOD APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. WELD POROSITY PRIOR TO EXPOSURE. ERRATIC FITTING, BROAD & PIN-POINT ESPECIALLY TOWARD LOWER HALF. NO VISUAL CHANGE - EXCELLENT APPEARANCE. FEW PITS IN SIDES - GOOD APPEARANCE. NO VISUAL CHANGE - EXCELLENT APPEARANCE. FEW SUPERFICIAL PITS AND PITS IN SIDES - GOOD APPEARANCE.
			AS WELDED	S-266	0.03	-	-	NIL	-	-	NIL	NIL	
		STATIC, PARTIAL IMMERSION	WELDED, ANNEALED & QUENCHED	S-272	0.30	0.12	-	NIL	-	-	NIL	0.02	
			AS RECEIVED & L-P FINISHED	S-252	0.18	1.01	-	1.86	-	-	NIL	0.36	
	VAPOR SUSPENSION	AS WELDED & L-P FINISHED	S-242	0.27	NIL	-	0.30	-	-	NIL	0.08		
		WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-281	0.25	NIL	-	0.02	-	-	NIL	0.01		
	234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	TOTAL IMMERSION	AS RECEIVED	S-233	3.29	0.62	-	1.86	-	-	1.33	1.62	SLIGHT STUB - GOOD APPEARANCE. OVER-ALL PIN-POINT FITTING. PIN-POINT FITTING AND FAIRLY ADHERENT GREEN CORROSION PRODUCTS. ERRATIC FITTING.
			AS WELDED	S-263	1.10	NIL	-	NIL	-	-	0.07	0.10	
		VAPOR SUSPENSION	WELDED, ANNEALED & QUENCHED	S-278	1.51	0.30	-	NIL	-	-	0.30	0.31	
			AS RECEIVED & L-P FINISHED	S-253	0.36	0.12	-	0.08	-	-	NIL	0.03	
TOTAL IMMERSION		AS WELDED AND L-P FINISHED	S-243	0.86	3.58	-	3.45	-	-	0.07	0.85		
		WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-283	0.08	NIL	-	0.03	-	-	NIL	0.01		
		AS RECEIVED	S-234	227.94	132.28	-	89.67	35.09	105.46	56.96	69.02		
		AS WELDED	S-264	48.06	20.74	-	11.87	26.17	-	-	26.67		
		WELDED, ANNEALED & QUENCHED	S-274	47.09	26.49	-	37.01	32.45	-	-	29.25		
		AS RECEIVED & L-P FINISHED	S-254	236.44	196.14	-	50.08	38.29	31.03	163.78	359.35		
	AS WELDED & L-P FINISHED	S-244	39.80	21.10	-	106.74	33.57	34.92	10.40	31.43			
	WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-286	21.97	12.62	-	12.27	327.98	-	-	117.30			
VAPOR SUSPENSION	AS RECEIVED	S-235	952.03	-	-	-	-	-	-	952.03	GENERAL CORROSION AND FITTING. GENERAL CORROSION IMMERSED PORTION, BROWNISH DISCOLORATION VAPOR PORTION. GENERAL CORROSION IMMERSED PORTION, BROWNISH DISCOLORATION VAPOR PORTION. LITTLE SUPERFICIAL FITTING. PITS AT CONTACT POINTS WITH GLASS HOLDER, BROWNISH DISCOLORATION. FEW SUPERFICIAL PITS, SOME BROWNISH DISCOLORATION - GOOD APPEARANCE. SOME BROWNISH DISCOLORATION - GOOD APPEARANCE. SUPERFICIAL FITTING, BROWNISH DISCOLORATION - FAIR APPEARANCE.		
	AS WELDED	S-265	6.99	11.68	-	3.88	801.88	-	-	247.90			
	WELDED, ANNEALED & QUENCHED	S-279	142.74	4.62	-	0.62	2.52	-	-	30.34			
	AS RECEIVED & L-P FINISHED	S-255	1511.93	-	-	-	-	-	-	1511.93			
	AS WELDED & L-P FINISHED	S-245	73.05	24.95	-	1895.71	-	-	-	418.34			
	WELDED, ANNEALED & QUENCHED, & L-P FINISHED	S-285	152.46	6.70	-	2.10	693.67	-	-	258.10			

APPENDIX 5 (CONTINUED)

MATERIAL	ENVIRONMENT	TEST	SPECIMEN PREPARATION	I.D. NO.	CORROSION / TEST PERIOD						REMARKS	
					1st 48 HRS	2nd 48 HRS	3rd 72 HRS	4th 1 WK	5th 1 WK	6th 1 MO		CUMULATIVE
DURIRON	47% HI, ROOM TEMP. (22°C)	STATIC, TOTAL IMMERSION VAPOR SUSPENSION	AS CAST & SANDBLASTED	HC-26	9.6	-	(+1.3)	0.1	-	0.16	0.16	GRAY FILM. NO PITTING. GRAY FILM. LIMITED RUST FORMATION. NO PITTING.
				HC-27	53.1	-	1.3	NIL	-	0.09	0.28	
HASTELLOY B	47% HI, ROOM TEMP. (22°C) 47% HI, BOILING TEMP. 234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	STATIC, PARTIAL IMMERSION TOTAL IMMERSION STATIC, PARTIAL IMMERSION TOTAL IMMERSION VAPOR SUSPENSION	AS RECEIVED & MACHINE FINISH	1	1.69	-	1.80	-	-	-	1.77	VERY SLIGHT DISCOLORATION OF LIQUID PORTION. GENERAL CORROSION, GRAIN BOUNDARY DEFINITION. GENERAL CORROSION, ERRATIC PITTING & FORMATION OF LOOSE GREEN SCALE. GENERAL CORROSION, GRAIN DEFINITION.
				2	449.0	-	-	-	-	-	449.0	
				3	1048.0	-	2894.0	-	-	-	2428.0	
				4	4416.0	-	-	-	-	-	4416.0	
				5	3313.0	-	-	-	-	-	3113.0	
HASTELLOY C	47% HI, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C) 47% HI, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C) 47% HI, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C) 47% HI, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	STATIC, TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION	AS ROLLED AND SANDBLASTED ROLLED, WELDED & SANDBLASTED ROLLED, WELD GROUND FLUSH, SANDBLASTED AS CAST & GROUND FINISH CAST, WELDED & SANDBLASTED	HC-1	19.4	-	0.2	0.1	-	2.8	0.98	ADHERENT, GRAYISH-GREEN CORROSION PRODUCTS. LOOSE, GRAYISH-GREEN CORROSION PRODUCTS, GRADUAL ETCHING WITH DISAPPEARANCE OF DEPOSITS. LOOSE BLACK CORROSION PRODUCTS FOLLOWED BY ADHERENT LIGHT-GREEN DEPOSITS. SAME AS HC-3). LT. GREEN DEPOSITS SOLUBLE IN 50% HCL. FC. CLEANED, RE-EXPOSED, BECAME GRAYISH. GREEN DEPOSITS, ETCHING AND PARTIAL DEPOSIT REMOVAL. BOILED DRY DURING FIRST 48 HR TEST PERIOD. ADHERENT LIGHT GREEN DEPOSITS. BOILED DRY DURING FIRST 48 HR TEST PERIOD. LOOSE, BLACK CORROSION PRODUCTS. YELLOW-GRAY & GREEN DEPOSITS, SOLUBLE 50% HCL. SOME BUSTING. SIMILAR HC-3). ETCHING AND WELD PIT. SEMI-ADHERENT BLACK AND GREENISH-BROWN DEPOSITS. BLUE AND YELLOW TARNISH. ADHERENT LIGHT-GREEN CORROSION PRODUCTS. ADHERENT GREEN DEPOSITS, WELD MACRO ETCHED. FC. SLIGHTLY DULLED, LIMITED PITTING, THE AS CAST HOLE IN FC. WAS ATTACHED. FC. SLIGHTLY DULLED, BLACKISH DEPOSITS, THE AS CAST HOLE IN FC. WAS ATTACHED. FC. SLIGHTLY DULLED, LIMITED PITTING, THE AS CAST HOLE IN FC. WAS ATTACHED. FC. DULLED, ADHERENT GREENISH DEPOSITS. LOOSE, BLACKISH DEPOSITS & SUBSEQUENT ETCHING. SOME ETCHING. SIMILAR HC-11. GREEN DEPOSITS, WELD MACRO ETCHED.
				HC-2	7.4	-	2.2	4.9	-	9.7	1.5	
				HC-3	15.8	-	3.0	0.8	-	3.3	1.7	
				HC-4	33.1	-	9.6	0.1	-	6.7	1.4	
				HC-5	1	76.5	34.5	-	-	-	55.5	
				HC-6	1	29.2	4.1	-	-	-	16.6	
				HC-8	89.1	108.9	-	87.7	-	53.1	65.2	
				HC-9	4.6	4.1	-	5.2	-	4.8	4.2	
				HC-10	45.9	-	21.7	3.0	-	13.0	3.84	
				HC-11	29.2	-	18.3	12.2	-	NIL	4.96	
				HC-12	139.2	-	88.0	-	-	-	113.7	
				HC-13	21.2	NIL	-	-	-	-	10.6	
HC-14	5.9	-	0.7	0.7	-	1.4	0.93					
HC-15	2.6	-	1.5	1.7	-	1.8	0.66					
HC-16	3.7	-	1.7	1.5	-	1.8	1.2					
HC-17	0.2	-	(+0.2)	NIL	-	NIL	NIL					
HC-18	69.8	71.3	-	-	-	-	71.5					
HC-19	21.4	2.7	-	-	-	-	12.1					
HC-20	4.2	1.7	-	0.7	-	1.5	0.72					
HC-21	6.0	6.6	-	1.5	-	3.0	0.9					
HC-22	4.0	-	1.1	0.5	-	1.1	0.46					
HC-23	(+1.2)	-	(+0.3)	(+0.6-3WKS)	-	(+0.8)	(+0.27)					
HC-24	58.8	52.9	-	-	-	-	55.8					
				NO SAMPLE.								
TANTALUM	47% HI (1.5% H ₂ O ₂) ROOM TEMP. (22°C) 47% HI, ROOM TEMP. (22°C) 234-5 PROCESS SUPERNATANT, (1.5% H ₂ O ₂ -HI), ROOM TEMP. (22°C) 47% HI, BOILING TEMP. 234-5 PROCESS SUPERNATANT, (1.5% H ₂ O ₂ -HI), BOILING TEMP. 47% HI, BOILING TEMP. 234-5 PROCESS SUPERNATANT, (1.5% H ₂ O ₂ -HI), BOILING TEMP. 234-5 PROCESS SUPERNATANT, BOILING TEMP. (101°C)	STATIC, TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION STATIC, TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION TOTAL IMMERSION VAPOR SUSPENSION	AS RECEIVED SHEET	T-1A	NIL	NIL	-	NIL	-	-	NIL	NO SIGNIFICANT CHANGE.
				T-2A	NIL	NIL	-	(2 WKS) NIL	-	-	NIL	
				T-1B	NIL	NIL	-	(2 WKS) NIL	-	-	NIL	
				T-2B	NIL	NIL	-	NIL	-	-	NIL	
				T-3A	NIL	NIL	-	NIL	-	-	NIL	
				T-4A	NIL	NIL	-	(2 WKS) NIL	-	-	NIL	
				T-3B	NIL	NIL	-	NIL	-	-	NIL	
				T-4B	NIL	NIL	-	NIL	-	-	NIL	
				T-5A	0.68	(+0.73)	(+0.80)	-	-	-	(+0.28)	
				T-6A	0.79	(+0.72)	NIL	-	-	-	NIL	
				T-5B	NIL	NIL	(48 HRS) NIL	-	-	-	NIL	
				T-6B	(+0.16)	0.13	(48 HRS) NIL	-	-	-	NIL	
				T-7A	0.68	(+0.64)	(48 HRS) NIL	-	-	-	NIL	
				T-8A	0.72	(+0.73)	0.14	-	-	-	NIL	
				T-7B	NIL	NIL	(48 HRS) NIL	-	-	-	NIL	
				T-8B	(+0.23)	(+0.11)	0.16	-	-	-	NIL	